FACTORS CONTRIBUTING TO THE EFFECTIVENESS OF IMPLEMENTING A NATIONAL POLICY AT THE LOCAL LEVEL: A CASE STUDY OF COMMUNITY-SPECIFIC REGULATION OF MUNICIPAL WATER POLLUTION CONTROL

DISSERTATION

Presented in Partial Fulfillment of the Requirements for the Degree Doctor of Philosophy in the Graduate School of The Ohio State University

By

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* * * * *

The Ohio State University
1999

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ABSTRACT

As the role of local government expands to fill the gaps created by reduction in the federal government's involvement in the design of national policies, it is important to understand the variability and limits of a local government's capacity to adapt these policies. Policy instrument theory suggests the importance of the link between policy design and implementation success. This study expands policy instrument theory by linking a community's contextual capacity to its adoption of the design and operational criteria of a policy instrument. This linkage allows for the identification of some of the causes of effective adaptation of national policies at the local level. This study incorporates the socioeconomic and agency perspectives, derived from the theories of urban politics, economic/interest groups, and resource-dependency models, to explain the behaviors of local governments and local target groups that occur as a result of the implementation and the specifications of locally designed instruments.

A longitudinal and exploratory case study of municipal water pollution control of two Ohio communities is used to provide empirical evidence to shed light on the theoretical concepts and related hypotheses introduced here. In sum, the findings of this study provide evidence of the following: 1) local government's effectiveness in adapting a
federal policy is positively related to its increased involvement in designing and implementing the policy; 2) the outcomes of adaptation vary among local governments in part due to the context-specific elements of design and operation of the regulations; and 3) the punitive measures a local regulatory agency is legally allowed to use to insure compliance and the willingness of the regulatory authority to use these measures are highly correlated with the socioeconomic profile of the local community and the agency's resource independence.

This study adds to the details on policy instrument theory, and cautions against the over-simplification of the theory's conventional advice that "tool substitution" would bring success to policy implementation by replacing one tool with another. This study suggests that to fully utilize a policy instrument's potential, some attention must be focused on a local government's capacity to design and to implement policies. This study suggests that the way the instrument is designed and implemented by the local government is related to the socioeconomic profiles of the local community and the local agency's level of resource dependency. The relationship between the local contextual capacity and the local government's adoption of design and operational criteria of regulations affects the degree of effectiveness of local implementation of the national policy. This study provides a new perspective for examining how the contextual capacity of a local community interacts with its ability and willingness to adapt a national policy. It does this, in part, by studying the behaviors of local government and groups targeted by
the policy. This study provides information to policy makers about what a local
government can do, and suggests that the federal government designate resources and
authority by taking into consideration the contextual capacities of local governments.
This study also urges policy scholars to research the methods of incorporating contextual
capacity into policy designs.
Dedication

To my parents
ACKNOWLEDGMENTS

I am very grateful to Dr. Anand Desai for his scholarship, edification, and guidance. He has always encouraged me to move beyond where I am, and gave me timely support as needed. He encouraged me to work independently as a teacher and researcher under his direction, and in particular, the evaluation research for the Ohio Environmental Protection Agency, which produced this dissertation. I would also like to thank Dr. Mary Marvel. Dr. Marvel has been more than generous and diligent in coaching me with her valuable experience and her professionalism. I am very appreciative of her insightful criticisms and suggestions. I am also thankful for Dr. Fred Hitzhusen. He has continuously given me valuable lessons and advise for my research and future career. His wisdom and perspective is invigorating and very much admired. My acknowledgment also extends to Dr. Yen-Gen Hsieh. In part because of his inspiration, I was determined to become an academic while still a freshman at the National Chung-Hsing University.

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CHAPTER 1

INTRODUCTION

Like most governmental services, environmental protection is a mixed public good. Compared to many other government interventions (e.g., selling or buying the right to pollute via market exchange), government regulation of air and water quality or of utilization of these resources is difficult and can be very expensive. The difficulty in enforcing the laws enables polluters to neglect responsibility for their polluting behavior. Even in cases where the rights and fees to access air and water can be established, the detection and punishment of free riders or polluters requires technically able and financially sound legal authorities.

Traditionally, local governments have played the role of implementation agents that carried out federally set initiatives. Local actions to clean and maintain the environment were known to be expensive and controversial. Some of these actions were costly, but their costs could be calculated, such as the capital costs of constructing a treatment plant. Other costs were not only difficult to calculate, but also could be overlooked. For example, transaction costs brought about by resistance to the government actions; or the
time spent negotiating or lessening resistance from the community when siting a treatment facility.

George Stigler’s theory of economic regulation, commonly known as “industry capture”, provides a synthesis for describing government regulation. The theory postulates that a society loses during the process of regulation, due to the undue influence on the regulations and regulators of the financially and politically powerful industries, i.e. the captors. There is a strong incentive for industries to pollute because the fewer costs an industry needs to incur the more “rent” or profit it can capture. Opposition to environmental protections by industry is often accompanied by strong political means. These might include lobbying and campaign contributions to political representatives in exchange for favoritism in regulations. This can occur when the public has no reason to suspect the air they breathe and the water they drink is contaminated. Without obvious signals such as visible signs of pollution or media attention, the public may make no demands on their regulatory agencies. Limited by lack of information and without the incentives to organize, the public might need to rely on their “captive” political representatives and bureaucrats to act on their behalf.

The current trend of intergovernmental relationships indicates an increase in the involvement of local government and a decrease in the involvement of the federal government in policy design (May and Williams, 1986; Fix and Kenyan, 1990; Lowry,
1992). Under this new trend of federal initiatives, while the federal initiative remains relatively constant across the states, the different capabilities of local government are worth noting. For example, while some communities might perform beyond federal expectations, some might barely attain minimum requirements.

Given the prevailing trend of the expanding role of local government, it is important to understand a local government’s capacity for adapting a national initiative under the circumstances of limited resources. This study intends to further examine the factors that are crucial to the effectiveness of local government’s adaptation and implementation of a national policy under this current trend. This study, however, does not intend to debate the importance of the role of the federal government. In fact, under the new federal initiatives, the federal government is crucial in setting up guidelines and in overseeing the local adaptation. The existence of a federal government is also essential in areas such as income redistribution among states, providing services that meet economies of scale, and managing affairs or spillover effects that extend beyond state boundaries.

Policy instrument theory suggests a causal linkage between policy design and implementation success. It provides the theoretical context for the empirical elements of this study. However, lacking a behavioral dimension between contextual capacity (the circumstances in which the policy instrument is implemented) and design and operational components (the attributes by which the policy instrument is specified), this theory has had limited practical application. This study further expands the policy instrument theory by exploring contextual capacity from socioeconomic and agency perspectives. Using
empirical data, this study conducts a longitudinal and exploratory case study comparing the behavior of the local regulators (i.e., the local governments) and the regulated groups (i.e., the industry) in two communities in controlling water pollution.

Many intergovernmental policies have shared common characteristics under current federal initiatives. These characteristics are as follow: 1) federal grants as a percentage of state and local revenues have sharply decreased since 1980 (Hayes, 1989). 2) Increased demands from the federal government to require state and local governments to take part in designing programs and punitive policies (Norris and Thompson, 1995). 3) State and local governments are being required to assume an increased fiscal burden of administration, enforcement and program responsibilities resulting from federal initiatives (Gullo and Kelly, 1998).

The following table provides a broad view of intergovernmental policies, illustrated by examples and distinguished by the level of federal intrusion imposed on the lower implementing governments. The level of intrusion for the three types of intergovernmental policy, i.e., direct order, conditions of assistance, and partial preemption\(^1\), is ranged from high to low respectively (Fix and Kenyon, 1990, and Hayes, 1989). The common characteristics of the current trend of federal initiatives mentioned above have become manifest in the area of partial preemption (Table 1.1). This study chooses local governments as the primary implementing governments in the area of partial preemption for the inclusion of theoretical scope. Although local governments

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\(^1\) Partial preemption means that lower level governments can only assume program responsibility once they can demonstrate their programs meet or exceed the standards imposed by the higher level governments.
can be further distinguished as counties, cities, and townships, the unit of analysis can be arbitrary. The local government as a unit of analysis might vary depending on the scopes of the goods and services being provided.
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Table 1.1 Types of Intergovernmental Policy
This study uses the nation's municipal water pollution control policy as an example to illustrate this current trend of federal initiatives (Jessup, 1988; Environmental and Energy Study Institute, 1992; Lowry, 1992; Plater, et al., 1992; Ringquist, 1993; and OEPA, 1992; 1994). The present set of surface water quality regulation mostly originated with the 1972 Federal Water Pollution Control Act also known as Clean Water Act, (CWA). Three major intergovernmental policies were enacted under the CWA and its subsequent amendments (in particular, 1981 and 1987). The first is the Municipal Wastewater Treatment Grant Program, which provides financial assistance for the construction of publicly owned treatment works (POTWs). In the late 80's, the grant program was changed to a loan program with the local governments financing the loans. The second is the National Pollution Discharge Elimination System (NPDES)\(^2\), which grants the state governments the right to issue permits, and which assigns to the state governments the responsibility to monitor and regulate the permittees whose wastewater directly discharges into their surface waters. The third is the Pretreatment Program, which grants the state and local governments the right to issue permits, monitor, enforce regulations, set standards, and oversee Industrial Users (IUs) whose wastewaters are treated at the source before being discharged into POTWs (Gold, 1988). In particular, the Pretreatment Program provided with the local government the legal authority to assume the responsibilities of regulating industrial water pollution.

1.1 Problem Statement

In the 1980's, efforts to reduce state and federal budgets and bureaucracy forced local governments to find new ways to fund programs. Policy instrument studies and the use

\(^2\) NPDES permit limits are reputed to be the operable definitions of federal and state regulation.
of the private and the nonprofit sectors to perform many governmental functions and services blossomed during the time. Policy instrument theory, in particular, privatization, was applied to several areas of policy practice and has been found to be useful in guiding the improvement of the productivity of government.

**Brief Review of Policy Instrument Theory**

In general, a policy instrument or a policy tool is known to the policy field as "a method through which government seeks a policy objective" \(^3\) (Salamon and Lund, 1989, p. 29). Theodere Lowi’s research on policy instruments has suggested that government policy is based on the criterion of coerciveness (1966). Scholars who follow this taxonomy either expand upon Lowi’s categories, such as Kellow, (1988 and 1989), Steinberger, (1980), and Spitzer, (1987), or differentiate policy functions, such as Elmore (1987) and Rosenbloom (1983).

Responding to the financial stress placed on government, policy instrument studies shifted gears from the taxonomy approach (i.e., Lowi, Kellow, and others) to productivity of government. Innovative ways of delivering government services, such as rearranging incentive and institutional structures, were among the platforms discussed. These studies “introduced” the concept of privatization to the cities in need of saving money by cutting unnecessary in-house production. Contracting public services out to the private sector, to not-for profit organizations, or to inter-governmental units were among the options recommended to improve government productivity and efficiency. Such organizational

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\(^3\) The terms of “policy instrument (s)” and “policy tool (s)” are used interchangeably in this study.

Other policy scholars questioned the adequacy and/or applicability of privatizing public goods and were concerned about the magnitude of the claimed cost-saving. A group of scholars drew attention to the inconclusive findings of privatization (Moe, 1984; Sappington and Stiglitz, 1987; Ferris and Graddy, 1991; and Marvel and Marvel, 1992). These studies further distinguished differences between the public and the private sectors. A typical public agency might pursue multiple objectives, and be monitored by multiple principals. This multiplicity of efforts and bureaucracy created situations in which information that was crucial to ensuring the agency's productivity was either lacking or asymmetrical among the principals and the public agents. Without proper monitoring and incentives, the increases in productivity promised by privatization has not taken place (Shiang, 1995).

Policy scholars recognized the limitations of the theory and provided broader analytic schemes to examine policy tools. Instead of providing an exhaustive list of tools, classifications were provided based upon the characteristics of a tool, such as the structure of delivery systems, the degree of centralization, and the degree of autonomy. These characteristics have then been linked to policy consequences, administrative feasibility, effectiveness, political support, efficiency, and equity. Hypotheses were established to contrast and compare individual tools (Salamon, 1989; Salamon and Lund,
1989). However, Salamon’s (1989) and Salamon and Lund’s (1989) theoretical assumptions have not been verified. The ambiguity of the classification of most taxonomy studies results in difficulty in testing their hypotheses. Taxonomy studies use the policy instrument as the unit of analysis. The essence of the studies remains the concept of “tool substitution” (i.e., replacing one tool with another). Without further refinement of definitions, a generic tool (such as social regulation) might consist of operational elements (such as standards, rules, monitoring, and sanctions), that can be further treated as a mixture of mini-tools. It is inappropriate to compare the effectiveness of one tool to another without considering the possible variations that can occur during tool operation. Such discrepancies raise doubts about the empirical implications of this body of literature.

Another body of literature emphasizes the characteristics of policy options and instruments that make up a design approach. The policy design approach includes the work of Linder and Peters (1984, 1987, and 1990) and Schneider and Ingram (1990). They assume that policy makers are rational decision makers and can choose a best fitting instrument to solve their policy problems. The determination of what constitutes a best fitting instrument is based upon the common properties of each of the instruments. These properties are generic so that policy makers can use them as criteria when choosing an instrument. Linder and Peters (1989) give conceptual definitions and samples of these properties/criteria. They identify resource intensiveness, targeting, political risk and constraints on government activity as some of these properties. These properties can be further developed into operational criteria such as operational precision, targeting, public
opposition, and coerciveness of government. Decision-makers are assumed able to make a rational appraisal among instruments and adopt the most suitable design and operational criteria.

Policy scholars of the design approach contribute to the policy instrument theory by exploring generic properties that can include common characteristics of policy instruments. This approach provides decision-makers with design and evaluative criteria to select a suitable policy instrument and shifts the focus from individual tools to the common characteristics of these tools. However, the notion of tool substitution is the essence of this school of thought. Attention to tool substitution limits the provisions of in-depth study on the generic properties of these tools and on the most important factors of appraising these properties. The linkage between these properties and objective measurements of their effectiveness is missing.

The theoretical focus of tool substitution ignores the fact that a specific policy instrument can be used to achieve various policy objectives and can be more efficient in achieving some objectives in one circumstance than in another. Assuming that rational preference can be made based upon the comparisons of instruments as the policy instrument theory claims, when one instrument is substituted by another, organizational rearrangements need to occur. Such organizational rearrangements in public agencies can be infeasible because it is difficult to fully account for all costs. In addition, the focus of tool replacement might lead to discarding an instrument before its full potential
has been studied. Little effort has been taken to explore possible operational improvements of an instrument that is currently employed.

**Two Theoretical Approaches of Policy Instrument Studies**

![Diagram showing the two approaches: Group I: Classification Approach and Group II: Design Approach.]

- **Group I: Classification Approach**
  - Common Properties of Tools
  - Tool Substitution
  - The Attainment of Policy Objectives

**Types of Evaluative Criteria:**

1. Resource-intensiveness (e.g., operational simplicity)
2. Targeting (e.g., precision)
3. Political risk (e.g., public support)
4. Constraints of government activity (e.g., coerciveness)

**Types of Evaluative Criteria:**

1. Effectiveness
2. Efficiency
3. Equity

Figure 1.1 The Development of Policy Instrument Studies

In summary, policy instrument studies can be categorized as being based on one of two theoretical approaches. As shown in Figure 1.1, the first group results from a classification approach that differentiates functions among policy tools/instruments. The
first approach postulates that tool substitution (B in Figure 1.1) brings about the attainment of policy objectives (measured by criteria such as effectiveness)\(^4\) (C in Figure 1.1). The second group results from a design approach that searches for properties common among policy tools/instruments (measured by criteria such as availability of resources)\(^5\). The second approach postulates that properties common among tools (A in Figure 1.1) cause tool substitution (B). By logical inference, if tool substitution (B) implies that policy objectives will be met (C), and if certain properties of a tool that are more likely to be adopted than another (A) imply tool substitution (B), then these properties (A) should imply the attainment of certain policy objectives (C). That is, certain properties of a policy tool bring about the attainment of policy objectives. If these properties determine the success of a policy, then it is reasonable to ask whether these properties should be the unit of analysis rather than the tools themselves. Prior research has investigated both the substitution of one tool for another as well as the elements common to several tools. This current research examines elements common to several tools in order to determine whether varying the magnitude of these elements affects the attainment of policy objectives.

\(^4\) Types of evaluative criteria indicate the methods used to determine whether policy objectives have been obtained. Generally, these are measured by effectiveness, efficiency, and equity although other measures may be used. These measures are listed below Box C in Figure 1.1. The focus of this research is on Effectiveness.

\(^5\) Types of evaluative criteria indicate the elements used to determine whether one tool is more appealing than another. Common elements, which have been studied by other scholars, are listed below Box A in Figure 1.1. This research investigated 1) resource-intensiveness, 2) targeting, and 3) constraints of government activity.
Furthermore, an attribute that is largely unexamined by the instrument studies is contextual capacity (i.e., the conditions in which a policy instrument is implemented). Later studies like Linder and Peters (1989 and 1990a) and Hewlett (1991) stressed the significance of context. Hewlett found that the conceptual scheme derived from the studies of the classification approach differ among nations. Although the significance of context was identified, the factors that constituted the contextual capacity and the ways in which the contextual capacity was related to the design and operational criteria of a policy instrument were not clearly delineated.

1.2 Research Questions

In sum, the deficiencies of policy instrument studies include 1) lack of in-depth exploration of the properties of an instrument, 2) lack of clearly specified linkages between properties of the instrument and their effects on attaining policy objectives, and 3) inattention to significance of the context in which the instruments are used. As a consequence of these deficiencies, the empirical contributions of the studies have been limited. These studies neglect two major areas of a policy tool; 1) the context in which the tool is implemented and 2) the properties that underlie the selection of a tool. The following graph (Figure 1.2) is a visual display of the deficiencies of these studies.
This current study emphasizes:

1) **Contextual capacity**: the circumstances in which the policy tool is implemented,

2) **Design and operational attributes**: the properties that define the tool, and the way the tool is implemented.

This study thus raises the following research questions:

*Does contextual capacity affect the attainment of policy objectives?*

*What are the significant factors that constitute contextual capacity?*

*Is there a relationship between contextual capacity and the local government's adoption of design and operational criteria of a policy tool?*

*Does the relationship between the contextual capacity and the local government's adoption of design and operational criteria of a policy tool impact the attainment of policy objectives?*
To address these questions, this study proceeds with the following steps:

1) Establishing a conceptual framework to examine the relationships among contextual capacity, design and operational attributes of a tool, and the attainment of policy objectives.

2) The synthesizing of various literatures to identify critical components of these concepts.

3) Drawing theoretical inferences from various studies including urban politics, economic theories of interest groups, and resource dependency theory, to build a priori premises of a relationship between contextual capacity and the local government’s adoption of the tool’s design and operational attributes.

4) Developing a case study research design to implement these theoretical concepts by comparing the actual behaviors of two communities in municipal water pollution control.

5) Operationalizing these concepts by using the case and policy setting.

6) In the final step, the expected consistency between theory and practice is examined, results are explained and further recommendations made.

1.3 Purpose and Objectives of This Study

The purpose of this study is to examine factors that are crucial to the effectiveness of local government’s adaptation and implementation of federal initiatives, and to fill the gap between theory and practice in policy instrument studies. In particular, this study achieves the following objectives:

1. Identifies the effect of increased involvement of local government in designing regulations and programs to adapt a national policy, and explores the factors contributing to this effect.
2. Provides an operational definition of the local community’s contextual capacity

3. Establishes a relationship between contextual capacity and the local government’s adoption of design and operational criteria of local regulation

4. Evaluates policy outcomes of community-specific regulation

1.4 Policy Implications and Research Contributions

This study emphasizes what a local government can do, and does not intend to provide answers to what a local government should (or should not) do. By exploring the factors that are positive to a local government’s effectiveness in adapting national initiatives, this research identifies areas that local government should consider in order to enhance the effectiveness of their regulatory actions and capacity building, as well as the areas that the higher level governments should consider in formulating policy, standards, and resource allocation. In addition, attention is focused on the pivotal role of involving local government in designing intergovernmental policies. Under appropriate federal guidelines and supervision, a resource-capable local government can design and implement its programs and regulations to improve the outcomes of these intergovernmental policies at the local level. This theoretical framework draws from implementation studies, urban politics studies, economic theory of interest groups, and resource dependency theory in an attempt to reduce the deficiency of policy instrument theory.
This study also identifies areas to which the scholarly policy community can contribute. By further exploring the behavioral dimension, theory and practice are brought a step closer together. By signifying the importance of the relationship between contextual capacity and common properties of a policy tool, both the predictability of the ways in which policy makers adopt design and operational criteria of a policy tool and the estimation of policy success are greatly enhanced. By operationalizing contextual capacity, this study provides utility for policy makers to identify the areas of a local community’s contextual capacity in need of improvement, and sheds light on the ineffective implementation of local regulations.

In addition, this study also raises challenges to the policy community to incorporate context-specific attributes into the design of policy instruments. With improved understanding of the association between contextual capacity and the ways in which an instrument is designed and implemented by the local government, the scholarly policy community is urged to research the means by which a local community’s capacity can be incorporated into policy design. In this way, local resources and authority can be better targeted to the areas that need improvement in order to assure greater implementation effectiveness at the local level.

Another theoretical contribution of this study is that it provides a more complete explanation of industry capture (Stigler’s theory of economic regulation). By incorporating Olsen’s interest group models and resource dependency models to explain the connections between contextual capacity and the influence of interest groups, the
outcome variations of implementation and enforcement of local regulations can be understood. This study suggests that ineffective implementation of regulations may be the result of insufficient resources rather than industry capture. This study also suggests that a community has strong contextual capacity, the influence from industry or a particular interest group is minimal.

1.5 Organization of This Study

The remaining chapters are organized as follows. Chapter 2 reviews relevant literature and the contributions and limitations of this literature are discussed. Chapter 3 introduces the design of this study. This chapter also provides a brief policy background, an analytical framework to explain the conceptual linkages this study explores, an operationalization of the theoretical concepts, a description of the research methods used, an explanation of the manner in which data was collected, and clarification of this study's limitations. Chapter 4 provides data analysis, significant findings, and interpretations. Chapter 5 provides the concluding remarks of this study. Limitations, policy implications and further study recommendations are also discussed in this chapter.
CHAPTER 2

REVIEW AND RELATED LITERATURE

This chapter 1) provides a synthesis of previous studies of policy instruments, 2) reviews these studies' contributions and deficiencies, 3) proposes linkages and components that would alleviate these deficiencies, and 4) provides theoretical arguments derived from policy studies as well as other literatures, including urban politics, economic theory of interest groups, and resource-dependency theory, to support the proposed hypotheses of this study.

In particular, these theories are useful in explaining the behavior of local governments and regulated industries. These theories also offer insights into the reasons for the rules and enforcement actions that local governments use to regulate industries. Policy instrument studies often lack in-depth examination of these behaviors, and do not adequately explain the circumstances in which a local government can effectively adapt a national policy, nor the reasons why local policies are designed and implemented in the way that they are.
2.1 The Review of Policy Instrument Studies

An appropriate starting point is a quick review of the implementation studies. Pressman and Wildavsky pointed out that policy resides in a chain of causation between initial conditions and future consequences. They also pointed out that "the separation of policy design from implementation is fatal." (p.xxv, 1973). It is important to bring policy design and implementation together, as indicated by Pressman and Wildavsky's theory; however, it is not easy to implement this concept in reality. To suddenly bring all programs to be implemented by one level of government "is neither economically nor politically feasible" (Marvel, 1982, p.30). Perhaps, this is why more than two decades after Pressman and Wildavsky's study, scholars are still striving to develop research that is theoretically sound and that can be empirically replicated in practice.

Overall, these implementation studies range from the top-down first generation, to the bottom-up second generation, to the integrated third generation studies. Palumbo and

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6 Pressman and Wildavsky in the Oakland Project study stated that a breakdown at one stage needs to be repaired; otherwise, the mission becomes impossible to accomplish. Once policy circumstances change, initial goals are subject to "slipage". The subsequent chain of causality is no longer valid. The actions followed become unpredictable. Therefore, the longer the chain of causality in a policy, the more complex the implementation process becomes, and the more likely the policy is to fail (Pressman & Wildavsky, 1973).

7 Implementation research can be grouped into three categories. The first category examines how a single state/authoritative decision is carried out in states/localities. The contributions of these studies (e.g., Derthick's New Towns in Town, and Pressman and Wildavsky's Oakland Project study) include providing explanations of the obstacles of centralization and how the central government fails to consider the importance of local politics. A top-down model often is adopted in such studies. However, the limitations of these studies are: 1) they are less replicable due to single case study methods; 2) case informants of these studies are less reliable due to a single view from higher authorities (triangulation with state/local administrators and cross-examination with policy target groups are absent); and 3) they use federal ideology to judge local/state value. Consequently, the policy is often labeled to be a "failure". A bottom-up model advocated by Lipsky (1980) takes into account policy actions and policy actors derived from the implementation environment. Street-level bureaucrats are believed to be experts who know what their clients need. However, these studies are not problem free, due to: 1) difficulties in determining whose values count (e.g., clients, or citizens?) 2) difficulties in determining an agreeable goal (due to competing
others provide fairly thorough overviews of the development of policy implementation studies (Palumbo, 1987; Mazmanian and Sabatier, 1989; Goggin, 1990). In brief, the arguments of the first and the second generation mirror the practical issue of the differences in policy perspectives between the federal government and local governments. Respectively, the first and the second generation scholars claim that the failure of policy is due to: 1) the imposition of federal ideology or the unimplementability of policy goals set forth by legislators, or 2) tunnel vision of local interests, or goal fragmentation from too many “street level bureaucrats”. As strongly advocated by the third generation studies, the integration from both ends might rely on the communications across states, across programs, or across time where the implementation occurs. Perhaps, the common drawback of the third generation studies is the gap that exists between the theory and practice. The theoretical propositions of the third generation are difficult to validate in the actions taken in any particular implementation situation because operable definitions of these propositions are underdeveloped.

Implementation studies focused attention to the importance of the linkage between design and implementation. Some policy studies have provided evidence that a separation of formulation and implementation dooms a policy to failure. For example, Derthick’s New Towns In-Town study revealed that the failure of the federal program was due to the federal bureaucrats’ ignorance of local authorities and local politics (1972). A later study conducted by Marvel (1982) showed that federal programs

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values), and 3) local tunnel vision resulting in doing business as usual. Therefore, a third group of researchers (e.g., Elmore, 1985, O’Tool, 1989) provide frameworks that model implementation from a collaborative middle ground (bottom-up plus top-down).

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implemented by state governments are less effective than ones implemented by the federal government. One of the valuable lessons learned from these policy studies is how to diagnose policy failure. However, the remedies for policy failure are not readily apparent, in part due to the unfeasibility of giving all responsibilities to one level of government.

In the current trend of decreasing federal resources, the federal government often has to cut its budget and shift more program responsibilities to the lower levels of government. The increased implementation of federal policy by local governments seems inevitable. Indeed, recent studies that examine intergovernmental relations have consistently pointed to this trend of increasing local adaptation of federal policy (May and Williams, 1986).

Studies including those by Beam and Benton (1986) and Lowry (1992) have provided reviews and predictions on a developing trend of federal initiatives. Increasing number of intergovernmental policies including environmental policies are established in a partially preemptive policy context (Fix and Kenyan, 1990; Lowry, 1992). In a partially preemptive policy, lower level governments can only assume program responsibility if they can demonstrate that their programs meet or exceed the standards imposed by the higher level governments. However, the level of effectiveness achieved by the implementing governments varies, and the conditions that enable the policy effectiveness are different among these implementing governments. Therefore, the federal government
is faced with the risk of failure when it delegates program responsibilities to state/local
governments without knowing the local government's ability to adapt these programs.

Perhaps, the decrease in federal resources to assist local governments is one of the
reasons that the policy instrument literature has prospered and gained recognition in the
field of policy implementation since the 1980's. The intention of these policy instrument
studies is to find the best "means" of implementation in a practical setting (Mazmanian
and Sabatier, 1989). These studies have suggested innovative ways of delivering
governmental services and have been able to help many cities overcome financial
difficulty.

Two Approaches of Policy Instrument Studies

The essence of policy instrument studies is a concept of "tool substitution". In brief,
the development of policy instrument studies can be categorized as resulting from one of
two approaches: 1) the classification approach which leads to the development of
classifications and typology systems of policy instruments, and 2) the design approach
which leads to the search for design attributes that are common to most of the policy
instruments. The contribution of the first approach is to the establishment of the linkage
between types of tools and attainment of policy objectives. The first approach postulates
that certain tools produce certain policy outcomes. The contribution of the second
approach is the establishment of the linkage between common attributes of policy tools
and the selection of the policy tools. The second approach postulates that the selection of
a successful policy tools is determined by an evaluation of these common attributes, and these attributes can be used as evaluative criteria of the performance of the tool.

**Classification Approach**

The development of tool classification mostly originated from the studies by Theodore Lowi (1964 and 1972). His policy taxonomy was based on the degree of coercion available to governments. Lowi categorized policies as distributive, regulative, constituent, and re-distributive. His taxonomy explains the connection between the types of policy formulated at the national level and the types of politics and group activities that might be associated with these policies. Later studies such as those of Steinberger (1980) used and expanded his typology. Steinberger’s classification is based upon the potential socially-relevant impacts of a policy. His study pointed out that the definition of a policy tends to vary with time and circumstance. One of his examples was a tax policy, that might have been substantive at one time and symbolic at another. Other studies by Lowi (1988) and by Spitzer (1987) and Kellow (1988), expanded Lowi’s original views by adding continuous taxonomy for policy types. However, problems of the classification approach result from the difficulty of categorizing policies that involve aspects of more than one category or that change the classification over time.

Ripley and Franklin’s study can also be included in this approach. Shifting their focus of policy typology from the perspective of policy formulation, Ripley and Franklin explored Lowi’s typology at the implementation level. They emphasized the significance
of the perceptions of the individuals involved and the importance of the clarity of policy objectives at the stage of implementation (Ripley and Franklin, 1986).

Other studies using the classification approach emphasize functional differences among policy tools. For example, Mosher (1980) differentiated tools based on expenditure vs. non-expenditure types. Rosenbloom’s definitions (1983) of policy included managerial, political, and legal approaches. Each approach is found associated with a particular era, value, organizational structure, and group activity. Elmore developed a classification system based on the functions of policy tools to address policy problems. His tool classification includes mandates, inducement, capacity building, and system-changing (1987).

Later policy instrument studies included in the classification approach brought more practical references into discussions and placed more attention on the analysis of the implementation process. In particular, in the 1980's, scholars like Savas (1982 and 1987), Salamon (1989), Osborne and Gaebler (1992), Mercer (1992), Donahue (1989), and Rosen (1993), provided detailed discussions of the link between various types of policy approaches and the suitability of those approaches to solve policy problems. Their classifications are based mostly on the degree of governmental intervention a policy tool provides. Structural changes in service delivery such as providing market-based incentives are among these classifications. One of the most discussed structural changes to address the inefficiency of government production was privatization.
In summary, one of the major contributions of the first group of policy instrument studies, the classification approach, has been the identification of a full range of policy tools that can be at the government's disposal.

**Limitations of Structural Change in the Public Sector**

Institutional economics provides the major theoretical foundation for the privatization literature, and discusses the concept of tool substitution reminiscent of the policy instrument studies. Institutional economics theory suggests that there is a relationship between the choice of institutional design and organizational performance. The Coase Theorem suggests that trading can solve an external diseconomy problem (e.g., pollution), when transaction costs are assumed to be trivial and the initial property rights are clearly assigned (Coase, 1960).

However, the examination of policy issues and the provision of problem solving methods derived from Coase’s literature might be unrealistic. The application of market-incentives to public policy needs to be carefully examined. Especially, the assumption of trivial transaction costs and the feasibility of assigning initial property rights might not be valid. For example, environmental protection policies often carry high transaction costs as well as external costs that are difficult to minimize.
The institutional economics literature suggests minimization of transaction costs by examining various structures based on degrees of a third-party intervention (e.g., monitors, mediators, or government). These alternative structures involve variations in governing forms. Common criticisms of transaction costs literature are that they lack proper definitions and measurements for accounting for these costs. These problems are particularly apparent in the public sector, where changes in the governing structure might bring resistance from powerful interest groups and associations, might involve lengthy legal procedures to legitimize such changes, or might contradict other societal values. Potential problems of changing governmental structures also include agents' difficulties in efficiently resolving disputes and/or in negotiating an agreeable solution.

In many policy cases, the externality associated with transaction costs is not trivial at all. According to the concept depicted by Hardin (1968), disputes would result from trying to negotiate the use of common resources because of the involvement of multiple parties. The transaction costs of bringing all parties together to negotiate a solution may exceed the benefits. Scholars writing in this area include Buchanan and Tullock (1969), Williamson (1975 and 1985), and Moe (1984). Their discussions of alternative governing structures that can reduce these transaction costs (e.g., costs of information, bargaining, monitoring, or contracting) have had a significant influence on the literature of collective action, theory of the firm, principal and agent theory, and public choice.

However, there are concerns regarding empirical verification of the concept of structural changes discussed in policy instrument studies and institutional economics.
Mitnick (1993) argues that this literature focuses on the choice of organizational structures, not on the means of influencing the activity that populates those structures. Without further analyzing the means of these organizational structures, structural changes recommended by the policy studies may not be promising. The implementation of drastic institutional changes can be problematic for the public sector. For example, the political costs associated with a reluctance to change can be too high to be efficient. In reality, incremental changes seem to suit political environments better. Lindblom's (1959) "The Science of Muddling Through" provides classic arguments for such incremental changes (Lindblom, 1959).

Similar concerns have also been raised by another group of policy scholars. They questioned whether efficiency resulting from changing organizational structure by outsourcing in the private sector could be replicated in the public sector. These scholars include Moe (1984), Sappington and Stiglitz (1987), Ferris and Graddy (1991), and Marvel and Marvel (1992). Their studies examine the differences between the public and the private sectors. One difference between public and private sector is that the transaction costs that could be easily minimized in the private sector by contracting out services or production instead of producing them in-house could be substantial in the public sector. A second difference is that it is typical for a public policy to have multiple objectives and conflicting interests among groups, unlike the private sector that has a common interest in profit. With this complication due to multiple and conflicting objectives in the public sector, determining who is the principal actor and defining, not to mention honoring, the demands of that principal is difficult. A third problem is the lack
of information. The asymmetry of information or the lack of information makes it difficult for a principal to monitor or motivate agents.

**Lack of Attention to the Refinement of Operational Methods**

Lack of attention to the refinement of operational methods that an instrument uses is another major deficiency of policy instrument studies. Although later policy instrument studies provide a broader analytic scheme with which to examine policy tools, these studies adhere to the substance of the theory, “tool substitution”. The selection of a tool is assumed to be based on an understanding of its effects on policy outcomes, the classification of its characteristics, the types of activity it encompassed, the structure of its delivery system, and the degree of government intervention it requires (Salamon, 1989). However, the hypotheses offered by these studies have not been operationalized, leading to a lack of empirical verification in support of the theory.

**Lack of Freedom to Replace One Tool with Another**

Furthermore, the concept of tool substitution in the policy instrument theory raises another empirical problem. Its theoretical assumption that policy makers can freely choose among an array of instruments may be false. In some policies, the selection might be very limited because these policies are prone to select a generic or a hybrid policy instrument. For example, standards and guidelines for issuing permits, or initiating a procedure are mini-instruments commonly used in a regulatory policy. These tools are usually applied to certain policy areas, and the government bureaucracy is structured to support those tools. Some choices might not be socially acceptable although they might
produce better outcomes. In addition, applying the notion of tool substitution to a mixture of tools may be very costly and infeasible. Therefore, the degrees of freedom for policy makers to replace one tool with another can be severely limited by the circumstances.

If policy makers are limited in their choice of policy instruments and have to select the same instrument for a policy, will the implementation outcomes of this policy instrument vary under different circumstances? If the implementation outcomes vary, what are the factors would affect these variations? Policy instrument studies address very few of these questions. One should question whether these studies conclude too quickly that tool replacement is the key to policy success. Instead, success may result from the improvement of an existing instrument.

In brief, previous policy instrument studies are limited in the following ways. First, policy instrument studies assume that policy makers would replace an existing tool with another in order to improve efficiency. Without examining under what circumstance this assumption becomes valid or weighing potential political or social costs involved, this assumption may have promised a quick-fix approach that is unrealistic. Furthermore, the assumption that policy makers are free to choose one tool over another without any constraints may be misleading. Above all, what is lacking from these studies is an in-depth investigation of an instrument. This study is interested in exploring the possibility of how improvement of a policy instrument affects the success of the policy’s implementation.
Design Approach

The second group of policy instrument studies is based on a design approach. Linder and Peters (1989) pointed out that many instruments could be functionally similar, but operationally different. They asserted that the conclusions drawn from the classification based policy instrument studies are crude and unrealistic. Linder and Peters (1989) stressed the limitations of the classification approach, arguing that these studies failed to build the linkage between the choices of instrument and the behavior of those using the instrument (such as policy makers).

The design approach of policy instrument studies raises an important concept, "levels of generality", which defines the common attributes of policy instruments. These studies established linkages between the attributes common among instruments and the choices of a policy instrument. This group of studies asserts that policy makers can choose the best fitting instrument by evaluating these attributes, and then use these evaluations as criteria to determine the fitness of the instrument as well as to determine the success of the instrument.

The scholars that brought the design aspects of policies to policy instrument studies include Linder and Peters (1984, 1987, 1990a, and 1990b) and Schneider and Ingram (1990a and 1990b). These scholars argued that the failure of a policy is often caused by the faulty design of policy. Schneider and Ingram asserted that:

"Effective designs must take into account the political, social, cultural, and economic circumstances of the
individuals upon whom policy success depends, and must motivate individuals to engage in policy-preferred behavior.” (1990b, p.76)

Linder and Peters pointed out that a theory of design requires at least three elements: 1) the characteristics of the problem being addressed, 2) the characteristics of the policy’s goals, and 3) the characteristics of the instruments chosen (1984). The concept of design as described by Linder and Peters is “…to link together values, models of causation, and the choice of instrumentation so that better choices can be made” (Linder and Peters, 1987, p.468).

Schneider and Ingram establish linkages between policy instruments and the behavioral dimension of the instrument. They assert that attributes that are common among instruments and the behavior of the various participants involved in the implementation of a policy instrument are missing from the earlier classification approach studies (Schneider and Ingram, 1990a). Theoretical explorations of these aspects include the work of Linder and Peters (1989) who developed a set of generic characteristics of tools such as resource intensiveness, targeting, political risk, and constraints of the tool. Schneider and Ingram identify some behavioral characteristics of policy instruments including authority, incentives, capacity building, symbolism, and learning (1990a). The basic concept of this design approach is that empirical samples of tools, such as grants, contracts, and fines, can be evaluated by examining the strength of these underlying generic characteristics. Policy makers can evaluate these tools and then select the one that can best maximize their objectives.
Limitations of Design Approach

The salience of the design approach is that makes clear evaluative and generic characteristics (or criteria) that underlie most policy tools. The major difference of the design approach from the classification approach is that instead of developing exhaustive lists of tools within classifications, the design approach attempts to identify attributes that are common among tools. These attributes vary in the degree to which they are present in the tools. This design approach attempts to bring theory a step closer to practice by postulating that a tool is chosen because of the common criteria of a tool and the values ascribed to the criteria. The decision-makers will choose the best fitting tool based on their evaluation of these criteria. The empirical implications of this approach are limited because the linkages between the criteria and the choice of instrument are based on normative assumptions of policy makers. The reasons that certain values of these criteria of policy tools are adopted by decision-makers are not identified in the literature.

One attribute that is missing from the literature of both classification and design approaches is contextual capacity. Both approaches fail to build in a relationship between the circumstances in which the policy instrument is implemented (i.e. contextual capacity) and decision makers’ adoption of the common attributes underlying the instrument (i.e. design attributes defining the instrument, and operational attributes specifying the implementation of the instrument). Howlett added methodological arguments that the choice of instrument relies on existing social, political and economic circumstances (1991). He indicates that general theories of policy instrument appear to differ on a national basis, by comparing instrument literature originating in three
countries. He further raises a valuable viewpoint: "instrument choice is context bound" (p.15). Linder and Peters in their later studies (1989 and 1990b) recognized the significance of context by indicating it as one of the causes of instrument choice. However, the impacts of the context and the magnitude of the impacts are not specified in their studies. Their models are limited by the lack of empirical evaluation. The following table is a synthesis of literature that is representative of the development of policy instrument studies.

<table>
<thead>
<tr>
<th>Author/year</th>
<th>Tool argument</th>
<th>Major Proposition</th>
<th>Empirical Verification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salamon, L.M. (1989)</td>
<td>classification approach</td>
<td>choice of instrument varies according to the objectives of policy</td>
<td>none</td>
</tr>
<tr>
<td>Linder &amp; Peters (1984, 1987, 1989, and 1990b) Schneider &amp; Ingram (1990b)</td>
<td>design approach</td>
<td>choice of instrument varies according to the evaluation of design attributes</td>
<td>none</td>
</tr>
<tr>
<td>Howlett, M., (1991)</td>
<td>choice of instrument is context-bound</td>
<td>choice of instrument varies according to national policy styles</td>
<td>none</td>
</tr>
</tbody>
</table>

Table 2.1 Critical Development of Policy Instrument Studies
2.2 Missing Components: Contextual Capacity, Design and Operational Attributes

Briefly, policy instrument studies can be classified as taking one of the two approaches: 1) the classification approach and 2) the design approach. The contribution of the first approach is the refinement of classifications of policy tools. In addition, these classification studies discuss the significant linkage between the selection of tools and the solving of policy problems. The major missing theoretical element of the first approach is a description of under what circumstances the selection of a tool is made by decision makers. The design approach improves this deficit by identifying common attributes of tools that can be evaluated. As a result of this evaluation a best-fitting selection can then be made.

The major limitation of both of these approaches is that they use the effect of the tool as the unit of analysis, although it might suit their theoretical focus of “tool substitution”. In addition, the public sector may lack freedom to replace one policy tool with another, in part due to potential political costs or public resistance. Limitations of the literature also include insufficient information to predict a policy maker’s selection of a best-fitting tool and to predict the results that the tool selected may promise. In addition, the association of design and operational elements of tools with achievement of policy goals is not clearly identified. Furthermore, by focusing on the effects of the tool selected, research attention of policy instrument studies is diverted from exploring the possible operational variations of one policy instrument. These studies also downplay the significance of the contextual capacity that is related to these operational variations. Hence, the empirical application of the policy instrument studies is limited because: 1) without exploring how a policy instrument chosen by various localities might be designed and implemented
differently, and 2) without knowing why a policy instrument might be a success in one locality but not in another.

This study develops conceptual elements that can help to address some of the limitations identified above, and improve the understanding of how the context in which the policy is implemented affects the implementation outcomes of the policy. In order to explore possible variations in the ways that an instrument is designed and is implemented, this research uses regulation as an example.

2.3 Design and Operational Components of A Generic Tool - The Example of Regulation

The development of this section is based on the work of Bardach (1989), Linder and Peters (1989), May and Williams (1986), Burby and Paterson (1993), and May and Burby (1995 and 1996). By focusing on regulation, this study is able to develop an in-depth analyses of design and operational components underlying a generic instrument (or a mixture of mini-tools).

Bardach suggests that government regulation might consist of three elements: 1) a body of rules and standards prescribing responsible behavior, 2) agents monitoring and enforcing these rules, and 3) sanctions applying to the individuals who do not comply with these rules (1989). These elements are in agreement with the common design and operational attributes among policy tools described by Linder and Peters. Linder and Peters identify several attributes common among policy instruments including policy intention, institutions, agents, target groups, and policy effects (Linder and Peters, 1989).
May and Williams (1986), Burby and Paterson's (1993) and May and Burby's studies (1995 and 1996) are among the few studies that have empirically examined the policy outcomes of two different regulation designs. Their studies were conducted in an intergovernmental policy context. May and Williams (1986) studied the significance of the roles of local governments in the success of adapting intergovernmental policy.

May and Burby used a case study method and compared intergovernmental environmental management in two countries. They conclude that in the intergovernmental relationship, the outcomes of a cooperative regulatory design (i.e., the local government cooperates with and is committed to the national government) are superior to those of a coercive design (i.e. the national government has to force the local government to implement policy designated by the national government) (1995 and 1996).

This group of studies provides useful descriptions of the design and operational elements of regulation, which include rules, institutions, agents, and target groups. In Peter May and others' studies, the outcomes resulting from the local government's involvement in the development of a national policy are investigated by comparing empirical results of two dichotomous regulatory designs. One of the independent variables identified in their studies is agency's capacity (May and Williams, 1986; May and Burby, 1996). Their studies suggest that a cooperative design relationship between the implementing governments and the mandating government is superior to a coercive
one. Their discussions however, did not address the conditions necessary to allow the implementing governments to act in the specific ways that they do, nor did it address the relationships between the implementing governments and their target groups.

Based on the above theoretical discussions, this research identifies elements of a regulatory relationship between a local government and a regulated group that can affect the effectiveness of an implemented regulatory policy.

Design and Operational Attributes of Regulation

The regulatory relationship was operationalized by using the components identified in the studies of Linder and Peters and May and Burby, and included:

1) The amount of stringency and the level of comprehensiveness of rules used by the local government to regulate the target groups’ behavior,
2) The amount of precision of operational specifications used to govern both governmental agents’ and the regulated groups’ behaviors, and
3) The amount of coercive authority available to the local government and the level of willingness of the local government to use the coercion to regulate the target groups’ behavior.

2.4 Identification of Contextual Capacity

To improve the deficiency of prior studies, this study has identified components of contextual capacity of local communities. These components are then used to determine the contextual capacity of the local community in which the regulatory policy to be
examined was enacted. The definition of contextual capacity and the identification of the effects of the contextual capacity are developed based on the literature of urban politics and economic/interest groups theories.

The literature discussions of urban politics have provided insights into the policy process of a local community. Several studies in urban politics were developed based on the theory of interest groups. Olson (1971) discussed group theories based on the costs of organization that are affected by purposes of organizing, group size, and group behavior. One of the basic arguments of his theory is that the incentive of a group to seek influence on policy depends on the extent of gains (or losses) they may obtain (prevent) from such actions. In general, theoretical discussions of group theory can be grouped into the areas of formation of groups, strength of groups, and the behavior of groups. Policy literature examining interest groups has focused almost entirely in a single arena where a policy is formulated (Eldersveld, 1958 and Eulau, 1973). ⁸

Policy activities associated with national politics are very different from those associated with local politics. The activities of lobbyists and organized groups are less evident in local politics. In addition, local citizens exercise their political influence in a less organized manner. Local dominant groups are also very different from the groups that are active in influencing policy making at the higher level of government.

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⁸ A body of literature provides excellent discussions on the formation of national policy including the process of how a national agenda gets set. For examples, see studies by Cobb, R. and Elder, C. (1972) and Kingdon, J. (1984).
Discussions concerning political power in urban politics have been partitioned into two camps: arena theory (led by Robert Dahl (1981)), and elite theory (led by Floyd Hunter⁹). The essence of arena theory is that political power in American society is distributed unequally to the most identifiable groups in the system. These groups constantly strive to create new issues to attract marginal voters from rival groups or to increase support among the major social grouping. Their issues can usually be heard in the decision making. The essence of elite theory is that the political power in the society is concentrated in the hands of few men in power. These are men who can be identified as top leaders or a ruling class of hierarchy within a community, and who take part in the decision-making (Keynes and Ricci, 1970; Waste, 1987). The arena and elite theories can be used to explain a community's power distribution. For example, the interests of a few powerful groups are likely to dominate most of the political issues. The strategies to channel these interests into a policy action will most likely be set by a few top-decision makers or group leaders.

The ways in which citizens influence their decision-makers are discussed in the studies of Zisk (1973) and Gray and Eisinger (1991). In Zisk's study, methods used by local groups include formal activities, such as contacting officials by phone calls, visits from group leaders to policy makers, and policy makers' visits to social affairs or group functions. The less formal approaches include social contacts, luncheons, or dinners, or

⁹ Hunter provided discussions that community's decisions are made by a few men in power. The discussions were illustrated by using examples of small communities and its ruling classes, such as business and financial leaders (1956, 1963, and 1965).
group memberships (1973). Political participation can also be such activities as voting, contributing money, contacting officials, and protesting (Gray and Eisinger, 1991).

Policy issues, the organization of groups, and access to policy processes within a local community are also different from those at the state and national levels. The interests and concerns of the local community are found to influence local policy decisions; city executives and council members are found to influence departmental programs and objectives. Groups that are influential in local politics include local business associations and neighboring groups such as tax payers or homeowners groups, and general service groups, such as youth-oriented and women's or church groups (Schultze, 1985). From Abney and Lauth’s survey study, among the three most influential interest groups identified are neighborhood groups, business associations, and major business leaders (1986).

Indicators of Contextual Capacity

One of this study’s underlying assumptions is that local contextual capacity and the ways the local government adapts a national policy will impact the implementation outcomes of the policy. The following section discusses contextual capacity related literature. Contextual capacity is strongly associated with the profile of the community. The profile of a city is extensively discussed in urban politics literature. In the literature of Wilson, (1968), Zisk, (1973), Schultze, (1985), Abney and Lauth, (1986), and Waste (1989), a city’s policy development is found to vary among cities with different characteristics. A common profile used to depict a city may include size, growth rate,
demographic factors, and the resource capability of the city. These factors appear to affect a city’s ability to develop and implement a policy.

Eyestone and Eulau conclude in their study that the willingness of policy-makers to tap available resources is an important factor to the development of a city's policies. They established linkages between socioeconomic conditions of a city and the program activities of city government. In addition, they determined that larger-sized cities with advanced policy development are related to the diversity of groups (1968).

In brief, in the literature of urban politics, socioeconomic factors are found influential in translating the needs of the citizens into policy. The relationships between socioeconomic variables and the community’s contextual capacity are discussed. In addition, explanations of behavioral dimensions among the key players including decision-makers are addressed at a micro level (i.e., behaviors of group members) in this group of studies. These studies suggest that only a few group members are able to acquire political power in the community. However, discussions of linkages between characteristics of a city and possible group influences at a macro level are limited. To model such relationships, this study used the discussions of economic/interest groups and resource dependency theories.

2.5 A Behavioral Dimension of Regulation

This section provides a brief review of the theories offering models of the behavioral dimensions of key players in the formulation and implementation of regulation. The
basic components of regulation include rules, agencies, agents, and regulated groups. The implementation of regulation allows for formal as well as informal interactions among the agents and the regulated groups. The behaviors of both groups affect the outcomes of the policy. The explanations of why the agents and the regulated groups behave the way they do are drawn from economic/interest groups and resource dependency theories. The economic/interest groups theory includes industry capture theory and Mancur Olson’s models on the strength of groups. Resource dependency models are used to explain the local agency’s ability to effectively implement the policy.

**Industry Capture Theory**

Some scholars argue that interdependence between the regulators and the regulated industry hinders the effectiveness of regulation (Anderson, 1982). The conventional theory of regulation postulates that policy outcomes of regulation can be explained by examining the amount of influence exerted on regulators by industry, commonly referred to as “capture”, with consumers and the public being the underrepresented group. The capture theory also suggests that consumers are less likely to act collectively because the costs are too high and the rewards are too small.

Mitchell (1990), Mitnick (1993) and Berry, Mitnick, Marcus, et.al., and Anderson (1982) review industry capture theory. These discussions can be categorized as belonging to one of two schools of thought: 1) the Chicago school (from the producer perspective) and 2) the Virginia school (from the consumer perspective). The foci of both schools can be summarized as follows: 1) Rent seekers organize in order to
maximize their profit. 2) Factors such as size of interest groups, asymmetrical interests among group members, and the role of sanctions influence groups' rent-seeking behavior.

The Chicago school lead by George Stigler\textsuperscript{10} asserts that the groups (especially, industries) can benefit the most from wealth transfer in the society because regulation, although a potential threat to an industry’s profits, is actively sought by the industry (p. 209, Stigler, 1988). Industry groups seek to influence those in government especially with capital. Often, they use regulation as a means of reducing competition. Regulation resulting from such industry influence would allow a maximization of industry’s interest. Peltzman expanded the Stiglerian model of regulation, showing how it complies with the law of diminishing returns with regard to group size. He suggests that small special interest groups, which control large amounts of capital, would have the strength to extract rent (i.e., profit) from the regulatory process. His assumption is that the smaller the group size becomes, the more rents the group can capture from regulation because the bigger the group becomes, the greater the cost to organize and the more opposition such size arouses (Peltzman, 1988).

In sum, Stigler’s model demonstrates the favoritism of industry by a political process: “a political process does not allow participation in proportion to interest and knowledge.” It is obvious that the publics, who lack an interest in and who have little knowledge of the political process, are excluded. As Stigler pointed out “regulation is acquired by industry and is designed and operated primarily for its benefit.” (1988)

\textsuperscript{10} Representative scholars also include Gary Becker, Sam Peltzman, and Richard Posner. Their selective work can be found in the collection of \textit{Chicago Studies in Political Economy}. (1988).
The Virginia school economists are represented by Buchanan and Tullock (1969), McCormick and Tollison (1981), and Tullock (1989). This school postulates that individuals in the society who seek to maximize their utility might forfeit their private decisions and turn to collective decisions (Buchanan and Tullock, 1969). This school of studies attempts to explain the roles and activities of consumers, citizens, bureaucrats, and their legislative representatives within the regulatory process (Mitchell, 1990).

The Virginia School’s theory asserts that regulatory decisions are made by 1) representative legislatures that can be influenced by voters’ choices or by 2) a bureau that can be influenced by political participants. The managers of a bureau act in ways that would increase the relative power of the bureau. One way of doing so is to expand the “sales” of political influence and public support (Tollison and Wagner, 1988). Moe also addressed the administration of a collective good from an organizational point of view. The leader of an organization, a so-called “political entrepreneur”, is one whose decisions might be influenced by the different types of participants in his group. Some members might have more influence than others (1980). Similarly, McCormick and Tollison established a model of policy brokers engaging in the process of wealth transfers among voters. In their model, the legislators act as a middleman among groups (or voters) and have the self-interest to maximize the “brokerage fee” (e.g., votes or resources). These fees can compensate politicians and can affect their behavior in developing and enacting a piece of legislation (1981). Powerful industries are most likely to be able to allow bureaucrats to maximize their self-interests by supplying them with resources. In
addition, special interest groups are more informed, and are more willing to fight for their own cause than the general public. Consumers and the public who are not well informed about political issues, thus are the ones who most likely lose in the political process (Berry, 1982; Tullock 1988).

Principal-agent theory is in agreement with the Virginia school’s “information asymmetry” discussions. In the principal-agent theory, information is the key that allows principals to monitor agents’ behavior. With consistent information among the principals and agents, better production can be expected (Moe, 1984). However, political principals (such as citizens) are not as well informed and are not as resourceful as powerful interest groups. Monitoring agents’ (such as policy makers and implementers) behavior becomes difficult.

Both the Chicago School and the Virginia School suggest that industry can capture more rent than citizens can because they are better organized and have more to gain or lose. The limitations of the industry capture theory are that their arguments are not clear, and are not always consistently supported by empirical findings. In the capture theory, the self-interest hypothesis underlies the industry’s rent seeking behavior; however, the hypothesis does not sufficiently explain why regulations are formulated the way they are, nor does it comprehensively explain the factors that affect the outcomes of enacting regulations. For example, smaller plants may be the ones most hurt by environmental regulation (Pashigain, 1988). The smaller industry might be unable to fund the development of cleaner or safer technology, and might drop out of the market in lieu of
complying with the costly regulations. The theory's major proposition that the smaller the size of the group, the greater the degree of capture by the industry, is not suitable to explain this outcome. In a further example, when human or environmental health is "visibly" endangered, community groups often successfully form coalitions to block noxious facilities from siting and operating in their community. The capture theory does not explain this phenomenon, as it does not take into account citizen action.

Sabatier and Pelkey critically review various models of regulatory policy making identified by various scholars (e.g., Gomely, 1982, Weingast and Moran, 1983, and Moe, 1982) and develop an advocacy coalition model in an attempt to provide explanations of why regulations are formulated the way they are (1987). Sabatier and Pelkey suggest that those coalitions whose members are stable and whose leaders share the same political belief over a long period of time (e.g., a decade) are dominant in affecting an agency's policy. The coalition's strategies might include altering the agency's political structure or directly influencing the decisions the agency makes (1987). Their study provides indications of the characteristics of groups and the approaches of groups to influence policy within a policy subsystem. However, their proposal also leads to a problem that is common among super-conceptualized models. That is, the model does not provide for empirical testing of its concepts. The external constraints and resources of the policy subsystem are not elaborated. In addition, identification of the key players and the ways policy is affected by these players is not made explicit by their study.
Mancur Olson’s Models

Another group of economic/interest groups studies, led by Mancur Olson (1971 and 1982), explores conditions that affect interest groups’ power. Olson identified factors including the sizes of the groups, the number of groups, the homogeneity of group members, and the strength of the government that can affect group power (1971 and 1982). Although Olson’s conceptualization provided insight into the behavior of groups, it has received little empirical validation (Gray and Lowery, 1988).

A few scholars provide support for Olson’s theories by examining the socioeconomic settings in which groups operate. They include Zeigler and Hendrik van Dalen (1971), Zeigler (1983), Morehouse (1981), and Thomas and Hrebenar (1990). In brief, these studies arrive at similar theoretical premises: 1) economic diversity of a society affects diversity of interest groups, and 2) diversity of interest groups affects the power of interest groups. These scholars conclude that an economically and socially well off society would make interest groups diverse and pluralistic. In such a society, the diverse groups would be competitive and would make it more difficult for any particular interest group to be dominant.

Pashigain (1988) proposes a similar idea concerning the relationship between socioeconomic conditions and regulations. He points out that votes on environmental issues are highly associated with the growth rate of income, and suggests that a wealthier community is more likely to solicit the public as well as governmental support for a cleaner and safer environment. On the other hand, a heavily polluted community in
which there is heavy industry pollution may be unwilling or unable to develop or enforce environmental regulation because the community’s economic well being is closely associated with the polluting industries. Such regulation could conflict with the community’s self-interest.

The major contribution of Olson’s models is to provide links between socioecoonomic factors and the power of interest groups. Scholars of Olson’s models add a socioeconomic perspective that is lacking in industry capture theory. Due to the limitations of data at the local level, most of this group’s empirical studies analyze national and state policies because records on registered group activities are more accessible at the national and state levels. Gray and Lowery (1988 and 1992) and Lowery and Gray (1993) use state data (e.g., registered lobbyists in the state legislatures) from 1980 for 44 states. They conclude that group diversity is highly associated with wealth, size, and numbers of groups (1992 and 1993).

One major drawback of the studies of Olson’s models is the lack of discussions concerning the strength of political authority (e.g., regulatory agency). Although industry capture theory repeatedly asserts the unavoidable capture of an agency by industry, the strength of a political authority can be a factor that undermines the power of interest groups (1972). Gray, Lowery, and others’ studies do not address possible influence of a political authority. Mitnick points out that most of the arguments of a theory of regulation fail to provide an integrating framework that can provide linkages of
regulatory behavior and the design of regulations of an institution. Little research attention has investigated the effects of the design of a regulatory agency (1982).

**Regulatory Agency’s Resource Dependency**

Ideally, a regulatory agency is established primarily to look after the public interest. One group of theorists suggests that a regulatory agency will go through a “life cycle” and at different stages may be prone to be captured by special interests (Anderson, 1982, Waste, 1989). Anderson suggests that factors affecting an agency’s ability to defy industry capture involve agency personnel, agency-industry relationships, and the regulatory environment (1982). In addition, Marcus, et al. suggests strategies that may improve an agency’s effectiveness to enact and enforce regulation. The strategies include 1) examining obstacles affecting the implementation of regulation, 2) identifying mechanisms that can overcome these obstacles, and 3) incorporating the mechanism into the designs of the regulation (1982).

The hypotheses of resource dependency theory can be used to address the component of political authority overlooked by the interest groups theory. From an agency’s perspective, the literature on interorganizational relations helps to explain the relationship between of the agency’s environment and the policy-implementing agency. Hall introduces resource dependency theory drawn from various sources. His review includes the works of Van de Ven Ferry, Aldrich, Schmidt and Kochan. Their discussions explain: 1) the reasons why interorganizational relations are important, 2) the
environmental elements important in such relations, 3) the types of interactions among
the organizations, and 4) the typology of these relations (Rainey, 1991).

Theoretical concepts of resource dependency theory of particular interest to this study
are those exploring the relationships between key players and the implementing agency.
These relationships are described by examining the interactions among the agency,
resources, and key players (i.e., stakeholders or target groups). This theory suggests that
when there is a change in an organization's environment, resource acquisitions, power
structure, and interagency relationships will most likely then change. The work of
Pfeffer and Salancik (1978, 1979, 1981, and 1986) are representative of this research.
They discuss the resource-dependency of an organization and the organization's
interaction with the environments.

The ability of an organization to acquire resources is the pivotal factor used to explain
the effects of inter-organizational relationships. Resource dependency theory suggests
that an organization could seek to change the organizational environment and manipulate
external political processes in order to acquire resources. However, its ability to acquire
resources is related to its power. The theory also suggests that power is positively related
to the performance of the organization (Pfeffer, 1981; Rainey, 1991). As Pfeffer pointed
out, the capability to control access to and use of resources on which others (e.g., other
agencies or stakeholders) depend is critical to the power of the organization (1981). One
of the major contribution of this theory is that an input-output approach was developed
that can evaluate structural influence of an organization quantitatively (Salancik, 1979 and 1986).

The resource dependency studies suggest that an agency should become an active party in developing tactics (such as seeking resources and autonomy) that could successfully ensure the agency's survival (Oberman, 1993). One of the limitations of these studies is the possibility of bias from an agency's perspective because the effectiveness of a policy might only partially link to the performance of an agency. For example, localities may refuse to accept industrial wastewater they perceive would harm their wastewater treatment outcomes, and deny granting access to these industries (Jessup, 1988). A local agency's good performance with regard to pollution may be in part due to the absence of potentially harmful polluters. Furthermore, an agency can be created to perform various missions. These missions might be competing for limited resources; in the times of limited resources, the winner who aggressively acquires resources might not be the one in need. This might hinder the successful implementation of a policy.

As indicated in Echeverri-Gent's study, the effectiveness of a policy-implementing agency can be restrained or enabled by its organizational environment. Institutional rules on the other hand can be designed to strengthen or weaken outside political actors' bargaining positions as well as to provide or deny their access to the formulation and implementation of policy (1992). For example, to survive in a resource-limited environment, it is possible for an agency to avoid difficult groups or difficult tasks in
order to maintain its level of performance or implement tasks that can easily gain public recognition. Therefore, a high performance agency may not directly link to the attainment of objectives of a policy. With this concern, when determining the attainment of objectives of a policy, other measures that can be used to evaluate the outcomes of a policy need to be considered in addition to the commonly used measures of agency performance.

Conclusion

The discussions from the literature indicated above are limited in certain aspects in addressing the relationship between contextual capacity of the local government and the ways a policy is designed and implemented by that government. Collectively, the theories can be used to support the concepts this study proposes. There are two a priori premises derived from these studies. The first is based on the theory of interest groups: there is a negative relationship between the economic diversity of a community and the power of its interest groups to affect policy development and implementation. The other theoretical premise is based on the study of resource dependency theory: there is a negative relationship between the contextual capacity of the local government and the resource dependency of the implementing authority. A determination of the influence of interest groups and the resource dependency of the implementing authority is based on the empirically measured conditions of the local environment where the policy instrument is designed and implemented.
2.6 Summary

The essence of policy instrument literature is that tool substitution, by replacing one policy instrument with another, can improve policy outcomes. This is the essential assumption that also drives the foci of most of the studies on either classifications of instruments or choices of an instrument. Due to these studies’ distinct focus on tool substitution, variations in the contextual capacity of the locality in which a tool is designed and operated and variations in the design and operation of the tool are left largely unexamined. Consequently, empirical results of a policy’s effects based on tool substitution may not as promised. It is not clear that the successful use of one policy instrument can be replicated in other circumstances. The linkage between the effects of policy instruments and their underlying design and operational factors is also not clear. The assumption of tool substitution also fails to examine how the differences in the local contextual capacity relate to the ways in which the policy instrument is designed and implemented. The policy instrument theory does not provide empirical guidance in modeling policy actions, and is insufficient to address how the design and implementation of an instrument affect policy outcomes.

This literature review suggests the following areas for further study: 1) fuller explanation of the relationships between the design and operational attributes of a policy instrument and policy outcomes, and 2) better understanding of the effects of contextual capacity, i.e. the circumstances in which the policy instrument is designed and implemented, and 3) more empirical data to validate the major hypothesis of policy instrument theory, namely, that policy outcomes can be improved by tool substitution.
This research suggests that the key to improving policy instrument theory is to further incorporate the components of contextual capacity and design and operational attributes of a policy instrument into the policy instrument theory, to establish relationships between contextual capacity and the design and operational attributes of a policy instrument, and to identify the effects of the relationship on the success of policy implementation. This study uses theoretical inferences from urban politics, economic theory of interest groups, and resource dependency theory to further explain the suggested components and linkages.
CHAPTER 3

DESIGN OF THIS STUDY

This study has four objectives. The first objective is to establish a research framework that provides linkages among the following theoretical concepts: a) the increased local government’s involvement in designing and implementing the regulations and programs to adapt a national policy, b) the contextual capacity of a local community, c) the relationships between the contextual capacity and the local government’s adoption of design and operational criteria of local regulations, and d) the level of attainment of related policy objectives by the local community. The second objective is to operationalize contextual capacity by using the local socioeconomic conditions and resource dependency of the local government as indicators. The third objective is to provide a rationale for the community-specific adoption of design and operational criteria of local regulations. The fourth objective is to evaluate the effectiveness of community-specific regulations.

A case study of municipal water pollution control is used to provide empirical evidence of the theoretical concepts discussed above. The basic proposition of this study is that community-specific regulation affects the outcomes of the implementation of the national water pollution control policy. The components of this proposition are: 1) the increased involvement of local government in designing regulations and programs to
control municipal water pollution, 2) the contextual capacity of the local community, 3) a relationship between local contextual capacity and the local government's adoption of design and operational criteria of local regulation, and 4) improvement of water quality and wastewater treatment outcomes.

This chapter is organized in the following fashion. Section 3.1 explains the policy background. Section 3.2 describes the conceptual framework of this study. Section 3.3 provides a research design using a longitudinal-exploratory case study. This section discusses and operationalizes the analytical concepts of the theoretical framework. Section 3.4 includes the discussions of the theoretical propositions and hypotheses. This section also identifies tasks and models further describing the theoretical concepts. These tasks are operationalized by a set of proxies and variables. The final section, Section 3.5, provides the discussion of the methodological approach used in this study. Included is a discussion of case study methods, case representation, data sources, data collection protocol, data limitation and analytical methods.

3.1 Background of the Municipal Water Pollution Control Policy

Federally mandated municipal water pollution control is partially preemptive, providing a unique type of intergovernmental relationship. Under this type of intergovernmental relationship, the federal government can set minimum standards and specific methods for their attainment (Fix and Kenyon, 1990). The lower level governments can only initiate their own standards if those standards are equivalent to or more stringent than the federal standards. A further analysis of the intergovernmental mandating relations specifically addressing the two cases, is indicated in Table 3.1.
<table>
<thead>
<tr>
<th>Regulatory status quo</th>
<th>Federal government</th>
<th>Ohio</th>
<th>Columbus and Lima</th>
</tr>
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</table>
| **Statutory authority** | partially preemptive\(^{11}\) to all programs | 1. preemptive\(^{12}\) to NPDES\(^{13}\) dischargers  
2. partially preemptive to pretreatment | preemptive to pretreatment |
| **Control authority** | oversight | 1. direct control  
2. oversight | direct control |
| **Direct control target groups** | (not significant in the case context) | NPDES dischargers, including POTWs\(^{14}\) | industrial users |

**Table 3.1 Regulatory Status of Intergovernmental Mandating Relationships**

In such an intergovernmental relationship, if local standards meet and exceed the higher level government's mandates, the higher level government then becomes an oversight authority of the local government. When the lower level government fails to accomplish or to meet the goals set forth by the higher level government, the higher level government assumes authority to implement the legally proscribed standards.

\(^{11}\) 33 U.S.C. sec. 1313, 1342  
\(^{12}\) Ohio has standards that meet or exceed federal standards. Thereby, the state's standards are the ones that should be complied.  
\(^{13}\) National Pollution Discharge Elimination System (NPDES).  
\(^{14}\) Publicly owned treatment works (POTWs).
Before 1990, the United States Environmental Protection Agency (USEPA) delegated thirty-eight states as the ones that met specified federal criteria to implement NPDES permit programs (source: U.S. EPA, Office of Wastewater Management, October, 1997). Once a state assumes this authority, it is also responsible for its enforcement and must monitor for compliance (Magat and Viscusi, 1990). The reasons the remaining states were not able to obtain jurisdiction of the federal program at the time included: 1) lack of scale, staffing or funding, 2) had programs that only partially met the federal standards, or 3) could not meet the minimum federal water quality standards. The 1987 Water Quality Act relaxed the partial program provisions\(^\text{15}\) and allowed states to assume full authority within five years as long as they could demonstrate their ability to manage either the administration of a major category of discharges, or a major component of the NPDES program (Jessup, 1988 and Okaru, 1994).\(^\text{16}\)

The state of Ohio, being one of the thirty-eight states with an early-approved program, is the direct control authority for its NPDES dischargers. All NPDES dischargers in the state therefore should abide by the State’s water quality standards. Ohio does not set uniform permit levels for all its dischargers. The permit limits are community-specific as well as discharger-specific.

\(^{15}\) Section 402 of the Clean Water Act.

\(^{16}\) A common characteristic for the states gaining control of NPDES programs is the level of industrialization in a state (Interviews, OEPA, August 17 and 18, 1998). The greater the level of industrialization in a state, the more likely that a state would seek approval from the federal government for its program (Hunter, et. al. 1996). By 1997, the remaining six states without approved state NPDES programs included Alaska, Arizona, Idaho, Maine, Massachusetts, New Hampshire, New Mexico, and Texas (U.S. EPA, 1997) These states have relatively fewer problems with point source pollution; in particular, the western states, are more concerned about water quantity and/or non-point sources discharges from agricultural and timber industries. Water quality improvement contributed by NPDES programs is likely to be minimal (Hunter and Waterman, 1997).
Furthermore, both municipalities, Columbus and Lima, with state approved pretreatment programs, obtained direct control authority to design water quality standards and to regulate their industrial users. Before both communities assumed this authority, the local governments were not granted any legal authority to enforce federally designed pretreatment standards. However, after the establishment of local control authority, each city's pretreatment program became community-specific. Columbus and Lima had very different programs and means to regulate, monitor, and enforce their industrial users to comply with local standards.

As indicated in the Clean Water Act, municipalities that discharge wastewater from POTWs must meet the minimum water quality standards and comply with the regulations specified in the NPDES permit. The municipalities that treat more than 5 million gallons of wastewater per day must establish a control authority thatformulates and implements various programs and regulations. The majority of municipalities in Ohio do assume responsibilities as local regulatory agencies as defined in the national policy.

Table 3.2 provides a summary of the legal demands of water pollution control within the scope of this study. The initiation of legal demands of municipal water pollution control can be partitioned into three levels of government, federal, state, and local. The legal demands include legislation, which serves as a guideline for rules and regulations. Goals and objectives, though, can be identified from the content of the legislation, but best judgment must be used by policy makers when there is ambiguity in the stated goals and objectives. To achieve these goals and objectives, policy makers need to further develop operational definitions, such as standards, rules, and regulations. Therefore, the
hierarchy of legal demands is organized from the abstract concepts of legislation, to the operational definitions of rules and regulations. The elaboration by lower level of government of these legal demands allows interpretations by policy makers and provides access points to policy interests.
<table>
<thead>
<tr>
<th>Legal demands of water pollution control</th>
<th>Federal government</th>
<th>State government</th>
<th>Local government</th>
</tr>
</thead>
</table>
| Legislation                            | Federal Water Pollution Control Act | Ohio Water Pollution Control | • Columbus Regulation of Sewer Use  
|                                        |                    |                 | • Lima Ordinance, Sewers, Sewer rates, Fees  
| Goal                                   | "...to restore and maintain the chemical, physical, and biological integrity of the Nation's waters."\(^{17}\) | "...to improve and maintain the quality of such waters for the purpose of protecting the public health and welfare, and to enable the present and planned use of such waters for public water supplies, industrial and agricultural needs, propagation of fish, aquatic life, and wildlife, and recreational purposes..."\(^{18}\) | • Columbus: "...to protect the public health, in conformity with all applicable local, state, and federal laws..."\(^{15}\)  
|                                        |                    |                 | • Lima: not clearly stated in the ordinance |

**Table 3.2 Legal Demands of Municipal Water Pollution Control**

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\(^{17}\) Federal Water Pollution Control Act, 33 U.S.C. sec. 1251  
\(^{18}\) Ohio Revised Code (ORC), Chapter 6111, sec. 6111.041  
\(^{15}\) Columbus City Code (CCC), Chapter 1145, sec. 1145-01

63
Table 3.2 (continued)

<table>
<thead>
<tr>
<th>Legal demands of water pollution control</th>
<th>Federal government</th>
<th>State government</th>
<th>Local government</th>
</tr>
</thead>
<tbody>
<tr>
<td>Objectives for publicly owned treatment works (POTWs)</td>
<td>• to achieve effluent reduction attainable through the application of secondary treatment(^{20})</td>
<td>• comply with national effluent limitations,</td>
<td>Columbus: (^{22})</td>
</tr>
<tr>
<td></td>
<td>• to prevent discharge of any pollutant into POTWs, which may interfere with, pass through, or otherwise be incompatible with such works(^{31})</td>
<td>• national standards of performance for new sources, and</td>
<td>• to prevent interference and incompatibility with treatment processes,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• national toxic and pretreatment effluent standards</td>
<td>• to prevent adverse effects to the water quality of the receiving stream, prevent damage to the environment, and</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• to prevent violation of any Federal or State discharge permit issued to the City</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Lima: (^{23})</td>
</tr>
<tr>
<td></td>
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<td></td>
<td>• to prevent harm to the sewers, wastewater treatment process or equipment,</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• prevent an adverse effect on the receiving stream,</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• prevent violations of the NPDES regulations,</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• prevent endangering lives, limb, public property, or constituting a nuisance</td>
</tr>
</tbody>
</table>

\(^{20}\) 33 U.S.C. sec. 1314  
\(^{21}\) 33 U.S.C. sec. 1311, 1313, 1314, 1317  
\(^{22}\) CCC, Chapter 1145, sec. 1145-01  
\(^{23}\) Lima Ordinance (LO), Chapter 1040, sec. 1040.13
Table 3.2 (continued)

<table>
<thead>
<tr>
<th>Legal demands of water pollution control</th>
<th>Federal government</th>
<th>State government</th>
<th>Local government</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standards</td>
<td>• Effluent Limitation$^{24}$</td>
<td>• Water quality standards$^{25}$</td>
<td>Columbus: • Regulation of effluent; $^{27}$ adhere to all conditions and regulations of federal effluent guidelines and standards.</td>
</tr>
<tr>
<td></td>
<td>• Rules requiring compliance with national effluent standards$^{26}$</td>
<td></td>
<td>Lima: • National categorical pretreatment standards$^{28}$</td>
</tr>
<tr>
<td>Operational regulations &amp; rules</td>
<td>• Secondary treatment regulation$^{29}$</td>
<td>• Water Quality Standards$^{31}$</td>
<td>Columbus: • Standards of discharge$^{33}$</td>
</tr>
<tr>
<td></td>
<td>• Effluent guidelines and standards$^{30}$</td>
<td>• Ohio NPDES permits$^{32}$</td>
<td>Lima: • Use of Public Sewers$^{34}$</td>
</tr>
</tbody>
</table>

The review of the legal demands of each level of governments helps to indicate the complexity of the legal system and environmental policy. Each of the legal demands

$^{24}$ 33 U.S.C. sec. 1311
$^{25}$ ORC, Chapter 6111, sec. 6111.041
$^{26}$ ORC, Chapter 6111, sec. 6111.042
$^{27}$ CCC, Chapter 1145.17
$^{28}$ LO, Chapter 1040, sec. 1040.12(c) and (d)
$^{29}$ 40 CFR Part 133
$^{31}$ Ohio Administrative Code (OAC), Chapter 3745-1
$^{32}$ OAC, Chapter 3745-33
$^{33}$ CCC, sec.1145.20-1145.29
with associated authority is summarized in Table 3.2. A citation of each legal demand is also indicated in the footnotes.

To meet legal demands from federal, state and local levels, the design of a municipal water pollution control policy becomes community-specific, and the local government needs to integrate the following into its design. First, the local government needs to conduct an industrial inventory or survey to determine the amount and concentration of regulated substances, i.e., parameters, that might influence, pass through, or interfere with its POTW operation. Second, the local government needs to decide the maximum amount or concentration of a parameter that can be accepted in its treatment work. Third, the local government needs to decide how to implement local limits for each parameter with respect to its industrial users (p. 513, Gold, 1988).

The federal grant program has provided for a high degree of federal involvement in local construction and renovation of wastewater treatment facilities. NPDES requires all industrial and municipal wastewater treatment facilities to obtain permits that limit their discharge by type and amount. However, the high hopes set by the CWA, all waters being fishable and swimmable by 1983 and reaching zero pollutant discharge by 1985, were not feasible or desirable from an economic perspective, and were not attained. The major amendments of the 1972 CWA in 1981 and 1987 shifted responsibilities from the federal government to the states and local governments and tightened standards on water pollutants. For instance, more constraints have been placed on toxic elements and heavy metals in water. States were supposed to develop lists of polluted water and strategies to

34 LO, Chapter 1040, sec. 1040.13 from (a) to (j)
control the pollution. In the meantime, the federal grants have been replaced by State Revolving Loan Funds. The changing nature of federal financial aids, from "free money" to low interest rate loans, has brought great financial challenges to local governments.

Financing is a major concern for municipal wastewater treatment. It is an expensive proposition for the federal government to impose its intention on facility design and construction. Without sufficient funds, improperly designed or outdated facilities could pose threats to local water quality and health. Title II, Construction Grants Program of the CWA in 1972, authorized municipalities to obtain grants from the federal government. Financial aid to local communities authorized by the federal law has been a major stimulus to investment in sewer infrastructure and construction.

However, there are limitations placed on communities wanting to obtain federal funding. These limitations have a greater impact on small communities. First is the problem of cost sharing. The federal government assumed 75 percent of construction costs and the state and local governments assumed 25 percent prior to October 1, 1984. The Municipal Wastewater Treatment Construction Grant Amendments of 1981\textsuperscript{35} reduced the federal cost sharing from 75 percent to 55 percent (\textit{William Mitchell Law Review}, 1984 and Okaru, 1994). The federal-local cost sharing imposes problems. In particular, some smaller communities are not able to match the amount of local sharing. The second limitation is lack of economies of scale. Small communities are sometime not able to make the wastewater treatment services efficient and affordable due to their smaller scale. The per household costs for wastewater treatment facilities in the small

\textsuperscript{35} 33 U.S.C. § 1251.
Communities are relatively higher than those in the large communities (Okaru, 1994). The third limitation is funding eligibility. The 1981 Amendments made several treatment systems ineligible for federal funding. Some communities simply do not have projects that fit the federal funding specifications (William Mitchell Law Review, 1984). The final limitation is a bias in allocating the State Revolving Funds (SRFs). The SRFs are administered by the states, and are available to wastewater treatment capital programs and other projects. Studies also find that SRFs favor large communities and provide disincentives to private sector competition (Okaru, 1994).

Although the 1988 CWA provided a remedy such that smaller communities with a population of 25,000 or less and with start-up cost of treatment works of $8 million or less could receive a non-recurring grant for the cost of designing and building the treatment facility, smaller municipalities (cities that are between large municipalities and small townships) are not eligible to benefit from such relief. Financial concerns have been evident in these smaller municipalities. In this study, Lima being a smaller municipality has shared a similar experience. Lima has completed its federal grant in 1983 (with a 25% cost sharing), but since then, its wastewater treatment construction costs are obtained through local funding. The local officials express their concerns in the future funding (Interview, August 1, 1996).

There have also been debates on the effectiveness of federal grant assistance. One of the debates has been that in many communities, the amount of federal funding for capital

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36 The federal funding can only be used for projects including secondary treatment or more stringent treatment, new interceptors and appurtenances, infiltration-inflow corrections, correction or rehabilitation of major sewers, collector sewers, interceptor sewers, and projects to correct combine sewer overflows (p. 908, 1984).
expenditures has been more than necessary to achieve the federally mandated treatment. Some communities have used the federal grants to upgrade or expand their facilities, which they would have done with or without the federal mandates (Jondrow and Levy, 1984).

Besides financial problems, there are concerns regarding industrial wastewater that flows into the POTWs. A large quantity of industrial wastewater is discharged into POTWs. A POTW is primarily designed to treat domestic sewage. The discharge from industry can interfere with the treatment. The extent of clean up required can be indicated by the changes in magnitude of conventional parameters, such as biochemical oxygen demand (BOD), total suspended solids (TSS), pH, fecal coliform, and oil and grease. Two major processes, primary and secondary treatment, can remove up to ninety percent of the amount of conventional parameters in the wastewater. However, toxic discharges mostly from industrial sources can severely interfere with the secondary treatment. Even more damaging, the toxic components may pass through the POTWs without undergoing treatment and be released into the receiving stream. It may further become a threat to human health or increase the costs of treating drinking water (Gold, 1988).

The dilemma created by the intergovernmental mandates is that if the state and local governments only had to achieve the objectives of POTWs set forth by the federal government, which is secondary treatment, the State’s water quality standards would never be able to be met (Legislative reviews and Interview on May 31, 1995). In addition, this research finds that general spending on sewer operation (including capital
costs for pretreatment and management) is as critical as construction costs (the major
component for federal funding) in explaining the improvement of water quality. In sum,
the current trend of intergovernmental mandates provides decreasing financial assistance
to assist the local community.

Specific Environment to Which Theoretical Concept is Applied

In the case of municipal water pollution control, the federal government has been
greatly involved in formulating regulations and in providing assistance to the local
communities since the 1960's. Under the authorization of the federal Clean Water Act
and its antecedent legislation, the federal government has provided financial assistance in
capital construction projects of publicly owned municipal wastewater treatment works
(POTWs) over two decades. In the late 80's, the type of financial assistance offered by
the federal government changed from grants to low interest-rate loans. While water
quality of some streams is still to be improved, the financial aid from the federal
government to the local governments has dramatically decreased. The improvement of
water quality in the communities therefore relies heavily on the decisions and actions of
the local authorities.

The control authorities of Columbus and Lima have similar managerial as well as
policy challenges as they attempt to control their water pollution. Both local
governments provide treatment services for domestic wastewater and accept pretreated
industrial wastewater. They both were granted the authority by the federal government to
become mini-water pollution control agencies. Nearly 1,500 large municipalities in the
United States were required to implement and enforce alike industrial pretreatment
programs to regulate industrial discharges to their POTWs (Evans, 1991). These municipalities assumed responsibilities to identify the sources of industrial pollution, develop allowable limits to meet federal initiatives as well as local demands, educate industrial users on all pertinent regulations, inspect and monitor their compliance, and investigate and possibly prosecute them for violations (Rosenbloom and Schwartz, 1994).

Both local communities are subject to the regulations of water quality imposed by higher level governments. Therefore, the policies the two local governments developed should not only meet the legal demands from the higher level governments, but also satisfy the demands of the local communities. In addition, the actions that the local government has taken should not only be evaluated using standards of the higher government, but also taking into account the legal, financial, and technical capability of the local community, because the tasks imposed on the local governments are resource-intensive and technically challenging.

In addition to the above footers which impact local community actions, political interest groups with different points of view and motives can be expected to try to influence local government authorities' actions. The degrees of strictness of local discharging standards and local enforcement are likely to be associated with the strength of influence from the targeted industries. Serious consequences and high costs are often associated with the lack of clean up. In the communities without strict regulations to clean up, these costs can be passed on to other parties. These costs can become part of the cost of operation and even the cost of construction of POTWs. In addition, when industries remove fewer pollutants from their discharge, the responsibility to remove
these pollutants falls on the LCAs. If the LCAs are unable to remove enough pollutants to meet federal guidelines, these LCAs are subject to fines and/or legal actions by the federal government. Further, when industries remove fewer pollutants from their discharge, costs to the communities to treat their drinking water increases, if the wastewater receiving streams and the sources for drinking water are the same. In addition, there can potentially be long-term threats to human health and to the environment.

As local water-pollution-control authorities, the local governments not only are service providers who clean up the wastewater, but also are the police who enforce local water standards and regulations. Columbus and Lima, though faced with similar responsibilities of water pollution control are different in size, in characteristics of economy, and in the scope of control authority, so their ways of addressing their managerial and policy problems are different. To more clearly explain this, the following paragraphs provide profiles of the two cities.

**Brief Backgrounds of Columbus and Lima**

Columbus has a diverse and service-oriented economy; most of the one hundred thirty industries are mid-sized, discharging wastewater from 5,000 to 100,000 gallons per day per industry, \(^{37}\) and show wide variations in types of wastewater discharge. \(^{38}\) The city’s water pollution control authority has direct control over almost all of its pollution

\(^{37}\) The information was provided by an interview with the Manager of the Pretreatment Program, Department of Public Utility in City of Columbus on March 15, 1996.

\(^{38}\) Federal effluent limit categories are standardized by types of industries. Refer to 40 CFR Part 401-471 (1995).
contributing industries, except one stormwater discharger, and also controls all of the
community's allowable stream discharges.

Lima, on the other hand, has an economy with a heavy concentration in metal
finishing industries and two major oil refineries (i.e., BP Oil and Arcadian LP). The
LCA controls a majority of the polluting industries, which are homogenous in type, but
does not have control over the amount of the allowable stream discharges coming from
the two oil-refineries. These contribute between 22% to 53 % of wastewater flow
annually. For certain substances which the LCA is legally required to monitor, such as
Ammonia Nitrate (NH3-N), these two refineries are allowed to discharge up to 90% of
total allowable concentration in the community's stream discharges.

The willingness of local government authorities to adopt, enforce, and even improve
federal standards is indicative of the value the citizens place on the policy. For example,
in Columbus, citizens both expect and require reasonably clean wastewater discharge.
Such public support gives agents in Columbus the opportunity to set higher discharge
limits for a broader variety of elements than those specified in the federal standards.
Because of this, Columbus is characterized in this study as valuing the design and
operational criteria of the federal policy more than Lima. Lima, for which those
standards have lesser values, regulates fewer elements than Columbus and sets lower
standards than Columbus. Furthermore, Columbus has more comprehensive and clear
specifications to define both regulatory agents' and industry's behavior with regard to
monitoring and operations; Lima on the other hand has less comprehensive and less clear
specifications for the behavior of agents and industry. The enforcement of compliant
behaviors of the local communities is also different. Columbus adopts more severe measures such as progressive punishment for more severe and repeat offenders, while Lima adopts milder measures of enforcement of such offenses, being more inclined to work with violators before imposing punitive actions.

3.2 Conceptual Framework

To fully understand how a policy tool might behave in a given context, it is critical to determine the environment in which a tool is developed and implemented. Most studies address policy development at the national level. However, the design of a policy's implementation is as critical to the success of the policy as the policy's formulation. In most policy studies, the role of the implementing governments (e.g., most state and local governments) is characterized as being one of merely carrying out the directives issued by the mandating governments (e.g., the federal government). Policy design usually refers to policy formulation rather than to the context in which policy implementation takes place. But, without further investigating the methods used to achieve policy objectives, policy implementation remains a black-box. Consequently, obtaining full understanding of the causes of a policy's success or failure has been limited.

Realizing the difficulty in explaining a policy's success or failure without a better understanding of the methods used to implement the policy, Schneider and Ingram pointed out that studies of policy tools are often lacking in empirical data describing the methods used for policy implementation and thus lack explanatory power (1990). To
address this limitation, the search for common elements among policy instruments has become a distinctive focus in policy instrument studies. The elements of policy instruments are described in the context of policy implementation. These common elements include policy intention, implementing institutions, implementing agents, groups targeted by the policy, and effects on the targeted groups. Schneider and Ingram state that policy implementation can be better understood by describing the mixture of tools employed and the behavioral dimensions of those tools (1990). Although their studies provide further understanding of the tools used in policy implementation, empirical verification of their research are limited.

Moreover, examining the tools used in policy implementation brings greater complication to the understanding of the success of a national policy. Understanding these complications has become more critical because of the trend of the new federal initiatives. Under this trend, implementing local governments are given more discretion and more responsibilities in adapting a national policy to local conditions. The implementing local governments may need to redefine and to re-operationa.lize the implementation methods in order to produce desired policy outcomes.

The environment in which the policy is implemented is one of the critical elements in determining the implementation outcomes of a policy. The increased involvement of the local government in the development of the policy has brought attention to studies. May

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39 The behavioral dimensions of a tool include authority, incentives, capacity building, symbolism and hortatory, and learning. These are dimensions that a tool (or tools) may possess and may be suitable for addressing certain policy needs (Schneider and Ingram, 1990).
and Burby examined the role of local governments in adapting a national regulatory policy, and stated that policy outcomes vary as a result of variations in the relationship between the federal and the local governments (1996). May and Burby investigated the type of intergovernmental relationship existing between the national and local governments, whether it was coercive or cooperative and which type of relationship leads to greater success in implementing a regulatory policy. They used a case study method and explored the intergovernmental relationship from the local perspective. Their research showed that cooperative intergovernmental relationship produced more successful policy outcomes. This present study also analyses regulatory policy from the local perspective, but instead of focusing on the type of intergovernmental relationship, it focuses on the type of relationship between the local government and the regulated industry.

One of the reasons to determine the level of coercion in the relationship between the local government and the regulated industry is to determine how it affects the implementation outcomes of the policy. The relationship between the local government and the regulated industry is highly related to 1) design attributes: the components that the local government uses to define the local policy and 2) operational attributes: the ways that the policy is implemented by the local government. This study later demonstrates that there is an relationship between the ways in which local government adopt the design and operational attributes of local regulation and the local contextual capacity. This interaction affects the implementation outcomes of the policy.
The conceptual framework of this study links local contextual capacity and design and operational attributes of a policy tool to analyze policy outcomes in a way previously ignored. This framework is developed to make explicit the linkages among local contextual capacity, the adoption of the design and the operational attributes of local regulation by local government, and the attainment of policy objectives.

3.3 Research Design

In the past thirty years, the expectation that local governments simply implement federally designed policy has changed. With regard to water pollution control policy, since 1985, local governments have been given, in addition to more autonomy in implementing federal policy, the responsibility of designing their own policy if the policy meets or exceeds federal guideline.

This study uses a longitudinal-exploratory method to examine two Ohio communities, Columbus and Lima, and their efforts in water pollution. The longitudinal review of water pollution control policy includes examining pertinent regulations that were in effect in the time period from 1980 to 1995. The review includes the national and state legal demands, the Clean Water Act and associated federal and Ohio codes and regulation, as well as the policies of the two local governments developed to adapt the federal and state mandates and to fulfill wastewater treatment needs. The chronological review uses the time at which both local governments assumed control authority of their industrial users as an interrupted point. This means that it is possible to determine the level of water pollution prior to the establishment of LCA as well as after the establishment. The
control authorities of Lima and Columbus became increasingly involved in municipal water pollution control, and the effect of the involvement of local governments is further examined. In addition, the local policies as well as contextual capacity of both communities are further explored and compared. The effects of contextual capacity on water quality improvement are identified. Furthermore, both communities’ differences in contextual capacity and in adoption of design and operational criteria are used to illustrate the relationship between the regulators and the regulated. Lastly, the effect of community-specific regulation on water quality improvement is evaluated.

The community-specific regulation is rested on the local community’s contextual capacity and its adoption of design and operational components of regulation. The design and implementation of the community-specific regulation not only can depict the specific regulatory relationships between local government and the industry, but also can bring variations to the outcomes of water pollution control.

The specific foci of this study are the implementation of federal initiatives of municipal water pollution control by Columbus and Lima and how these two communities’ water quality improvement are affected by the community-specific regulations of the localities. The local community’s water quality improvement is assessed by examining 1) each local government’s intervention, 2) the economic strength of the community and the degree of the agency’s resource independence, and 3) the community-specific regulatory relationships between the local government and the regulated industry.
A local government with an established water pollution control authority has two major responsibilities: 1) providing municipal wastewater treatment and 2) regulating industrial users. There is a relation between the two responsibilities and that is that regulating the discharge from industrial users reduces the demands for the treatment process, and regulating this discharge ensures better treatment outcomes. Therefore, the quality of the streams receiving this discharge can be improved and maintained.

Although municipal water pollution control does not cover all polluting media in the environment (e.g., air and land), its implementation does provide lessons regarding the implementation of other environmental policies. In addition, in spite of the fact that the case of municipal water pollution control is only a minor part of environmental protection, policy problems that occur here are very similar to other policy contexts. Lessons to be learned include increased understanding and knowledge about: 1) the capacity of a local government to adapt the increased demands of federal government, 2) how the contextual capacity of a local community interacts with the ways in which the regulations are designed and enforced by the local government, and 3) how that interaction affects the outcomes of policy implementation.

3.3.1 Organization of Concepts:

The conceptual framework, Figure 3.1, graphically presents the relationships among the depicted concepts by using the case of municipal water pollution control.
Figure 3.1 An Analytical Framework of Community-Specific Regulation

This section describes the theoretical concepts and the elements used to implement them.

The Increased involvement of Local Government

This study assumes that the increased involvement of local government in designing regulations and programs to adapt national initiatives can affect the effectiveness of the regulations and programs at the local level. This study also identifies the factors contributing to the effectiveness by exploring the differences in local responsibility before and after the increased involvement. This study examines two local communities that are given authority by the federal government to design and implement regulations
and programs to ensure the local water quality meets or exceeds the federal/state final effluent standards.

Intergovernmental policies have experienced a number of changes in recent years. For instance, federal grants as a percentage of state and local revenues have sharply decreased; the federal government now requires greater participation from state and local governments in program design. Fix and Kenyan (1990) and Lowry (1992) discuss in their studies how the involvement of local government exceeds the role of an implementing agent. Considerable responsibility has been shifted to the local level for the monitoring and enforcement of environmental standards. The local governments become responsible for developing policies that not only should meet the intentions of higher level mandating governments, but also should ensure the needs of their own communities.

The extent to which the local regulations and programs exceed the federal/state standards can be indicative of the local valuation of pollution control. The characteristics of an local control authority include: 1) demonstrated ability to meet/exceed federal/state guidelines, 2) policy formulation and implementation are local-specific, 3) close identification of policy targets and target groups at the local level, 4) establishment of local enforcement responsibilities, and 5) identification and enforcement responsibility for undesirable policy behaviors.

In this case study, both local governments assumed responsibility to become water pollution control authorities before 1986. Fulfilling these responsibilities is highly
resource-intensive for both authorities. The job of regulating industry is financially, technologically, and legally demanding. Both local governments’ regulatory actions also directly affect their water and wastewater treatment services to their communities, which are under the scrutiny of higher level governments. Therefore, the responsibilities of the municipal governments are enormous (Rosenbloom and Schwartz, 1994; Okaru, 1994; Evans, 1991; and Gold 1988).

Establishing such a local control authority can be costly and resource-intensive for the municipality. For instance, to designate an agency as an enforcer of policy requires legal as well as technical expertise. Furthermore, more legal demands are imposed upon the municipality (Rosenbloom and Schwartz, 1994). A municipality needs not only to assess the demands of the community being served, but also to prevent damages or interference with the municipal wastewater treatment processes caused by the regulated industry, to prevent violations of any federal or state permits issued to the city, and to protect the quality of the receiving streams and the environment. Given such highly demanding responsibilities, the contextual capacity of a local community becomes critical.

**Contextual capacity**

The guiding hypothesis of this study is that the outcomes of a local adaptation of a national policy are affected by the contextual capacity of the local community as well as by the ways in which the local government designs and implements the local regulations and programs. To empirically test this research’s guiding hypothesis, the concepts of contextual capacity and community-specific design and operational attributes are operationalized as follow. Contextual capacity is used to describe the environment in
which policy is enacted and is defined along two dimensions: 1) the strength of the local economy, and 2) the resource dependency of the local control authorities. To further operationalize these two concepts, the study draws upon various literatures, including urban politics, economic theory of interest groups, and resource dependency models. These studies provide a behavioral dimension of regulation by adding explanations of the regulatory relationships between local government and the regulated industries.

The proxy measurements used to explain the strength of the local economy and the resource independence of the LCA are discussed in the following sections. These two elements provide the underlying conditions, which influence the behaviors of the local governments and the regulated industries. As discussed in the previous chapter, the two elements of contextual capacity are based on the literature of urban politics, economic theory of interest groups, and the resource dependency model. Each body of literature is particularly useful in explaining certain behaviors relating socioeconomic settings, agents, target groups, and agencies.

The First Component of Contextual Capacity is the Strength of the Local Economy

The concept of strength of the local economy is operationalized by local economic diversity and local socioeconomic characteristics. The selection of local economic diversity as an indicator of the strength of the local economy is based on economic/interest groups theory. The selection of socioeconomic variables as an indicator of the strength of the local economy is based on the theory of urban politics. These two dimensions of local contextual capacity give some indications on the potential
strength of interest groups. Theories explaining the influence of interest groups include 1) industry capture and 2) Olson’s models.

In industry capture theory, regulators are assumed to make their decisions in favor of the group(s) which offer them the highest compensations, namely in favor of the regulated industries. The Olson’s models assume that the more diverse an economy the less powerful are the special interest groups. The scholars of Olson’s models conclude that economic diversity induces diversity in an interest group system, and the diversity of the interest group system is positive for the society because it leads to competition and pluralism.

The literature of urban politics and economic theories of interest groups provides excellent discussions of various aspects relating socioeconomic conditions to the strength of interest groups. The a priori theoretical premise derived from these studies is that a negative relationship exists between economic diversity and the strength of interest groups. The rationale for these assumptions is that economic diversity gives rise to a diversity of interest groups. Due to competition among groups, a single group is unlikely to become dominant. The less capture a particular group has, the less dominant any particular interest group, and the less able any group is to capture the regulatory agency, the better off the local community.

The studies of urban politics provide discussions of socioeconomic factors, and how these factors affect local politics. Zisk examines the relationship between socioeconomic factors and urban political process (p.128, 1973). Zisk developed proxies to represent the
cities’ political and social complexity and socioeconomic status. These proxies were used to measure characteristics of an urban environment and were chosen from census indicators. These proxies include the size of population, urbanization (the percentage of urbanized land in commercial or industrial use), and per capita income.

A later study by Gray and Eisinger (1991) identified the type of industries that can increase the strength of the local economy as it moves from a manufacturing economy to a service economy. Employment in traditional high-paying manufacturing has declined, and the nation’s economy has shifted to a service economy. Therefore, a community with service-based industry produces a stronger indication of economic strength than a community with a lot of heavy industry. The proxy measures for the type of local economy are identified by the number and types of industry within the city service area.40

In addition to the number and the types of industry, size and demographic factors have long been viewed as indicators of socioeconomic variables by policy scholars. However, Eyestone and Eulau (1968) suggested using size and demographic factors with caution. A large city might yield a relatively low resource capability. The reason is that the resource capability of a city is largely determined by the level of wealth in the city, and tax rebates and grants from higher levels of government. Resource capability also is affected by citizen’s tolerance of tax rates and decision-makers’ reliance on grants and tax rebates. However, a high-level of resource capability is necessary for a high level of city spending. Therefore, this study also includes financing ability as an indicator of the city’s resource capacity.

40 Both cities provide their wastewater treatment services to adjacent communities, in addition to the areas within the city limits.
Furthermore, the diversity of groups is also found positively related to a city’s size and growth. The larger a city’s population, the more diverse the interest groups are likely to be. The greater the diversity of interest groups, the more likely the citizens would demand the local government to provide various programs. A community with a diverse and active group system will offer more channels for direct citizen influence than a community where groups are few (Eyestone and Eulau, 1968). However, the influence of interest groups on the formulation and implementation of city policy has been found to be a debatable matter (Abney and Lauth, 1986). Abney and Lauth indicate that interest groups play a role in the city’s policy process, but are not the dominant force. Community groups also play a significant role in urban politics. Abney and Lauth’s discussions are helpful in providing explanations of interest groups’ behaviors in relation to industry capture theory.

Similar concepts are also found in other literature, such as the economic theory of interest groups and the studies that follow Olson’s models. Both groups of studies use socioeconomic settings to examine the strength of groups and the relations to the economy. Diverse economies tend to have more interest groups, and it is less likely for any of the groups to become dominant (Gray and Eisinger, 1991). Gray and Lowery (1992 and 1993) find economic growth and interest group diversity highly related. Zeigler (1983), Morehouse (1981), and Thomas and Hrebenar (1990) use industrialization, income, and economic size as proxies for socioeconomic complexity. Most of the studies that follow Olson’s models investigate socioeconomic settings at the state-level. As discussed in the previous chapter, the interest group and political
activities of a state are different than those of a city. The proxies of the studies of Olson’s models developed are either not readily transferable or are lacking in the local environment.

**Proxies of the Strength of Local Economy**

This study develops its proxies for indicating the strength of the local economy by adapting the studies of urban politics and of Olson’s models. These proxies are economic diversity variables and socioeconomic variables. These variables are measured by municipality, and include 1) population, 2) total personal income, 3) per capita personal income, and 4) percentage of national average of per capita personal income. Economic diversity is measured by an index derived by the types and numbers of industry. Population is used to indicate the size of the city. Other variables are used to indicate the relative wealth of the city.

**The Second Component of Contextual Capability is the Resource Independence of the Local Government**

This attribute can be further defined by the inclusiveness of local control and local government’s financial ability. As pointed out in the reviews, the agency’s perspective is rarely discussed in the literature of economic theory of interest groups. This research derives the agency’s perspective based on the resource dependency model and urban politics theory. The degree of resource dependency of an agency can be used to indicate the degree of contextual capacity of the community.
What is lacking in both theories of interest groups is the explicit and positive role of government in regulations. Mancur Olson examined the strength of government by comparing it to the strength of interest groups (1971 and 1982). However, neither his studies nor those of his followers address these elements sufficiently. Thus, the second component of contextual capacity identified by this study, i.e. the resource dependency of LCA, is based on the theoretical arguments from resource dependency theory. This theory is used to explain an agency’s perspective on regulation. The main proponents of the theory, Jeffrey Pfeffer and Gerald Salancik, suggest that an organization’s outputs are determined by input factors from the environment, such as the influence of stakeholders and resources. Pfeffer and Salancik conclude that an organization’s ability to acquire resources is related to its power, and power is positively linked to the effectiveness of the organization. This conclusion is used to guide this study’s theoretical underpinning of resource independence of local control authority (LCA), that is, the resource independence of the LCA is positively linked to local contextual capacity. Two components, inclusiveness of local control and local financial ability, are used to operationalize the degree of resource independence of the LCA.

Proxies of the Degree of Resource Independence of LCA

As defined by this study, the inclusiveness of authority is defined as the amount of control of a local government over the groups whose behavior directly affect the water quality of the community. For example, if none of the industries have direct discharge into the receiving stream, an agency could be defined as having total inclusiveness.
Schultze has suggested that local autonomy fundamentally determine the ability of the city to take control of its urban environment. Limited local autonomy severely constrains the range of policy choices of urban decision-makers. Many variables may interfere in the attainment of local autonomy. For example, in the legal context in which the city resides, the city is subordinated to higher levels of mandating governments. In addition, private business decisions can determine if that industry is to be under or outside the direct control of the local government (pp. 89-96, Schultze, 1985). Furthermore, the higher government (such as the OEPA) can deny the approval of permits in order to turn permit applicants away, and perhaps place the applicants into the hands of the local authority. In addition, the community might need to give way in its regulations to retain or attract businesses. Or, it may be that the community can not afford to regulate such an industry that is the major job supplier for the community. On the other hand, an industry might have incentives to locate in an area, because of cheaper land and labor. The industry may also decide to apply for a direct permit from the state government, instead of placing itself under the control of the city. Due to the authority of the state government, the games that can be played by the industry, and the socioeconomic conditions of a community, the scope of local control is likely to be predetermined. Most likely, a community with higher socioeconomic profiles would be able to exert more enforcement authority over an industry than a community with a lower socioeconomic profile.

**Indicators of the Inclusiveness of Local Control**

The two variables used to indicate the inclusiveness of local control are the proportions of a community’s allowable concentration and loading of a substance (e.g.,

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copper) that are under the control of the local government. The community’s allowable concentration by parameter indicates the strength of the pollutant that can be discharged into the stream, while the community’s allowable loading by parameter indicates the amount of the pollutant that can be discharged into the stream. The determinations of water quality parameters are based on: 1) the frequency with which they appear on the dischargers’ NPDES permit limits; 2) data availability from the state and local databases within the study time frame; and 3) expert opinion from specialists of state and local governments. The first two bases are highly correlated. Both strongly indicate the strength of the regulatory attention that are placed on these water quality parameters at the time and the types of pollutants that are significant to the communities at the time. For example, most conventional parameters were consistently monitored and regulated throughout the time frame. Some metal parameters began being regulated in the 1990’s long after the establishment of the local authorities. This means that conventional parameters attracted federal/state regulatory attention and were required to be treated before metal parameters did.

All industries are subject to the intergovernmental mandates of water pollution control if they are active polluters to the community’s streams. Industrial as well as commercial water polluters are either controlled by the city or controlled by the higher level governments (such as the county or the state). In this study, by definition, the higher the proportion of concentration (or loading) that is under the control of local government, the more inclusive the local control. The rationale is that the greater the inclusion of the local authority with regard to pollution both in amount and in strength, the less reliance there is on other authorities to regulate polluters. For example, an
industry that emits toxins that are high in strength but low in amount, can significantly affect the quality of the stream. If the local government controls the major amount of industrial discharge, but does not control a highly toxic but small portion of discharge; then, there would still be a serious risk for the discharge to pollute the stream. However, the local government does not have any authority over this discharger and has to rely on other authority to monitor or to prevent undesirable polluting behavior.

**Financing Ability**

Financial capacity is another important indicator of the resource independence of the agency. To meet the requirements of higher level governments as well as the demands of the local community, financing can be expensive and can be a challenge to the local government. As specified in the federal, state, and local legislation, financial provisions to assist the construction of POTWs are made available by the following means. Table 3.3 provides citations of legislation regarding the financial mechanisms and their associated government authorities.
<table>
<thead>
<tr>
<th>Authority</th>
<th>Federal government</th>
<th>State government</th>
<th>Local government</th>
</tr>
</thead>
<tbody>
<tr>
<td>Financial mechanism of wastewater treatment construction</td>
<td>• Title II construction grants(^{41})</td>
<td>• Construction grant fund(^{43})</td>
<td>• Bonds</td>
</tr>
<tr>
<td></td>
<td>• Title IV State Revolving Loan Fund(^{42})</td>
<td>• Water pollution control loan fund(^{44})</td>
<td>• Assessments</td>
</tr>
</tbody>
</table>

Table 3.3 Financial Means for Sewer Constructions

Under a partially preemptive intergovernmental policy scheme, the lower level governments must always at least meet or exceed the standards set by the higher level government. The local governments often argue that federal assistance is not sufficient for most of the objectives mandated in the bodies of intergovernmental mandates. For instance, the most apparent objective of federal legislation is secondary treatment of wastewater. One thing worth noting is that federal water quality standards are only recommended criteria, they are not enforceable. However, by only achieving federal standards, most of the POTWs would fail to meet most of the NPDES permits issued to them. Furthermore, meeting federal demands can be burdensome in terms of taking care of proper procedures and paperwork. One of the local officials in the study pointed out that the city of Columbus has to slow down its efforts on controlling water pollution in

\(^{41}\) 33 U.S.C., Title II
\(^{42}\) 33 U.S.C. Title VI
\(^{43}\) ORC, Chapter 6111, sec. 6111.033
\(^{44}\) ORC, Chapter 6111, sec. 6111.036
order to meet the demands imposed by federal government (Interview, February 9, 1996). It is also up to the judgment of the state agency (such as OEPA) to fund construction projects that might not be specified in the federal legislation but might be deemed necessary in order to meet water quality standards and NPDES permit limits set by the state. Ohio is one of the states with the most stringent standards, and its NPDES permit limits are the operational and enforceable definitions of the water quality standards (Interview, May 31, 1995). Therefore, the financial burdens imposed by the construction of water treatment infrastructure might exceed the financial assistance specified in the federal regulations.

Therefore, it is assumed that an economically sufficient community might be able to raise funds from various resources to improve the infrastructure of a sewer system; by doing so, the community would rely less on a single source. For example, being funded by the federal government, the local government can be constrained by its lengthy criteria and review. By reviewing most of the spending on local community’s sewerage capital projects, inferences can be made about how a local community can finance its sewer infrastructure. In both cities used in this research, local funding mainly comes from selling bonds, with a small amount from property assessment. The method of refinancing mainly comes from user fees. Therefore, the ability of attracting investors and soliciting low interest rated bonds is crucial for both cities.

As also indicated in Gray and Eisinger’s study (pp. 256-7, 1991), although there are various other sources of financing for cities (e.g., intergovernmental transfers, user
charges, and taxes), to pay for large redevelopment and construction projects, cities borrow money by selling bonds. However, not every city is equally capable of attracting investors; in addition, the bond rating\(^{45}\) of a city has tremendous fiscal impacts. For example, the difference between a AAA rated city and a AA rated city could render a difference of up to $100,000 over a twenty year life of a million dollar bond.

The ability to attract investors and sell bonds is particularly critical in this case. With decreasing financial support from the federal government, bonds become the number one financial source to sustain the future development of the city of Lima’s wastewater treatment (Interview, August 1, 1996). The City Auditor of Columbus attributed the city’s ability to acquire low interest rate loans to its consistent AAA rating throughout the years. Consequently, the city was not concerned about its funding and was able to develop its infrastructures with very limited federal aid (Interview, June 27, 1995). This study thus includes two indicators, annual capital costs on sewer system from all resources and the city’s bond rating, to indicate the financial ability of the local control agency.

**Regulatory Relationships Between Local Government and Industrial Users**

The third concept of the research framework is a relationship between the local contextual capacity and the local government’s adoption of design and operational criteria of local regulation. This study develops this relationship based on theoretical inferences derived from interest groups theory and resource dependency model. This study assumes that the contextual capacity of the local community is related to the ways

\(^{45}\) Typically, an AAA rating stands for the best, an AA rating stands for the second best, and a D rating stands for the worst. The reputable rating organizations include Standard & Poor’s and Moody’s. This study uses standard criteria in the annual publication, *Moody’s Manual*, for evaluating municipal bonds.
in which the local regulation is designed and operated. Hence, the local regulation is community-specific. The implementation of this community-specific regulation and the specifications of the regulation are indicative to the expected relationships between the local government and the industry.

Analyzing the behavioral components of regulatory relationships between the local government and the regulated industry is an attempt to operationalize the Linder and Peters’ study in 1989. Their four design attributes of a tool include, 1) targeting, 2) operational precision, 3) public opposition, and 4) coerciveness of government action. To further refine these four attributes, this study synthesizes the studies of Bardach (1989), May and William (1986), Burby and Paterson (1993) and May and Burby (1995 and 1996) and arrives at three operationalized components. Although these three components are not inclusive, they are comprehensive in representing the design and implementation aspects of a policy tool. These components consist of rules and actions, which define the behaviors of agents and target groups. They are: 1) stringency and comprehensiveness of standards to regulate industry, 2) precision of operational procedures specifying agents and industry’s behaviors, and 3) coerciveness the authority uses to enforce industry’s behavior. Each of the three components can be measured by strength.

The Expected Relationship between Contextual Capacity and the Local Government’s Adoption of Design and Operational Criteria of Local Regulation is developed as follow:

The stronger the contextual capacity of a community,

1) the higher the standards to regulate targeted industry,
2) the more precise the operational procedures to define agents’ and industry’s behavior, and
3) the more coercive the approach used to enforce industry’s behavioral changes.

These community-specific adoption and implementation of local regulation assumptions are supported by multiple sources. First are two theoretical deductions from economic/interest groups theories and resource dependency models. The two deductions include: 1) a negative relation between economic diversity and the power of special interest groups, and 2) a negative relation between contextual capacity and the resource dependency of a regulatory authority. As a result of these two deductions, a LCA with stronger contextual capacity is concluded to be less likely to be captured by any particular industry. Hence, a local control authority with stronger contextual capacity is more likely to adopt and to enforce more stringent and comprehensive standards. A second source to support the relationship between the contextual capacity and the local government’s adoption of design and operational criteria of local regulation comes from comparisons of the local regulation and rules of Columbus and Lima. The third source for support of these assumptions comes from comparisons of local enforcement and monitoring records. These records contain monitoring, violations, and enforcement activities of both localities, and are used as indicators for the local authorities’ willingness to enforce these standards. The final source of data to support these community-specific adoption and implementation assumptions is interviews with local officials. These interviews further disclose ways in which the local governments implement these regulations.
Policy attainment of the community

To identify the effects of the establishment of local control authority, water quality before and after the establishment of the LCA is determined. Using the establishment of the LCA (with some time lag) as an intervention, longitudinal pre-intervention and post-intervention observations are compared from 1980 to 1992. The expected result is a jump in water quality improvements following the local intervention.

To identify the effect of community-specific regulation, first, the discharge from each community is monitored and the amount of specific regulated substance is determined. These results are then compared to the amount of these regulated substances allowed under the federal mandated standards. Then, effects of community-specific regulation are determined by comparing the frequency and amount of violations of the federal standards by both communities. This research postulates that the community with higher contextual capacity adopts higher standards, more precise specifications on governmental agents and industries behavior, and more willingness to enforce these stringent standards. This study also postulates that this community with higher contextual capacity and its specific regulation will contribute to better water pollution control.

As indicated in the previous chapter, the use of the performance of an agency as a sole indicator for policy outcome measures can be misleading. In theory, the drawbacks arise from: 1) government agent’s self-maximization (see the discussions of industry capture; Chapter 2, Section 2.5); and 2) an agency’s striving for survival (see the discussions of resource dependency model; Chapter 2, Section 2.5). In this case study, the agency’s performance is used as one of the indicators for the community’s attainment
of policy objectives. However, using the agency’s performance measures can only partially represent the degree of the attainment of policy objectives by the community. The more inclusive is the local control, the fewer polluters state and federal governments regulate, and thus, the greater the responsibility the local government has for improving the community’s water quality. However, the inclusion of polluters to be the local policy target groups can be biased. Based on the theoretical discussions of a agency’s survival and self-maximization, the agency (as in local government) can refuse to grant the uses of the POTWs to heavy polluters to ensure compliance and can avoid potential risks of political opposition from either the consumers or the polluters. Or, the industry can also evaluate its costs of compliance with the LCA and decide to apply for a direct discharge permit from the higher level government instead of going under the regulation of the local government. Therefore, the evaluation of the agency’s performance alone might not reveal the effects of community-specific regulation.

**Measurements of the Attainment of Policy Objectives**

This study utilizes the work of Ripley and Franklin (1986) to define the attainment of policy objectives. Their two methods of measuring policy attainment include achievement and compliance. The attainment of the intergovernmental policy objectives of the community to be evaluated include: 1) what is achieved, by measuring the improvement of water quality, and 2) the compliance of expected behavior, by comparing actual discharging behavior from all NPDES dischargers to expected behavior that is specified in the NPDES limits.
Theoretical References of the Research Concepts

This study integrates explanations drawn from various schools of thought to support its theoretical inquiries. The study builds a coherent view of local governments' capacity in adapting a national policy. In particular, these theories are helpful in explaining the behavioral dimension of regulation, from the relational aspects among socioeconomic settings, agents, target groups, and agencies. The following table indicates the behavioral dimensions of each of the listed theories. In brief, 1) the theory focus of urban politics that is of particular interests to this study provides linkages between socioeconomic conditions and the development of government programs. 2) The theory of industry capture provides rationale for favoritism of industry in regulations. The Chicago school postulates the capture as a result of industry self-interest maximization; while 3) The Virginia school postulates capture as a result of bureaucrats’ self-interest maximization. 4) The Olson’s models provide linkages between socioeconomic conditions and the power of special interest groups. And 5) the resource dependency theory provides external resource factors that can affect the performance of an agency. These different schools of thought can be used to explain causal links in theory proposed by this research. Relevant arguments from these theories are incorporated, adding to the body of supporting literature, and bridging the gaps in the policy instrument theory.
<table>
<thead>
<tr>
<th>Theory Focus</th>
<th>Socioeconomic Setting</th>
<th>Agents</th>
<th>Target groups</th>
<th>Agency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urban Politics</td>
<td>X</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Industry Capture (Chicago School)</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Industry Capture (Virginia School)</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Olson’s Models</td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Resource Dependency Models</td>
<td>X</td>
<td></td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>

**Table 3.4 Behavioral Dimension of Regulation**

In summary, this study draws inferences from these theories to support its model. First, this study defines contextual capacity by selecting socioeconomic variables of local communities identified by the literature, including urban politics and economic/interest group theories. The relationships determined to exist between design and operational criteria of instruments and attainment of policy objectives are based on the deductions made from policy instrument theory identified earlier in this chapter. Second, this study draws various theoretical inferences to support and explain the causal linkages in the model. The relationship between socioeconomic variables and the community’s contextual capacity are discussed in the literature of economic theory of interest groups, in particular Olson’s models. The relationship between local contextual capacity and the local government’s adoption of design and operational criteria developed in this research is based on the discussions of economic theory of interest groups and resource
dependency models. Although none of these theories includes all of the behavioral dimensions, collectively, these theories provide the theoretical underpinning of this research.

3.4 Theoretical Propositions and Hypotheses

This study explores the factors that enable a local government to successfully adapt a national policy and the factors that contribute to the variability of this success. The theoretical concepts of this study are: 1) that the increased involvement of local government in designing and implementing a national policy can affect the outcomes of the implementation, 2) that the contextual capacity of the local community can be determined, 3) that there is a relationship between local contextual capacity and the local government’s adoption of design and operational criteria of local regulation, and 4) that the improvement of water quality is an indicator of the effectiveness of local implementation of the national policy. The major hypothesis of this study is that the implementation of the community-specific regulation can affect the attainment of policy objectives, in this case, water pollution control. The objective function is the community’s water quality improvement that can be represented by the amount of discharges from NPDES dischargers and wastewater treatment outcomes.

The proposed theory is applied to the case of municipal water pollution control. Implementation of the above framework can be divided into four tasks: 1) identifying the effect of establishing the local control authority and the factors contributing to this effect, 2) identifying the effect of contextual capacity, 3) establishing the link between contextual capacity and the local government’s adoption of design and operational
criteria of local regulation, and 4) evaluating the effect of community-specific regulation. Expected results are the following:

1) Analyses of water quality, including trend analysis together with simple transfer function models with a policy intervention variable (the establishment of the LCA) will indicate whether the LCA affects the outcomes of the implementation. Furthermore, the qualitative analysis of legislative reviews and interviews will increase the explanatory power of the quantitative data.

2) Analyses of contextual capacity and water quality, including correlation, regressions, ARIMA, and simple transfer function models will be used to identify the significance of contextual capacity variables in explaining the outcomes of the implementation.

3) The regulatory relationships will be established using theoretical inferences, synthesis of local regulatory methods, t-tests of operational measures of regulatory activities, and interviews. A regulatory relationship between the local government and the industry which requires higher standards, more precise specifications of agent’s and industry’s behavior, and more coercive enforcement is expected to be found in the community with higher contextual capacity. Operational measures from monitoring and enforcement are also used to support this expected finding. T-test results obtained by comparing contextual capacity, indicate one community is stronger than the other over time. In addition, descriptive statistics of longitudinal data of city profiles and the city’s water
quality standards provide information on the city’s contextual capacity and the city’s water pollution control policy over time.

4) Discharge improvement (i.e., the effluence of Copper), the overall decrease of metal discharge (e.g., Copper, Chromium, and Lead), and wastewater treatment outcomes are evaluated to identify the effect of community-specific regulation. Simple transfer models are used to provide the degrees of improvement in copper discharges. In addition, an interview with the state official and together with data plots are used to confirm the expected overall improvement of metal discharge. Wastewater treatment outcomes are evaluated by comparing each community’s discharging behavior with NPDES permit limits. The indicators of wastewater treatment outcomes include frequency of violation and the magnitude of each violation. The community with weaker contextual capacity and with regulation containing lower standards, less precise specification of agent’s and industry’s behavior, and less coercive power for enforcement is expected to yield more and more serious violations of NPDES permit limits.

The following table consists of the relationships among this study’s proposed tasks, data sources, collection method, and data analyses. The data used in Table 3.4 are summarized in details in Table 3.5.
<table>
<thead>
<tr>
<th>Tasks</th>
<th>Data sources</th>
<th>Data collection method</th>
<th>Data analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. identifying the effects of establishing local control authority</td>
<td>1. state LEAPS(^{46}) database</td>
<td>1. in-house electronic database retrieval</td>
<td>quantitative analyses on water quality:</td>
</tr>
<tr>
<td></td>
<td>2. federal, state, and local legislation</td>
<td>2. library search</td>
<td>• trend analysis</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3. agency reports</td>
<td>• plots</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4. personal interviews</td>
<td>• simple transfer function models with dummy variable (before and after establishing the LCA)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>qualitative analyses:</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• review of legislative history</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• analysis of interview content</td>
</tr>
</tbody>
</table>

\(^{46}\) the Liquid Effluent Analysis Processing System (LEAPS)

Table 3.5 Relationships of Methods and Theoretical Propositions

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<table>
<thead>
<tr>
<th>II. identifying the effect of contextual capacity</th>
<th>I. socioeconomic data</th>
<th>1. library reference database</th>
<th>quantitative analyses on contextual capacity and water quality:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2. city sewer funds</td>
<td>2. personal interviews</td>
<td>• correlation</td>
</tr>
<tr>
<td></td>
<td>3. state LEAPS</td>
<td>3. telephone interviews</td>
<td>• regressions</td>
</tr>
<tr>
<td></td>
<td>database</td>
<td>4. in-house electronic</td>
<td>• ARIMA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>database retrieval</td>
<td>• simple transfer function models</td>
</tr>
<tr>
<td>III. establishing the link between contextual capacity and local government's adoption of design and operational criteria of local regulation</td>
<td>1. information used in the previous two tasks</td>
<td>1. on-site data collection</td>
<td>quantitative method:</td>
</tr>
<tr>
<td></td>
<td>2. documentation</td>
<td>2. personal interviews</td>
<td>• theoretical inference</td>
</tr>
<tr>
<td></td>
<td>3. local perspective</td>
<td>3. telephone interviews</td>
<td>• case illustration</td>
</tr>
<tr>
<td></td>
<td>statistics of programs, monitoring and enforcement</td>
<td></td>
<td>• synthesis of regulatory methods</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• analysis of interview content</td>
</tr>
<tr>
<td>iv. identifying the effect of community-specific regulation</td>
<td>state LEAPS database</td>
<td>data retrieval</td>
<td>quantitative analyses within and between the two communities:</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• descriptive statistics of city longitudinal profiles</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• t-tests comparing the cities' contextual capacity and operational measures</td>
</tr>
</tbody>
</table>

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Each task is further discussed in terms of operationalization, expected results, data sources and data collection methods, and analyses. Most information including contextual capacity observations, water quality observations and pertinent federal and state policies are collected over a thirteen-year period (1980 ~ 1993). The narrative information on local government's design and action on water pollution control is collected in various periods from 1986 to 1995, after both local control authorities were established. The purpose of the longitudinal design is to capture the profile of these two cities and possible policy changes over time.

Task I. To identify the effect of establishing the local control authority.

Hypothesis: Water quality after the establishment of the LCA is better than the water quality before the LCA.

The establishment of the local water pollution control authority becomes a policy intervention to be tested in this hypothesis. Before both cities assumed the responsibility of controlling the water pollution of industry, federal effluent standards for industrial users were not enforced due to lack of proper authority and limited knowledge of the extent and the types of pollution. During that period of time, the cities did not have information regarding the source, the content or the amount of wastewater that was discharged into the cities’ wastewater facilities. The cities also did not have any authority to regulate those sources or amounts. After establishing the authority, the local government could design and implement its own effluent standards as long as these standards meet/exceed the federal standards (Interview, March 18, 1996).
An a priori condition of this study is the establishment of the LCA that entrusts the local government with design, implementation, and enforcement authority. It also defines the scope of cases that can be generalized by this study. This first hypothesis is that LCAs, being the primary control authorities of municipal water pollution control can affect water quality. The null hypothesis (H_0) is that there is no significant difference in the water quality of the community before and after the establishment of the local control authority. The alternative hypothesis (H_a) is that there was a difference in the water quality in the community after the local government became a control authority. The pretest and posttest observations of Columbus and Lima are taken from the LEAPS database. The magnitude of discharge (e.g., Copper; Cu; 30-day concentration) of Columbus is aggregated by the discharge of two publicly owned treatment works (POTWs). The effects of state/federal regulation during the time observed are minimal. The related NPDES regulations for these dischargers only appeared after 1990.

Quantitative methods are used to test this hypothesis. The first is a simple data plot to present the pattern of water quality. The second is a simple transfer function model with fitted error process. Trend analysis and plots are used as inputs to help to find a fitted model. The policy intervening variable (the establishment of LCA), is a dummy variable, X, and has the values of either 0 or 1. Water qualities from both cities are expected to present similar effects due to the policy intervention. Qualitative analyses of legislative review and interviews are used to provide interpretations and insights on the expected effect.
The data sources used for the analyses include the state LEAPS database, federal, state, and local legislation and policies. The methods used include in-house electronic database retrieval, library search, reviews of agency reports, and personal interviews.

To provide empirical verification of the first hypothesis, a statistical model is implemented by using ARIMA to filter time associated errors, and then a simple transfer function model is used to call in the interruption caused by the local government intervention.

**Equation 1**

\[ Y_t = f(k, X_t, t) + N_t \]

Where

- \( Y_t \) is Copper, Cu, discharges from POTWs
- \( f(k, X_t, t) \) is a function of a set of unknown parameters, \( k \); an explanatory variable, \( X \), the involvement of local government; and time, \( t \); \( t \) is by month;
- \( X_t = 0 \), when \( t:1980 \sim 1985 \)
- \( X_t = 1 \), when \( t:1986 \sim 1992 \)

\( N_t \) is a noise term (including random error, so-called "white noise", and non-white noise which might be associated with cross-sectional and seasonal effects, and minor physical plant upgrade and policy changes)
The noise term, $N_t$, can be further modeled to include possible auto-regressive and moving average components. The function above can be written as:

**Equation 2**

$$Y_{it} = \alpha + bX_{it} + \sum_{p=0}^{t} \Psi_{ip} \varepsilon_{i(t-p)}$$

Where

- $Y_{it}$ is Copper, Cu, discharges from POTWs; $i$ denotes city; and $t$ denotes time; 01/80 ~ 12/92.
- $\alpha$ is the constant term
- $bX_{it}$ is the coefficient; an explanatory variable, $X$, the involvement of local government; $X=0$ when $t: 01/80 ~ 12/85$; $X=1$ when $t: 01/86 ~ 12/92$.
- $\sum_{p=0}^{t} \Psi_{ip} \varepsilon_{i(t-p)}$ represents the transfer function weights for the error term, $N_t$.
- $\Psi_{ip}$ is the coefficient of polynomial expression, $\phi(B)/\theta(B)$, where $\phi(B) = \phi_0 - \phi_1B - \phi_2B^2 - ... - \phi_zB^z$ is in backshift notation for moving average terms with degrees of $z, z = (0 \sim t)$ and $\theta(B) = \theta_0 - \theta_1B - \theta_2B^2 - ... - \theta_nB^n$ is in B for autoregressive terms with degrees of $n, n = (0 \sim t)$.

Task II. To identify the effect of contextual capacity.

Hypothesis: The discharges of Copper from POTWs can be explained by the capacity of the local community.
A set of contextual capacity indicators was collected mostly from 1980 to 1992 and is used in a statistical model to examine the relationship between contextual capacity and the changes in Copper discharges. Local socioeconomic variables and agency resource dependency variables are used to indicate the contextual capacity of both cities. The variables that are used in this task include the socioeconomic variables of total personal income (TPI), per capita personal income (PPI), per capita income percent of national average (PP), population (POP), and financing variables of total sewerage capital costs (TCC), total wastewater treatment costs (TWC), local sewerage capital costs (LCC), and local wastewater treatment costs (LWC). The cost variables listed above are in 1993 dollars, standardized by using Construction Cost Index (Lufkin and Pepitone, 1994). Simple transfer function models are used to model the variables after filtering the possible time associated errors.

The data sources include socioeconomic data from the Regional Economic Information System (REIS), city sewer funds, and state LEAPS database. These data were collected through a library search of census databases, data compilation of local sewer funds, and retrieval of state-maintained water quality data. Personal interviews and telephone interviews were conducted to obtain assistance from the cities’ financial personnel to collect information on sewer capital spending. Memorandums describing information that is of interest to the study were sent ahead to the interviewees before the scheduled meetings. The pre-interview contact helped the interviewees to be familiar with the study and be prepared for the interviews.

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47 The socioeconomic data from REIS consists of two Metropolitan Statistical Areas (MSAs): Columbus and Lima, Ohio.
A statistical model can be denoted as:

**Equation 3**

\[ Y_t = g(h, X_j, t) + E_t \]

Where

- \( Y_t \) is Copper discharges from POTWs
- \( g(h, X_j, t) \) is a function of a set of unknown parameters, \( h \); exogenous variables, \( X_j \) that indicate contextual capacity, \( j \); and time, \( t \); is by year
- \( E_t \) is the noise term

The contextual capacity variables, \( X_j \), and the noise term, \( E_t \), can be further modeled to incorporate possible cross-sectional effect, and autoregressive and moving average terms.

The function above can be written as an individual general transfer function model with two explanatory variables. For example:
Equation 4

\[ Y_{jt} = \mu + c \cdot C I T_{jt} + \sum_{k=0}^{l} \Omega_{jk} X_{j(t-k)} + \sum_{q=0}^{u} \Phi_{jq} \pi_{j(t-q)} \]

Where

- \( Y_{jt} \) is Copper discharges from POTWs; \( j, j \) denotes contextual capacity variables; and time, \( t; t: 1980 -1992 \)
- \( \mu \) is the constant term
- \( c C I T_{jt} \) is a sectional dummy variable, \( C I T_{jt} = 1 \), Columbus, \( C I T_{jt} = 0 \), Lima;
- \( c \) is the coefficient

\[ \sum_{k=0}^{l} \Omega_{jk} X_{j(t-k)} \]

represents the transfer function weights for the explanatory variable, \( X_j \); \( \Omega_{jk} \) is the coefficient of polynomial expression, \( \omega(B) / \delta(B) \), where \( \omega(B) = \omega_0 - \omega_1 B - \omega_2 B^2 - \ldots - \omega_v B^v \) is in backshift notation for moving average terms with degrees of \( v, \nu = (0 \sim t) \). \( \delta(B) = \delta_0 - \delta_1 B - \delta_2 B^2 - \ldots - \delta_m B^m \) is in \( B \) for autoregressive terms with degrees of \( m, m = (0 \sim t) \).

\[ \sum_{jq=0}^{u} \Phi_{jq} \pi_{j(t-q)} \]

represents the transfer function weights for the error term, \( E_t \). \( \Phi_{jq} \) is the coefficient of polynomial expression, \( \lambda(B) / \sigma(B) \), where \( \lambda(B) = \lambda_0 - \lambda_1 B - \lambda_2 B^2 - \ldots - \lambda_s B^s \) is in backshift notation for moving average terms with degrees of \( s, s = (0 \sim t) \) and \( \sigma(B) = \sigma_0 - \sigma_1 B - \sigma_2 B^2 - \ldots - \sigma_r B^r \) is in \( B \) for autoregressive terms with degrees of \( r, r = (0 \sim t) \).
Task III. To establish the link between contextual capacity and local government’s adoption of design and operational criteria of local regulation

Hypothesis: A community with stronger contextual capacity uses higher standards, more precise operational specifications, and more coercive enforcement of regulation

First, the profiles of both cities are investigated by using descriptive statistics of the cities’ socioeconomic data over time. The profiles that are reviewed longitudinally include changes in local industries, economic diversity and census information, trends and changes of sewer financing and financing sources, the changes in the amount and the strength of pollutants, the trends and variations of water quality standards, and the variations in wastewater flow of direct dischargers.

Second, after examining the profile of each city, t-tests are used to compare contextual capacity of both communities. The contextual capacity variables that are used include the socioeconomic variables and financing variables used above, and an economic diversity index (DIV), Moody’s bond rating (MBR) and Inclusiveness of LCA (INC). The calculation of the index and Inclusiveness are provided in the following chapter. The data for MBR is obtained from 1985 to 1993 and then is transformed from ordinal into interval scale before testing.
Third, theoretical inferences are derived from interest group theory and the resource dependency model to develop premises for the community-specific regulation. Fourth, syntheses of regulatory methods of both local governments are provided to illustrate the expected regulatory relationships between the local governments and the regulated industries. The regulatory relationships are identified by three criteria: a) stringency and comprehensiveness of standards to regulate industry, b) precision of operational specifications for agent's and industry's behavior, and c) coerciveness of enforcing behavior change. Fifth, t-tests on operational measures (1989 ~ 1995) of local programs and interview information are used to further confirm this assumed regulatory relationships.

Task IV. To identify the effect of community-specific regulation.

Hypothesis: Community-specific regulation affects the wastewater treatment outcomes of the community.

First, representative water quality parameters are selected from each NPDES discharger. Second, discharges by parameters are compared to the limits specified in NPDES permit. Third, frequencies and deviation of discharges exceeding the limits are calculated. Fourth, T-tests are used to compare the wastewater treatment outcomes of both communities.
The data sources for task III and IV are documentation of city codes and enforcement plans, and interviews of state and local officials. In addition, operational measures are determined and collected from statistics of local programs for water pollution control. The source for the local program statistics is OEPA AR-2, 3, and 5 forms in local annual reports (pretreatment annual effectiveness reports, 1987 ~ 1996). The method of data collection includes on-site data collection, and personal and telephone interviews. The following table is a brief summary of variables/proxies and associated data that identify the theoretical concepts.
<table>
<thead>
<tr>
<th>Concept</th>
<th>Variable/Proxy</th>
<th>Data</th>
<th>Time Frame</th>
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<tbody>
<tr>
<td><strong>Strength of local economy</strong></td>
<td>Total per capita income (TPI)</td>
<td>REIS</td>
<td>1980 – 1993</td>
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<td></td>
<td>Per capita personal income (PPI)</td>
<td>REIS</td>
<td>1980 – 1993</td>
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<td></td>
<td>Population (POP)</td>
<td>REIS</td>
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<td>% of national average of per capita personal income (PP)</td>
<td>REIS</td>
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<td>Diversity Index (DIV)</td>
<td>OPEA AR-3 Form, Standard Industrial Code</td>
<td>1986 – 1995</td>
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<td></td>
<td>Type of industry</td>
<td>OPEA AR-3 Form, Standard Industrial Code</td>
<td>1986 – 1995</td>
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<tr>
<td><strong>Agency’s resource dependence</strong></td>
<td>Total sewerage capital costs (TCC)</td>
<td>Sewer funds</td>
<td>1980 – 1993</td>
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<td></td>
<td>Total wastewater treatment costs (TWC)</td>
<td>Sewer funds</td>
<td>1980 – 1993</td>
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<td></td>
<td>Local sewerage capital costs (LCC)</td>
<td>Sewer funds</td>
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<td></td>
<td>Local wastewater treatment costs (LWC)</td>
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<td></td>
<td>Inclusiveness of LCA by concentration (INC)</td>
<td>LEAPS -- BOD5, TSS, NH3, Cu, Cr, and Pb</td>
<td>1980 – 1992</td>
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<tr>
<td></td>
<td>Inclusiveness of LCA by loading (INL)</td>
<td>LEAPS -- BOD5, TSS, NH3-N, Cu, Cr, and Pb</td>
<td>1980 – 1992</td>
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Table 3.6 Lists of Variables / Proxies, Data Sources, and Timeframe

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<table>
<thead>
<tr>
<th>Table 3.6 (continued)</th>
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<tbody>
<tr>
<td>Design and operational criteria of local regulation</td>
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<td>Monitoring Activities Per Significant Industrial User</td>
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Abbreviation: Biochemical Oxygen Demand (BOD5), Total Suspended Solids (TSS), Ammonia Nitrate (NH3-N), Copper (Cu), Chromium (Cr), and Lead (Pb)
3.5 Methodological Approach

The following section discusses the methodological approach that the study employs. It includes reasons why the case study method is used, suitability and limitations of a case study, the criteria of case selection, data limitation, data collection and method of analysis.

To be able to address the research questions of this study, and to further elaborate the supporting concepts with theoretical and empirical evidence, this study employs a longitudinal-exploratory evaluation method. Such a design can provide in-depth explanations and narrative data to assess the development of a policy and its implementation.

The applications of this research design, data collection, and analytical methods are based on two schools of literature. One is the case study literature. The literature includes Cook and Campbell, (1979), Rosengren, (1981), Majchrzak, (1984), Yin, (1994), and GAO, (1995). The other set of literature is benefit transfer. Relevant methodological discussions can be found in the collection of 1992’s Water Resources Research by various authors including Brookshire and Neill; Boyle and Bergstrom; Desvousges, et.al. Loomis; and Luken, et.al., and Downing’s study in 1996.

Why a case study? One, it is appropriate because of the questions being asked, i.e., how does community-specific regulation affect the improvement of water quality? And why does community-specific regulation affect the improvement of water quality? And two, it is appropriate because of the empirical inquiry being implemented, i.e., how are these variations of water quality improvements explained by historical events and
contemporary evidence as opposed to laboratory evidence? This study examines the variations in water quality improvement from the perspectives of local government's involvement and local policy actions regarding water pollution control, and also investigates the contextual capacity factors that enable the local government to successfully adapt this national initiative. A longitudinal-exploratory case study is utilized with judicious use of quantitative and qualitative methods to 1) address the expected trends and variations of water quality improvement over time, and 2) to provide explanations and insights from the policy context and practitioners to illuminate the expected trends and variations.

Policy studies often are made difficult because of the unfeasibility of controlling environment or subjects, and because the links between causes and effects are often obscured or delayed. A longitudinal-exploratory case study with an integrated use of quantitative and qualitative methods is particularly suited to 1) follow case(s) of research interests that evolve over time, 2) perform in-depth analyses on these case(s), and 3) investigate the events that happen over which the researchers have no control. Therefore, case studies have become a widely applied evaluation method in the fields of government policy analyses, environmental studies, and social and behavioral science.

The methodology has evolved and improved over time, as have the types of case studies. The classifications of case studies have become more diverse, but not exclusive. The purpose of classification is to provide a generic profile of each class, matching it for specific research questions. Mixed-uses of several types of case studies within a research study is possible. A typical classification includes exploratory, descriptive, and
explanatory cases studies (Yin, 1994). The GAO study further expands these typical categories to include critical instance, program implementation, program effects, and cumulative case studies (1995).

Furthermore, qualitative methods can be combined with quantitative methods. There seems to be an increasing amount of this type of research in the evaluation profession (Patton, 1990). In fact, integrating qualitative and quantitative methods is useful to various studies. For many reasons, although quantitative expressions are often preferred over qualitative ones, not all subjects can be readily or easily measured numerically. In addition, research can be robust if the research results are supported by multiple sources and theories. To achieve this, the integration of the researchers’ learning process, the accumulation of knowledge by replicating, testing, and rebutting other studies, and the use of multiple methods can be instrumental (Harrison, 1994; Davis, 1994).

Moreover, integrating quantitative and qualitative methods is useful for policy studies. Policy researchers operate in a research arena, often driven by a policy question about which limited information there is. They might be faced with various types of information either qualitative or quantitative, or both; and be required to use types of analyses that are better suited for a specific question, and they might then decide the most adequate interpretation and presentation for their findings (Bernstein and Epstein, 1994; Loneck, 1994). During the process, policy theorists can learn from experiences and knowledge of practitioners in the subject area. Such knowledge can possibly reshape theorists’ own thinking for developing a theory that can actually be tested in practice.
The combinations of both methods can be strategically used to overcome the weaknesses of each. A brief summary of the relative strengths and weakness of qualitative and quantitative methods is provided based on Patton (1990) and the GAO (1995) studies. The strengths of qualitative methods include: 1) in-depth and detailed evaluation of selected issues by studying a smaller number of people and cases, 2) less constraints imposed because of fewer predetermined response categories and standardized inquiries, and 3) more flexibility in adjusting the design, which can be expanded and advanced for further research. The GAO study pointed out that a collection of informative questions and responses can be later matched and generalized at a more purposeful level. Moreover, analysis can be concurrent with data collection, resulting in alternative interpretations and rapid adjustments in research design (1995). On the other hand, the strengths of quantitative methods include: 1) more standardized measures for a greater number of observations with a limited set of inquiries, and 2) a broader and more generalizable set of findings (Patton, 1990). However, the predetermined and standardized measures of a quantitative study can limit the in-depth explorations on the policy events or interventions that are to be studied (GAO, 1995).

The exploratory method used to add depth and detailed reasoning to complete the study contains statistical patterns generated by quantitative data analysis (Patton, 1990). The characteristics of an exploratory study are as follows: 1) suitability for a cause-effect research question; 2) ability to explore great uncertainty or limited knowledge on research objects, such as program operations, goals, and outcomes, and 3) flexibility to be expanded into a larger-scale study. However, the research designs for an exploratory case study often face challenges, such as 1) selecting sites that are adequate to the study's
theoretical inquiry, 2) avoiding premature conclusions that are situation-driven, and 3) reducing the time spent on exploratory stage that are likely to be prolonged (GAO, 1995).

The Use of Quantitative and Qualitative Methods

Most of the quantitative data, such as time-series water quality and permit limit data, monitoring and enforcement activities, sewer funds, and socioeconomic data, can be collected in a numeric and standardized fashion. But in-depth data collection is needed to explore why these variations occur based on the theoretical inquiry of local government's actions and its contextual capacity. The in-depth data collection relies on open-ended interviews and written documents, and qualitative methods such as interviewers are used to collect detailed descriptions of the water pollution control program. The interviewees should be knowledgeable about and experienced in the subject matter. Documentation is reviewed by using sources such as organizational records, publications, and reports, which can provide explanations of organizational and program activities. Although the qualitative data should also be collected in a systematic manner, the responses and findings can be dynamic and sometimes surprising. Qualitative methods also allow researchers to interact with persons familiar with the program and policy and to move to another level of exploration.

The research questions raised in this study are: how and why does community-specific regulation affect the improvement of water quality in a community? To be able to explore the local government's adaptation of the national policy over time, a longitudinal design is integrated into the case study. Site selection is an important factor
to the validity and generalizability of an exploratory study. This study uses the following criteria for selecting cases.

**Site Selection Criteria**

These criteria are: 1) representation of research (literal replication of other cases based on critical case sampling), 2) comparability of contrast cases (theoretical replication based on deviant case sampling), 3) data availability and consistency (based on confirming case sampling), and 4) benefit transfer application (based on theory-based or operational construct sampling).

The above criteria are comparable to the case sampling strategies identified by Michael Patton (1990). These strategies include: 1) **critical cases sampling**, which permits maximum application of information from the case selected to other cases, 2) **deviant case sampling**, which contrasts and compares cases that are typical in their subgroups, 3) **confirming case sampling**, which elaborates and deepens analysis done in an initial study, and 4) **theory-based or operational construct sampling**, which selects the cases that can provide sufficient information to explain or operationalize a proposed theory (Patton, 1990)

Two forms of logical replications, as defined in Yin's study (1994), literal and theoretical replication, are used. A literal replication is used to predict similar results with similar cases. In this study, an a priori assumption is made that the water quality of both communities is improved due to a policy intervention, the establishment of a LCA. A similar improvement pattern of water quality is expected to be found in both
communities in a comparison of before and after the local governments became control authorities. This criterion, literal replication, is based on a critical case sampling. This strategy selects critical cases that permit maximum application of information to other cases due to this logical generalization (Patton, 1990).

Another logical generalization, theoretical replication, is also applied to produce contrasting results with opposite but predictable reasons (Yin, 1994). The two cases selected here can be used to indicate opposite case scenarios. The opposite cases represent more or less improvement of a community's water quality. Other cases with fitted descriptions are assumed to fall into either one of the two categories. The function of such is a theoretical replication. This criterion is based on a deviant case sampling. This strategy is to select two cases that represent deviant scenarios but are typical in their own subgroups (Patton, 1990). However, a common limitation of studies of dichotomy is a possibility of further expansion of categories. The further development of categorical refinement is not intended in this study. However, the proxies and protocol developed for this study can be useful to further refine these categories.

Perhaps a common limitation to all studies is data consistency and data availability. Lack of data and difficulties of data access are the most common problems in conducting empirical policy studies. The two cases being selected provide the best data available in their common case pool. The quality of the Scioto and Ottawa rivers, the rivers of interest in the two cases being conducted, has been well documented by on-going research conducted by the OEPA.48 Comprehensive diagnoses based on chemical,  

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48 An on-going Ohio water resource monitoring effort provides aquatic community status and trends for the principal rivers and streams in the lake Erie drainage basin. The inventory was compiled by a five-year
physical, and biological information for the healthiness of these two selected streams provide the preliminary information for the site selection. The trends for both streams are that they have been found improved over time, but to different degrees; the Scioto River was found to be greatly improved, but the Ottawa River was found improved but with remaining gross fish anomalies (OEPA, 1992). This criterion, data availability and consistency, is based on a confirming case sampling strategy (Patton, 1990). This sampling technique is applied to further elaborate and deepen initial analysis brought by the OEPA study.

Benefit transfer has been a widely adopted methodology in relation to non-monetary valuation studies in the area of environmental economics. It is a process to transfer the benefits estimated from “study sites” to the intended “policy sites” (Brookshire and Neill, 1992). The benefits estimated are often non-market values with limited measures developed and are resource intensive for studies that are larger in scale. This value is then directly transferred to the policy sites or used to further simulate research for the areas that are in need of similar research. This method provides for replication or simulation techniques that allow the transfer of observed parameters in the studies to other intended policy sites. This notion is consistent with the theory-based or operational construct sampling strategy (Patton, 1990). The cases are selected based on the sufficiency of information needed to operationalize and explain the constructs of the proposed theory.

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monitoring schedule. The earliest observations taken for the Scioto River was in 1979, and for the Ottawa River was in 1985 (OEPA, 1992).
One of the criticisms of benefit transfer methodology is similar to the one of case studies, that is, that it is impractical for the direct transfer of benefit estimates from one case to another (Boyle and Bergstrom, 1992). As Desvousges and others asserted in their study, the reliability of the benefit transfer methodology is dependent on the quality of the parameters depicted and estimated (1992). An investigator triangulation technique (a type of technique identified by Denzin in 1978, Patton, 1990) which consists of multiple perspectives from experts to interpret a single set of data, can be used to improve the reliability of parameter selection.

Quantitative synthesis of documentation review is further verified with the perspectives of state and local officials. Besides the validity of findings and the reliability of research protocol, the similarity in characteristics of the study sites and policy sites is the key to the transfer. Hence, with proper descriptions of the estimation of parameters and the research protocol derived from study sites, other policy sites can then readily apply these estimates.

In sum, this case study relies on multiple sources of evidence and on a priori development of various theories. The multiple sources of evidence strengthen the internal validity of this study, while the use of theoretical derivations from other theories to develop the research constructs strengthen the construct validity of this study. Both quantitative and qualitative evidence and analytical techniques provide broad generalizability from the "study sites" to the "policy sites", and also provide in-depth explorations of the scenarios of the study sites. Quantitative data used to measure impacts on water quality (water quality data and permit violations), socioeconomic data,
and financial information are consistent and available in a time series fashion from 1980 to 1993. The content of documentation and interviews with experienced officials add explanations to the design and actions of water pollution control policy, and add in-depth exploration to the expected results of water quality improvement.

3.5.1 Data Limitations

Case Selection

There are some limitations resulting from case selection and data. The first limitation is case selection. Many factors could contribute to the variations of water quality. By constructing the criteria that are discussed in the previous section, the representation can be improved. However there are other factors, like the possible influences of state standards, bio-region effects, non-point source effects, the accuracy of the samples taken and recorded, or other unknown interventions, that might affect water quality. Although unable to have as much control as a laboratory setting, the selection of the cases does control the intervening effects as much as possible. Both the Scioto (Columbus) and the Ottawa (Lima) rivers are in the same state and in similar bio-regions, and have minimal non-point source effects.

Data Limitations

The second limitation is data. The primary problem is the lack of consistent and available water quality data. This is a major hindrance to water quality studies (Ringquist, 1995). Due to a lack of consistency in regulations, some parameters were not continuously monitored. Other problems are the change in unit of measurement or collection methods for parameters that previously were undetected. For example, the
method for metal parameters was changed in 1993;\textsuperscript{49} some local governments still use the old method to submit data. Due to these problems, the availability of data is limited. Therefore, the parameters that the study analyzed were conventional parameters and metal parameters that were monitored from 1980 to 1992. They were the most frequently appearing in the data and are representative of the regulation and database, and are most significant for the sites that are studied. Other parameters are assumed to be less representative of water quality or would behave much the same as the ones that are studied.

Furthermore, there are common constraints to collecting longitudinal data and using multiple data sources. Allocation and retrieval of archival data can be labor-intensive and time-consuming, and consistency of information can be hard to maintain. Moreover, there are problems resulting from missing data or inability to interpret older data. In addition, the availability of informants who have substantive knowledge regarding the policy development over time can be greatly limited. Therefore, the support of data retrieval and the commitment of data sources become very critical. Regarding missing data, some interpolation and extrapolation techniques might need to be applied.

\textbf{Human Errors and Extreme Values}

Furthermore, there are several possibilities for extreme values to have occurred. One is random error such as typos or clerical error. With rigid quality control (such as spot checks), these type of errors might be detected and reduced to an extent. Another, and the most significant one, is the real discharge that is out of the ordinary. When "outlying"

\textsuperscript{49} The duration in acid analysis was changed from "total metal" to "total recovery metal" (OEPA Interview, May 7, 1996)
events occur due to abnormal discharges of the NPDES dischargers, they constitute serious environmental and health problems. Due to this concern, this study uses data filtering techniques (e.g., ARIMA) to smooth possible data fluctuations of seasonal effects, facility upgrades, and extreme weather, and does not omit any extreme (outlying) data point. Therefore, there is a compromise between the projection of a normative model and robustness of the model.

3.5.2 Data Collection

The parameters that are identified and further estimated from the two study sites can be grouped into the following categories. The first is local government's involvement in the development of water pollution control regulation and policies from 1980 to 1995. The second category is contextual capacity. The parameters indicating the strength of the local economy include: 1) the types and diversity of the local economy, and 2) local socioeconomic conditions. The parameters indicating the resource dependency of the LCA include: 1) the ability to finance the development of its sewer infrastructure, and 2) the inclusiveness of the LCA. The third category is the community-specific regulation, which defines the regulatory relationships between local government and industry. The parameters include: 1) stringency and comprehensiveness of rules to regulate industry, 2) precision of operational specifications for agents' and industry's behavior, and 3) coerciveness used to enforce industry's behavior changes. The final category is the water quality improvement by the community. The parameters include: 1) the discharge improvement and 2) wastewater treatment outcomes.
The assertion of this research is that the success of the local control authority is context bound. The interaction among the local government's involvement in developing regulatory policy, the community contextual capacity, and the community's design and operational criteria of regulatory policy are so intertwined that to indicate their individual causal effect is impossible. However, a relationship between community contextual capacity and its local government's adoption of design and operational criteria for local regulation is defined. The adoption of design and operational criteria varies across communities. The scope of the control authority is exogenous and predetermined in this study.

Data

The data of this study can be categorized into the following four groups. The first group of data is Chronological legal and policy content of municipal water pollution control from 1980 to 1995. These data are pertinent federal, state, and local regulations, policies, and program statistics. They were collected from legislative reviews and agencies' documentation in rules and regulations, executive summaries, implementation plans, forms and annual reports, and descriptions from officials. This information was used to construct classifications of regulatory relationships between local government and industry, and to verify and to explain the expected results of water quality improvement.

The second group of data is industry, clientele, and socioeconomic data. These were collected from OPEA AR 2 and 3 forms in annual reports, SIC, \(^{50}\) and REIS. These industry and clientele data are used to describe the types of the industry that the LCA

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\(^{50}\) References can be found in Standard Industrial Classification Manual, Office of Management and Budget.
provides services to and has regulatory authority over. The socioeconomic data are used to indicate the strength of the local economy.

The third group of data is financial information and bond ranking. Financial information is annual capital spending on sewer construction from all funding sources. Raw data are collected from microfiche or electronic records from agencies' sewer funds. Further descriptions to identify the sources of funding for projects or items were obtained from local and state agencies. Bond rankings were obtained from Moody's Manual. This information was used to assist in identifying possible relationships of funding impacts to water quality and the financial dependency of the local governments. 4) Water quality and permit data. These include effluent and limit data of NPDES dischargers including individual POTW and industrial dischargers. The data are derived from an electronic database system, the Liquid Effluent Analysis Processing System (LEAPS). Each raw data entry is identified by station, parameter, date, and specification (e.g., 30-day concentration and 7-day loading). This information is used to indicate communities' water quality improvement.

Most of the data are in quantitative form, which are interval data in standardized format. Most of the qualitative data are from the collection of interviews and documentation reviews. Due to the subjectivity of interpreting the qualitative data, content analysis from initial interviews and documentation reviews is further explained or verified by expert opinions collected from follow-up interviews or operational measures such as program statistics.
Data Sources and Collection Methods

Literature and Relevant Reviews

The location of data and data collection methods used are described as follows. The first data source were literature and relevant reviews conducted in the library and via online legal document searches. This information includes legislation and regulation on water pollution control related subjects. This effort provides history and law reviews on municipal water pollution control including legislation and programs initiated by the federal, state, and local governments. Furthermore, socioeconomic and bond rating data were also retrieved from the library’s databases, REIS, which is maintained by the Bureau of Economic Analysis, the US Department of Commerce, and Moody’s Manual.

Policy Oversight and Development Agency

The second data source is the policy oversight and development agency in the state of Ohio, the Ohio Environmental Protection Agency (OEPA). Interviews with administrators, field officials, and researchers were conducted in various sessions and divisions (e.g., the Division of Environmental and Financial Assistance, the Surface Water Division, Water Quality Division, and the Central District Office). Most of the interviews were conducted in an open-ended fashion either with a panel of discussants or with individuals. The efforts were to gain familiarity with the history and status of the wastewater treatment policy and programs development in the state. In addition, information and assistance were obtained in order to retrieve documentation and databases available in-house. The interviews and meetings provided background information and insight in the development and implementation of federal policy from
the state's perspectives, professional advice on site and water quality parameter selections, and database retrieval on water quality and permit data.

The Local Governments

The third data source is the local governments of Columbus and Lima, which adapted federal and state initiatives and further tailored them to meet the local needs. Interviews were conducted with decision-makers, administrators, and managers in various divisions, such as the Auditor's office, the Department of Public Utility, the Office of Pretreatment Program, and wastewater treatment works. Initial interviews were also conducted in an open-ended fashion that allowed the researcher to obtain the opinions and insights of these professionals on their adaptation to the legal demands of the federal government. Also, the initial interviews allowed the researcher to assess the amount and type of data available from the localities, and to further design a consistent format (as in relational databases) for data retrieval and linkage of the data obtained from the state offices. Follow-up interviews were more subject-specific in order to capture the individual efforts made by the municipalities to improve specific elements as well as the whole integrity of the quality of their streams. Memorandums were used and sent ahead of time to the interviewees to help explain the intent of the data collection. Key parameters for collecting capital spending on sewer infrastructure, pretreatment data, local legal demands, and policy information were identified. Telephone calls were also used as a validity check of the data and to reduce the mis-interpretation of the information. A log entry of interviews and meetings is listed in Appendix A. The entries include sources of information and summaries of meeting content.
Interviews

The format for initial interviews was less structured. The questions of these interviews were open-ended. This format is useful for collecting background information and relevant sources and references because it allows the interviewees flexibility in giving detail descriptions and opinions than the more structured interview format (For an example, see Appendix B). The initial interviews also provided access and direction for on-site data compilation. Follow-up interviews were more structured, insightful, and subject-specific (For an example, see Appendix C). The representatives from the organizations in the follow-ups served as “receivers” and provided validity control of the author's interpretation of initial interviews and documentation. Also, they provided further explanations as to what might be insufficient in the initial data collection efforts.

The informants selected for interviews are officials from the OEPA and the local governments. The criteria of selection was based on the informants' substantive knowledge in the specific subjects of wastewater treatment that were studied and their knowledge of the history of policy development over time. Types of informants included department heads, engineers, fiscal officers, legal analysts, water quality specialists, and researchers. Some of them are decision makers; some are intensively involved in the implementation processes. The development of proxy measures for qualitative parameters was based upon the observations, documentation, and descriptions of interviewees.
3.5.3 Data Analysis Techniques

Both quantitative and qualitative analytical techniques were used to analyze the information. Quantitative analysis included statistical techniques, such as pattern-matching with data plots, ARIMA, regression and simple transfer functions. These techniques were used to assess the explanatory power of local intervention on water quality (see Table 3.5 Task I) and the significance of contextual capacity variables in explaining water quality improvement (Table 3.5 Task II). Relational databases were built in order to link this information more effectively. The conceptual map of this database is listed below.
Figure 3.2 Conceptual Map of Relational Databases
Data Filtering

Before proceeding with regression analysis, data plotting, data interpolation, and data filtering were applied. Data plots were used to provide visual inspections of the data pattern as well as to identify extreme outlying data points. Data interpolation was used to make up missing data values by taking into consideration adjacent values within the time frame. Data filtering was used to smooth noise terms that are commonly present in longitudinal data. These consist of "white noise", random errors, and "non-white noise" which might be associated with seasonal effects, federal policy changes, and physical plant upgrades. If non-white noise existed, the technique of autoregressive integrated moving average (ARIMA) which was an invention of Box- Jenkins in 1970 (SAS/ETS, 1991) was employed. The techniques include autoregression, moving average, or some combination of both. They were used to filter each data series with non-white noise, and if possible, find a fitted model for the error, before examining the variables that are intended for this study.

Test of Differences in Means

Test of differences in means (T-tests) were also performed to test the differences between the two communities in contextual capacity (Table 3.5 Task III) and operational measures of regulation programs (Table 3.5 Task III). Descriptive statistics were also used to analyze the variations in NPDES permits, which provided the operational definitions of water quality standards.
Content Analysis

As for qualitative analysis, using theoretical inferences from various studies, preliminary regulatory relationships between local government and industry were developed. Furthermore, legislative reviews also provided policy background and context of water pollution control. Content analysis of local regulatory and policy documentation provided further illustration of the relationship (Table 3.5, Task III). Face to face and phone interviews were used to assist in interpretation and bring in operational and evaluative perspectives to this textual information. Multiple-sources provided verifications and further explanations to the individual data sources. Qualitative information was analyzed first by interpretation derived from the content of the interviews and documents by the researcher. The researcher synthesized the pattern of the content and assigned proxies or categorical values to the findings. If further explorations or verifications were necessary, follow-up interviews were then conducted.

3.6 Summary

In brief, this study examined factors that are important to the effectiveness of a local government's adaptation and implementation of federal initiatives and expanded the behavioral dimension of the policy instrument theory by adding components that are missing from prior studies. These components are contextual capacity and a relationship between the local contextual capacity and the local government's adoption of design and operational criteria of local regulations. A theoretical framework has been designed to
provide linkages among these components and the success of policy implementation. This study established four research objectives based on this framework. This framework was then implemented to study two municipalities in a longitudinal and exploratory case study, using municipal water pollution control as a policy backdrop. Information was collected from socioeconomic databases, codes and regulations, local governments’ archival documentation and reports, and agency’s in-house databases via library searches, on-line or in-house database retrieval, on-site data compilation, and telephone and personal interviews. In the next chapter, quantitative and qualitative information are analyzed by using a combination of statistical techniques including regression, ARIMA, t-tests, and descriptive analysis and content analysis. The following Figure is a visual representation of this summary.
Figure 3.3 Research Flow
CHAPTER 4

DATA ANALYSIS AND FINDINGS

This chapter discusses data analysis and the findings from the tasks of empirical testing the four research hypotheses proposed by this study. These tasks include the following:

1. identify the effect of establishing local control authority
2. identify the effects of contextual capacity
3. establish a relationship between contextual capacity and local government's adoption of design and operational criteria of local regulation
4. identify the effects of community-specific regulation

4.1 Identify the Effect of Establishing Local Control Authority

The first task of data analysis is to identify the effect of establishing a local control authority. Figure 4.1 displays the monthly copper effluent from 1980 to 1992 discharged by the cities' publicly owned treatment works (POTWs). Except for some peaks in 1988, all three plots show a decreasing trend with a reduction in copper discharge after 1986,
when the local control authority (LCA) was established. The effects from state/federal regulations were minimal because the NPDES permit limits appeared only after 1990. Table 4.1 containing annual averages of these three wastewater treatment works also shows decreases in discharge after 1986.

Columbus Jackson Pike

Figure 4.1 Copper monthly effluent plots, 1980 – 1992
Figure 4.1 (continued)

Columbus Southerly

Lima

Date

Unit = ug/l
<table>
<thead>
<tr>
<th>Year</th>
<th>Jackson Pike</th>
<th>Southerly</th>
<th>Lima</th>
</tr>
</thead>
<tbody>
<tr>
<td>1981</td>
<td>13.37</td>
<td>10.53</td>
<td>11.58</td>
</tr>
<tr>
<td>1982</td>
<td>10.58</td>
<td>9.00</td>
<td>8.00</td>
</tr>
<tr>
<td>1983</td>
<td>22.08</td>
<td>17.58</td>
<td>9.08</td>
</tr>
<tr>
<td>1984</td>
<td>6.81</td>
<td>11.07</td>
<td>9.58</td>
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<tr>
<td>1985</td>
<td>6.19</td>
<td>4.75</td>
<td>7.67</td>
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<td>8.40</td>
<td>7.55</td>
<td>4.17</td>
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<td>6.40</td>
<td>4.92</td>
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<td>5.17</td>
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<td>1989</td>
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<td>1991</td>
<td>4.34</td>
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<td>3.58</td>
</tr>
<tr>
<td>1992</td>
<td>5.55</td>
<td>2.60</td>
<td>4.33</td>
</tr>
</tbody>
</table>

Note: observations are in 30-day concentration

Table 4.1 Copper Annual Averages, 1980-1992

To more precisely assess the differences before and after establishing the local control authority (LCA), a simple transfer function model with a policy intervention variable is used to estimate the effect of establishing the LCA for each community’s time series data (refer to Equation 1, page 108). Columbus data are aggregated by using the data from the Jackson Pike and Southerly wastewater treatment plants. Simple regressions provide a poorer fit than transfer function models when cross-sectional and time-series effects are present. A simple transfer function model differs from a regression model in that 1) the independent variable is first modeled with an appropriate time series model fitted to explain its residual term; 2) a regression model for the dependent variable is then
estimated by including the independent variable with an appropriate error process; and 3) the variability in the forecasts of the independent variables is incorporated into forecasts of the dependent variable. In other words, a transfer function model is particularly suited for developing a model with longitudinal data.

Table 4.1 is a summary of the statistical results. Monthly data are used because of their consistency and then aggregated and interpolated into annual data for later analysis. A Durbin-Watson test was first performed on the monthly data to identify autocorrelation of the data. Several other tests were also performed. These tests are used to examine if the data present nonstationarity, a relationship between current time series data values and the time series data values of prior periods, or a the relationship between current time series data values and the random errors of previous time periods. Standard identification methods used include diagnosing plots of autocorrelation function, plots of partial autocorrelation function, and plots of inverse autocorrelation function (Hanke and Reitsch, 1986; Pindyck and Rubinfeld, 1991; SAS, 1991).

Data differencing, autocorrelation, moving average, and/or ARIMA models were used to fit and estimate the error process for the time series data. To study the effect of the establishment of the LCA in 1986, simple transfer function models were then used to model the policy intervention (dummy variable, \( X_t \); \( X_t = 0 \), when \( t:1980 \sim 1985 \); \( X_t = 1 \),
when $t$: 1986 $\sim$ 1992). Copper was chosen as the main indicator of water quality because it is a mandated indicator in both cities' ordinance and is a commonly occurring parameter in both cities' major industries (i.e., metal finishing). Before the establishment of the local control authority, local governments did not have established control mechanisms to regulate, monitor, or enforce industrial polluters. This study assumes that these authorities are critical to the improvement of water quality. The statistical significance of the dummy variable supports the claim that the establishment of local control authority did have a positive effect on water quality.

The equations below are the models estimated for Columbus and Lima. The numbers in parentheses are the t-statistics for each of the parameters that signify them being different from zero at 10% level of significance.

**Equation 5**

**Columbus:**

$$Y_{ct} = 13.11 - 5.25 X_{ct} + 0.39 Y_{ct-1} + \varepsilon_{ct}$$

(-2.98) (5.24)

**Equation 6**

**Lima:**

$$Y_{lt} = 14.28 - 4.2 X_{lt} + 0.15 Y_{lt-1} + \varepsilon_{lt}$$

(-3.84) (1.85)

---

$^{51}$Interpolation is performed on missing values. Missing values from Columbus are monthly averages in August 1985 and December 1985.
Where

\( Y_{ct}, \dot{Y}_{lt} \) denote monthly Copper discharge; \( t \) is time, \( t: 01/80 \sim 12/92 \)

\( X_{ct}, \dot{X}_{lt} \) denote the establishment of LCA (\( X_t = 0 \), when \( t: 01/80 \sim 12/85 \); \( X_t = 1 \), when \( t: 01/86 \sim 12/92 \))

\( \varepsilon_{ct}, \varepsilon_{lt} \) are random error terms

\( c \) Columbus

\( l \) Lima

<table>
<thead>
<tr>
<th>Time Series Models of Error Process for Cu, (( t, 01/80 \sim 12/92 ))</th>
<th>Test of Significance (T&gt;= 1.66, ( \alpha = .1 ), two-tailed test)</th>
<th>Simple Transfer Function Models, ( X_t ), (T&gt;= 1.66, ( \alpha = .1 ) two-tailed test)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Columbus</td>
<td>AR(1)</td>
<td>Lag (1), T: 5.24</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Significance: Yes</td>
</tr>
<tr>
<td>Lima</td>
<td>AR(1)</td>
<td>Lag (1), T: 1.85</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Significance: Yes</td>
</tr>
</tbody>
</table>

Table 4.2 Statistical Summary: the Effect of LCA on Water Quality

Equations 5 and 6 (p. 146) are interrupted time series analysis. The statistical interest of these equations is to test the significance of the establishment of the local control
authority (i.e., variables, $X_{ct}$ and $X_{lt}$). Using 1986 as a discrete break in the time series is to see if there is a significant difference in copper discharges ($Y_{ct}$ and $Y_{lt}$) before and after the establishment of the local control authorities. The test results show that both $X_{ct}$ and $X_{lt}$ are statistically significant, which means that the copper discharges before 1986 are statistically different from the copper discharges after 1986 in both equations. The negative coefficients of $X_{ct}$ and $X_{lt}$ indicate a negative relationship between the local authority variables and the copper discharges ($Y_{ct}$ and $Y_{lt}$), that is, after 1986 ($X_{ct}$=1 and $X_{lt}$=1), the copper discharges decrease.

In addition, the significance of the $Y_{ct-1}$ and $Y_{lt-1}$ indicates time-related errors in both the time series data. After incorporating $Y_{ct-1}$ and $Y_{lt-1}$ into the models, the errors ($E_{ct}$ and $E_{lt}$) are no longer related to the dependent variables ($Y_{ct}$ and $Y_{lt}$), so these equations are better fitted. The statistical significance of $Y_{ct-1}$ and $Y_{lt-1}$, (which is the copper discharge lagged one month) shows relationships between the current copper discharge ($Y_{ct}$ and $Y_{lt}$) and previous discharges ($Y_{ct-1}$ and $Y_{lt-1}$). The positive coefficients of the $Y_{ct-1}$ and $Y_{lt-1}$ indicate a positive relationship between the discharges one-month ago and the current discharges ($Y_{ct}$ and $Y_{lt}$).

The time series data in Columbus and Lima are modeled separately in order to estimate the cities’ individual changes in copper decreases after local control authorities are in place. The Columbus equation shows that after the establishment of the LCA, the
The copper discharge was 5.25 units lower than before. The Lima equation shows that after the establishment of the LCA, the copper discharge was 4.2 units lower than before. The results of both equations support the assumption that the establishment of LCAs has positive impacts on copper discharge improvement.

The interview with the pretreatment program supervisor at the state agency provided further support to these findings. He indicated that in the last ten years there were dramatic drops in metal discharges, due to the establishment of local pretreatment programs. There were about 99 POTWs with approved city programs (about 80-85% of all POTWs in the state), except for small townships that did not have sufficient scales. Most metal discharges have greatly improved and would have minimal future reduction (Interview, April 16, 1996, OEPA).

A review of municipal water pollution control policy can provide more explanations for the differences between copper discharges before and after the establishment of the LCA. Before the LCA was established, although the local government provided treatment services to wastewater, the amount and types of industrial discharges to the publicly owned wastewater treatment works were not clear to the local government. No monitoring or enforcement tools were available to the local government. Major responsibilities of the LCA included: 1) ensuring policy outcomes to meet/exceed federal/state standards and provide for local needs, 2) identifying policy targets and target

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groups by determining the industrial polluters and assessing the amount and the types of these industrial discharges, 3) establishing local policy goals by defining local water quality standards and acceptable/unacceptable policy behaviors, and 4) establishing liability and sanctions for undesirable policy behaviors by developing water pollution control regulations and programs.

The first hypothesis of this study postulates that the establishment of the local control authority (LCA) contributes to the improvement of the water quality. The construction of Equations 5 and 6 (refer to page 146) signifies the effect of the increased local government’s involvement, and the test results provide support for this hypothesis. That is, the establishment of the LCA provides positive impact on water quality. However, the local government’s responsibilities in design, implementation, and enforcement of water pollution control required significant amounts of engineering, financial, and legal support. This study further suggests that for the local government to be able to successfully provide these engineering, financial and legal supports, local contextual capacity must be considered as a crucial determinant.
4.2 Identify the effects of contextual capacity

The second task of data analysis was to identify the effect of contextual capacity. Contextual capacity is operationalized to measure the strength of local economy and to determine the resource dependency of the LCA.\textsuperscript{52}

Measuring the Strength of Local Economy

The strength of the local economy was then further identified by economic diversity and socioeconomic variables.

Economy Diversity

The diversity of a local economy is operationalized by using a diversity index. This study adopted the method used in Gray and Lowery's studies (1992 and 1996), a Herfindahl-type index of group concentration to develop its diversity index. The formula was modified based on studies of Gray and Lowery (1992 and 1996).

\[ \sum \left( \frac{p_i}{N} \right)^2 \]

where
\[ i \]: individual category (under the classification of Code of Federal Register)
\[ n \]: number of significant industry users (SIU) in category \( i \)
\[ N \]: total number of SIUs

This index is sensitive to classification error when the numbers of Significant Industrial Users (SIUs) are very small. In addition, an assumption made in applying this formula is that if a firm is classified in more than one Code of Federal Register (CFR) categories (say two), it would be counted as two entities in the number of Significant Industrial Users. The assumption is that the firm would act as an individual interest seeker in either classification.

Categorical industries are industries whose pollutant discharge limits are determined by the United States Environmental Protection Agency (USEPA). All categorical industries are considered as Significant Industrial Users. The industrial categories specified by Federal effluent guidelines and standards for categorical industrial users were expanded from 42 categories in 1980 to 51 categories in 1995.53 The following table provides information on the types and the diversity of the cities’ economies by using categories specified by Code of Federal Register, number of categorical industry, and the cities’ diversity index scores from 1986 to 1995. A perfect concentration (or no diversity) would have an index value of 1. Diversity is thus measured inversely by this index, i.e., the smaller the values of the index, the greater the economic diversity.

### Table 4.3 Diversity Index

Some conclusions can be drawn from Table 4.2. There is an increase in industrial categories in Columbus, while Lima remains dominated by one industry. Furthermore, Columbus maintained a greater number of categorical industrial users over the years, while the number in Lima remained constant and small. In sum, the analysis shows that Columbus' economy is diverse and Lima's economy rests primarily on one type of industry. This analysis indicates that Lima is more prone to be captured by industry, due to lack of diversity. The industry capture explanations might provide some support to the 1992 OEPA study\textsuperscript{54} that Lima's water quality was improved over time, but still was in need of further improvement.
Profile of the Local Economy

The following table provides information on the number of the categorical Significant Industrial Users (SIUs) as a percentage of the total number of SIUs in both cities. This analysis gives information on the major types of polluters in the cities’ economies. First, the categorical SIUs as a percentage of total SIUs is different in the two cities.

<table>
<thead>
<tr>
<th>Year</th>
<th>Columbus</th>
<th>Lima</th>
</tr>
</thead>
<tbody>
<tr>
<td>1989</td>
<td>0.47</td>
<td>0.88</td>
</tr>
<tr>
<td>1990</td>
<td>0.54</td>
<td>0.75</td>
</tr>
<tr>
<td>1991</td>
<td>0.48</td>
<td>0.75</td>
</tr>
<tr>
<td>1992</td>
<td>0.63</td>
<td>0.86</td>
</tr>
<tr>
<td>1993</td>
<td>0.73</td>
<td>0.86</td>
</tr>
<tr>
<td>1994</td>
<td>0.58</td>
<td>0.86</td>
</tr>
<tr>
<td>1995</td>
<td>0.67</td>
<td>0.86</td>
</tr>
</tbody>
</table>

Table 4.4 Categorical SIUs as Percentage of Total SIUs

The table above shows that categorical industries make up 47% ~ 73% of SIUs in Columbus, and 75% ~ 88% in Lima. Thus, a considerable portion of Columbus’ SIUs is made up of non-categorical SIUs that are not significantly contributing industrial pollutants, but are significantly contributing to the amount of discharge. The City’s 1984 survey showed that Columbus had a diverse and service based economy (Burgess &

51 Refer to the confirming case sampling strategy used in this study. The Ohio water resource monitoring
Niple, Limited, 1984). The findings here indicate that at least 27% of the Columbus industries' pollutants are not significant in federal categories.

Moreover, among these major categorical industries, the characteristics of these industries also differ. The major categorical industry in both cities is the metal finishing industry (40 CFR 433). This industry comprised up to 50% of categorical industrial users in Columbus over the study period, and the number of this industry has decreased in 1995. However, metal finishing industries are the only categorical users that discharge into Lima's publicly owned wastewater treatment work (Table 4.5). The above analysis shows that there were variations (e.g., a decrease in number of firms) in Columbus' major industry, while there were no variations in Lima's from 1986 to 1995.

<table>
<thead>
<tr>
<th>Year</th>
<th>Columbus</th>
<th>Lima</th>
</tr>
</thead>
<tbody>
<tr>
<td>1986</td>
<td>0.42</td>
<td>1.00</td>
</tr>
<tr>
<td>1988</td>
<td>0.49</td>
<td>1.00</td>
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<tr>
<td>1989</td>
<td>0.50</td>
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<tr>
<td>1992</td>
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<tr>
<td>1995</td>
<td>0.31</td>
<td>1.00</td>
</tr>
</tbody>
</table>

Table 4.5 Metal Finishing as Percentage of Total SIU

effort conducted by the OEPA showed that Ottawa River remained gross fish anomalies (OEPA, 1992).
Other major categorical industries in Columbus include electroplating, comprising 10% ~ 26%, and organic chemicals, plastics, and synthetic fibers manufacturing, comprising 13% ~ 17% (Table 4.5). The electroplating companies as a percentage of the total number of categorical industries decreased from 26% to 13% over time. Electroplating used to be a major industry and had the largest number of firms, followed by the metal finishing industry, in the early 1980s (Burgess & Niple, Limited, 1984). However, metal finishing had become the major industry containing the largest number of firms during the survey time period of this study, and also showed a decrease in number of firms in 1995. Table 4.5 also shows that a new category, organic chemicals firms, started to appear in Columbus's regulation list in 1992.

This analysis concluded that there was a fair amount of change in the major types of Columbus industries. In Columbus, there was a fairly consistent trend of a decrease in the number of firms in a major industrial category over time. One of the Columbus government officials suggested that some Columbus industries dropped out, due to their inability to comply with local limits; however, there was little concern about these drop outs because of the continuing growth and level of competition of the market (Interview, March 18, 1996). These findings are in agreement with Olson and others' theory that strong socioeconomic conditions have a positive effect on the diversity of interest group system. In addition, a diverse economic structure is less likely to be dominated by a
particular group due to group competition and diversity (Olson, 1971 and 1982; Morehouse, 1981; Thomas and Hrebenar, 1990; and Gray and Lowery, 1996).

<table>
<thead>
<tr>
<th>Year</th>
<th>Organic chemicals, plastics, and synthetic fibers manufacturing</th>
<th>Electroplating</th>
</tr>
</thead>
<tbody>
<tr>
<td>1986</td>
<td>-</td>
<td>0.26</td>
</tr>
<tr>
<td>1988</td>
<td>-</td>
<td>0.22</td>
</tr>
<tr>
<td>1989</td>
<td>-</td>
<td>0.23</td>
</tr>
<tr>
<td>1992</td>
<td>0.17</td>
<td>0.10</td>
</tr>
<tr>
<td>1993</td>
<td>0.13</td>
<td>0.10</td>
</tr>
<tr>
<td>1994</td>
<td>0.13</td>
<td>0.11</td>
</tr>
<tr>
<td>1995</td>
<td>0.14</td>
<td>0.13</td>
</tr>
</tbody>
</table>

Table 4.6 Major Industries as Percentage of Total SIUs in Columbus, 1986 ~ 1995

Socioeconomic Capacity

Socioeconomic variables are used to indicate the strength of the local economy. These variables include total personal income (TPI), per capita personal income (PPI), per capita income percent of national average (PP), and population (POP). The information was collected longitudinally from 1980 to 1993.

Although total personal income is a product of per capita personal income and population, total personal income is used as a socioeconomic variable in addition to its
multipliers. Per capita personal income or population alone may not sufficiently represent the wealth of a local community. For example, a large city with low per capital income can be as financially unable to afford public programs that require large capitals as a small city with high per capita personal income.

Figure 4.2 Total Personal Income in Columbus (CTPI) and Lima (LTPI), 1980 ~ 1993

The graph above shows that Columbus has had a steady increase in total personal income at a rate of $1.4 billion per year, while Lima has had a rather minor rate of $110 million per year. The difference of total personal income between the two cities is due to the increases in per capita income (PPI) and population (POP), as illustrated below.
Figure 4.3 Per Capita Personal Income in Columbus and Lima, 1980 – 1993

Although both cities have a similar range of per capita income, Columbus has had a rate of increase of $873 per year, while Lima has had a rate of increase of $695 per year. Columbus’ per capita personal income (PPI) in 1993 is 116% increase over the PPI of 1980; the PPI for Lima increased 95% over 1980. In addition to per capita personal income, population growth in both cities is also different (see chart below). Columbus increased at the rate of 15,124 persons per year, while Lima increased at the rate of 212 persons per year. Also, there was a drop in Lima’s population in early 80’s.\(^{55}\)

\(^{55}\) The scale of the chart (Figure 4.3) was not sensitive to show the decrease in Lima’s population in early 80’s.
Figure 4.4 Population in Columbus and Lima, 1980 ~ 1993

Measuring Agency’s Resource Dependency

The second construct of contextual capacity is measured by agencies’ resource-dependency. The variables include the measures of financing ability and inclusiveness of the authority of the LCA.

Financing Ability

Financing ability is further identified by Moody’s bond rating (MBR), total sewerage capital costs (TCC), total wastewater treatment costs (TWC), local sewerage capital costs (LCC), and local wastewater treatment costs (LWC). The cost variables listed above are
in 1993 dollars, and are standardized by using the Construction Cost Index (Lufkin and Pepitone, 1994). These variables (except Moody's bond rating) are tested by using time series data from 1980 to 1993. The data for MBR was obtained from 1985 to 1993 and then transformed from ordinal into interval scales before testing.

The following chart indicates that there were increases of sewerage capital spending after 1986 in Lima.

![Lima Total Sewerage Capital Costs](chart)

Figure 4.5 Lima Total Sewerage Capital Costs

The following chart indicates that there were increases of sewerage capital spending in Columbus after 1986 and a drop in 1993.
Figure 4.6 Columbus Total Sewerage Capital Costs, 1980 ~ 1993

Both charts above indicate that the spending on sewerage capital projects increased after 1986. There is strong indication that capital spending including sewer construction, expansion, and other sewer-related spending increased after 1986 for both cities. From the graph above, the increased spending in the sewerage capital projects seemed to jump after the establishment of LCA. The decrease in Columbus in 1993 is due to the funding changes from grants to State Revolving Loan Funds (SRFs). The data of SRFs was not available at the time of this survey.

To examine the effect of contextual capacity on water quality, financing ability variables were tested individually for their ability to explain water quality improvement
in Copper (Cu). Correlation analysis among variables was first performed on two sets of data including measures from the two cities within the time frame from 1980 to 1992 (Table 4.7). Columbus coefficients range from −0.46 to −0.69; Lima coefficients range from −0.42 to −0.66 (except 0.15 for PP). Coefficients among contextual capacity variables and copper emissions for both cities consistently indicate some negative correlation among these variables, except for the percentage of national average of per capita personal income (PP). The invariability of data in a percentage format for PP might have contributed to the insignificant result for Lima.

---

56 Copper is one of the two locally regulated parameters for allowable pollution (i.e., Copper and Lead) that is more stringent than the federal regulation in Lima, and is one of the seven common locally regulated parameters for POTWs. Time series model is recommended to test the improvement for each of the seven parameters if time and data are not limited.
\[
\begin{array}{l|c|c}
\text{Pearson Correlation Coefficient} & \text{Columbus} & \text{Lima} \\
\hline
\text{Copper Emissions (Yt)} & 1 & 1 \\
\text{Total Personal Income (TPI)} & -0.69 & -0.66 \\
\text{Per Capita Personal Income (PPI)} & -0.68 & -0.66 \\
\text{Population (POP)} & -0.68 & -0.54 \\
\text{Percentage of National Average Per Capita Personal Income (PP)} & -0.48 & 0.15 \\
\text{Local Wastewater Treatment Costs (LWC)} & -0.49 & -0.42 \\
\text{Local Sewerage Capital Costs (LCC)} & -0.58 & -0.48 \\
\text{Total Wastewater Treatment Costs (TWC)} & -0.46 & -0.42 \\
\text{Total Sewerage Capital Costs (TCC)} & -0.55 & -0.48 \\
\end{array}
\]

Table 4.7 Correlation Analysis of Variables of Contextual Capacity and Water Quality

Copper emissions, socioeconomic and financing ability data were pooled in a panel data format for both cities from 1980 to 1992. Cross-sectional differences and time-series errors are often confounded in panel data. Time series models with sectional dummy variables were performed on these variables to delineate possible cross-sectional and time-series effects.
The equations that are associated with each of the contextual capacity variables and municipalities are as follows. The numbers in parentheses beneath the coefficients are the \( t \) statistics that signify all parameters being different from zero at a 10\% significance level. Dependent variables at the left hand side, such as, \( Y \), denote copper emission; \( t \) denotes time. The variables at the right hand side of the equations, such as total personal income (\( TPI_i \)) are explanatory variables by time. \( \epsilon \) is random error for time lag. Sectional variables, \( CITY \), are dummy variables for identifying possible size effects.

**Equation 7**

\[
Y_t = 89.3 + 156.08CITY_t - 0.00000078TPI_t + \epsilon_t
\]

\[
(7.948) \quad (4.084) \quad (-3.807)
\]

\( n = 26 \)

\( r^2 = 0.42 \)

\( T > |1.714| \), two-tailed test

Where

- \( Y_t \) denotes annual Copper discharge\(^{57} \); \( t \): 1980 ~ 1992
- \( CITY_t \) sectional dummy variable; \( CITY_t=1 \), Columbus; \( CITY_t=0 \), Lima;
- \( TPI_t \) Total personal income
- \( \epsilon_t \) random error

---

\(^{57}\) The annual discharge is a sum of monthly 30-day concentration over a 12 month period. The unit for annual discharge is a micron gram per 12-liter.
**Equation 8**

\[ Y_t = 206.64 + 37.61CITY_t - 0.010143PPI_t + \varepsilon_t \]

(6.323)  (2.587)  (-4.278)

\[ n=26 \]

\[ r^2=0.47 \]

\[ T>=|1.714|, \text{two-tailed test} \]

**Where**

- \( Y_t \): same as above
- \( CITY_t \): same as above
- \( PPI_t \): Per capita personal income
- \( \varepsilon_t \): random error

**Equation 9**

\[ Y_t = 178.67 + 800.02CITY_t - 0.000685POP_t + \varepsilon_t \]

(5.686)  (3.652)  (-3.561)

\[ n=26 \]

\[ r^2=0.39 \]

\[ T>=|1.714|, \text{two-tailed test} \]

**Where**

- \( Y_t \): same as above
- \( CITY_t \): same as above
- \( POP_t \): Population
- \( \varepsilon_t \): random error
\textbf{Equation 10}

\begin{align*}
Y_t &= 69.66 + 49.43CITY_t - 0.000000661LWC_{t-2} + \varepsilon_t \\
&\quad (5.169) \quad (2.000) \quad (-1.886)
\end{align*}

n=22  
\(r^2=0.20\)  
T\(\geq|1.729|\), two-tailed test

\begin{itemize}
  \item \(Y_t\) \quad same as above
  \item \(CITY_t\) \quad same as above
  \item \(LWC_{t-2}\) \quad Local wastewater treatment costs, \(t-2\): time lagged 2 years
  \item \(\varepsilon_t\) \quad random error
\end{itemize}

\textbf{Equation 11}

\begin{align*}
Y_t &= 69.73 + 51.81CITY_t - 0.000000677LCC_{t-2} + \varepsilon_t \\
&\quad (5.196) \quad (2.057) \quad (-1.935)
\end{align*}

n=22  
\(r^2=0.20\)  
T\(\geq|1.729|\), two-tailed test

\begin{itemize}
  \item \(Y_t\) \quad same as above
  \item \(CITY_t\) \quad same as above
  \item \(LCC_{t-2}\) \quad Local sewerage capital costs, \(t-2\): time lagged 2 years
  \item \(\varepsilon_t\) \quad random error
\end{itemize}
Equation 12

\[
Y_t = 69.69 + 62.72CITY_t - 0.000000723TWC_{t-2} + \varepsilon_t
\]

\[
\begin{array}{c}
(5.341) \\
(2.362) \\
(-2.251)
\end{array}
\]

\[n=22\]
\[r^2=0.25\]
\[T>|1.729|, \text{ two-tailed test}\]

\[Y_t\] same as above
\[CITY_t\] same as above
\[TWC_{t-2}\] Total wastewater treatment costs, \(t-2\): time lagged 2 years
\[\varepsilon_t\] random error

Equation 13

\[
Y_t = 69.75 + 64.05CITY_t - 0.000000703TCC_{t-2} + \varepsilon_t
\]

\[
\begin{array}{c}
(5.329) \\
(2.350) \\
(-2.215)
\end{array}
\]

\[n=22\]
\[r^2=0.24\]
\[T>|1.729|, \text{ two-tailed test}\]

\[Y_t\] same as above
\[CITY_t\] same as above
\[TCC_{t-2}\] Total wastewater treatment costs, \(t-2\): time lagged 2 years
\[\varepsilon_t\] random error

Of statistical interest in Equation 7 (p. 165) is the ability to test if there is a relationship between total personal income \((TPI_i)\) and copper discharges \((Y_t)\). The statistical significance of \(TPI_i\) shows that there is a relationship between \(TPI_i\) and \(Y_t\). The negative coefficient of \(TPI_i\) indicates the relationship is negative, that is, the increase of
total personal income is related to the decrease of copper discharges. In addition, the test result shows statistical significance of \( CITY_i \). This means there is a relationship between city size and copper discharge. The positive coefficient of \( CITY_i \) indicates that size is positively related to copper discharges. Columbus, which is larger in scale, would have more copper discharge.

The same explanation can be drawn from Equation 8 and Equation 9, (p. 166). The regression results show statistical significance of per capita personal income (PPI) and population (POP), and indicate PPI and POP are negatively related to copper discharges. \( r^2 \) of Equations 7 to 9 range from 39% to 47%. All equations tested statistically significant in the effect of city size.

Equations 10 to 13 (pages 167 to 168) provide an opportunity to test for the relationship between financial variables and copper discharges. Total sewerage capital costs (TCC), local sewerage capital costs (LCC), total wastewater treatment costs (TWC), and local wastewater treatment costs (LWC) were found to have 2-year lagged relationship with copper emission. The negative coefficients of \( TCC_{t-2}, LCC_{t-2}, TWC_{t-2} \) and \( LWC_{t-2} \) indicate that a negative relationship exits between the financial data that occurred 2 years previously and the current copper emissions. The increase in \( TCC_{t-2}, LCC_{t-2}, TWC_{t-2} \) and \( LWC_{t-2} \) are related to the decrease in current copper discharges. The
of Equations 10 to 13 range from 20% to 25%. A positive size effect on copper emission is also apparent in each of these equations.

In sum, the increases in total personal income (TPI), per capita personal income (PPI), population (POP), total and local capital spending on sewerage two years ago (TCC_{t-2} and LCC_{t-2}), and total and local wastewater treatment spending two years ago (TWC_{t-2} and LWC_{t-2}) are related to the reduction of current year Copper emission (Y_t). These contextual capacity variables are modeled individually in order to isolate possible collinearity among the independent variables, and because of the limited number of observations.

These findings support the theoretical assumptions of this study. The increase in the magnitude of the socioeconomic variables indicates the increase in the city’s contextual capacity to provide higher water quality (i.e., the decrease of copper emission). These findings are in agreement with urban politics literature that the profiles of the cities appear to affect a city’s capability to develop policy and provide public services (Zisk, 1973; Schultze, 1985; and Waste, 1989).

The increase in the magnitude of the financial variables indicates the increase in the city’s contextual capacity to control water pollution and to support related sewer infrastructure. Financial variables are divided into two different categories. One
category provides the difference between total and local costs. The other category provides the difference between sewerage capital costs and wastewater treatment costs. Under the new trend of federal initiatives, there are increases in the amount of locally generated financial support. The first category, composed of local wastewater treatment costs (i.e., Equation 10, p. 167) and local sewerage capital costs (i.e., Equation 11, p.167) is used to identify a local community's self-financing ability. The results of both equations indicate that the reductions of copper emissions are related to the increase of local self-financing ability.

The second category, sewerage capital costs and wastewater treatment costs, is used to indicate a local community’s financial ability and willingness to pay for sewerage capital projects. There is a difference between sewerage capital costs and wastewater treatment costs in terms of how the money is spent. It is likely that the effects resulting from these two costs on the improvement of water quality are different. Wastewater treatment plants are mainly equipped for domestic wastewater; metal discharges, if harmful, should be pretreated before discharging into the POTWs. Therefore, the money spent on wastewater treatment might not directly associate with the reduction in copper emission. Total sewerage capital costs include all capital spending in sewer funds, which include pretreatment, combined sewer overflow, management and planning, office equipment, computers, and so on. The analytical results on the wastewater treatment costs (i.e., Equation 12, p.168) and sewerage capital costs (i.e., Equation 13, p.168) were
found significantly related to the improvement of water quality. It can be concluded that capital improvement in overall sewerage systems and the direct spending on wastewater treatment are both associated with the reduction of copper discharge.

The above findings, from Equation 10 to Equation 13 (pp. 167-168), are supportive of the study's resource independence hypotheses. That is, the ability of the local government to acquire resources and the local government's willingness to pay for related wastewater programs contribute to the improvements of water quality.

Under the new trend of federal initiatives, one would expect to see increased local funding in the sum of the total resources spent on water pollution control. The amount of the federal assistance in the total resources was expected to decrease. The following correlation analysis was performed to examine the relationships between the local funding and the cost variables. The results of the Pearson Correlation suggest that there is a strong interdependency between local and total spending. The correlation coefficient ranges from .99 to 1 indicating strong positive correlation between the two sets of variables. The results are summarized in Table 4.8. The results indicate that the increase in local funding is highly related to the increase in total funding.
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>TCC and LCC</td>
<td>0.99</td>
<td>1</td>
</tr>
<tr>
<td>TWC and LWC</td>
<td>0.99</td>
<td>1</td>
</tr>
</tbody>
</table>

**Table 4.8 Correlation Between Total and Local Funds of Sewer Capital Costs and Wastewater Treatment Costs**

Correlation analysis was also performed on total capital cost (TCC) and Federal sewerage capital costs (FCC) and Total wastewater treatment costs (TWC) and Federal wastewater treatment costs (FWC). The results show that there are lesser degrees of correlation between the total costs and federal costs in both cases, as compared to the correlation between the total costs and local costs in the previous analysis (Table 4.8). The Pearson Correlation Coefficients in Table 4.9 are 0.51 and 0.50 for Columbus, and are −0.38 and −0.29 for Lima. The results suggest that the interdependency of federal and total funding is less strong. In the case of Lima, there is a negative correlation, i.e., the increase in total funding is related to the decrease in federal funding.
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>TCC and FCC</td>
<td>TWC and FWC</td>
</tr>
<tr>
<td>Pearson</td>
<td>0.52</td>
<td>0.50</td>
</tr>
<tr>
<td>Correlation</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 4.9 Correlation Between Total and Federal Funds of Sewer Capital Costs and Wastewater Treatment Costs

The findings suggest that the amount of local funding is strongly correlated with the total amount of funding, and that the increase in the total amount of funding is related to the increase in the amount of local funding. However, the relationship between the amount of federal funding and the total amount of funding is less evident. In sum, these results are in agreement with this study’s assumption that local resource independence is positively related to the local government’s ability to attract funding for the support of wastewater treatment. Columbus showed a consistent pattern in an increase in both local and federal funding as well as the increase in total spending, while Lima did not. This finding supports the assumption that federal funding is more limited in smaller communities, and the financial burden for these communities are relatively higher than the larger communities (Okaru, 1994).
To further explain this finding, the following graphs present the relative portion of federal funds compared to local funds on sewer capital projects. Although federal funding is a proportionally small part of total funding, particularly as compared to local funds, Columbus has a steady stream of assistance from federal government throughout the time period under study. Being the capital city of the state, Columbus also has political assets to aid in attracting available resources. On the other hand, Lima's federal grants were awarded in the 70's and completed in 1983. After 1983, local funds became the only source of financial support for Lima, since federal grants authorized by the 1981 Amendment were absent. These analyses show that the ability to raise funds locally and attract potential investors is critical in sewer financing for both cities. In addition, acquiring financial resources might be more difficult for Lima. The absence of federal funding after 1983 for Lima is consistent with Okaru (1994) and others' (William Mitchell Law Review, 1984) findings that federal financial assistance tends to favor larger municipalities in wastewater treatment capital projects.
Figure 4.7 Columbus Funding Sources, 1980 ~ 1993

Figure 4.8 Lima Funding Sources, 1980 ~ 1993

58 No federal funds were available after 1983; the smallest value for local funds before 1986 is $6,426.
Measuring Inclusiveness of Local Control

The other indicator of an agency's resource independence is the amount of inclusiveness of its local control. This is analyzed by using the allowable concentration and/or loading of parameters that are specified in the NPDES permit limits. The inclusiveness of the local control is measured by the proportion of the community's allowable discharge that is under the control of the local government. The greater the control of the allowable discharge the local government has, the greater is the inclusiveness of the local control. The selection of parameters is based on the representation, commonality, and data availability of the major industries and POTWs.

The inclusiveness of the local control is analyzed in order to determine the amount of a community's industry discharges that are significant but are not regulated by the local control authority. Although more inclusion of discharges under the authority of an LCA will place more responsibility on the local government in regulating industry and in treating wastewater, it also indicates the amount of control of the local government over its water resources. Without control authority over polluters, the local government is dependent on the polluters' self policing efforts or the state/federal authorities to monitor and enforce any undesirable behavior.

The following tables summarize the inclusiveness of local control over the three most common conventional parameters, biochemical oxygen demand (BOD$_5$), total suspended solids (TSS), and ammonia nitrate (NH$_3$-N).
<table>
<thead>
<tr>
<th>Year</th>
<th>BOD5 (mg/l) Columbus</th>
<th>TSS (mg/l) Columbus</th>
<th>NH3-N (mg/l) Columbus</th>
<th>BOD5 (mg/l) Lima</th>
<th>TSS (mg/l) Lima</th>
<th>NH3-N (mg/l) Lima</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total</td>
<td>LC</td>
<td>Total</td>
<td>LC</td>
<td>Total</td>
<td>LC</td>
</tr>
<tr>
<td>1980</td>
<td>22.67</td>
<td>88%</td>
<td>9.50</td>
<td>47%</td>
<td>37.67</td>
<td>73%</td>
</tr>
<tr>
<td>1981</td>
<td>22.67</td>
<td>88%</td>
<td>9.50</td>
<td>47%</td>
<td>37.67</td>
<td>73%</td>
</tr>
<tr>
<td>1982</td>
<td>22.67</td>
<td>88%</td>
<td>9.50</td>
<td>47%</td>
<td>30.00</td>
<td>67%</td>
</tr>
<tr>
<td>1983</td>
<td>22.67</td>
<td>88%</td>
<td>9.50</td>
<td>47%</td>
<td>30.00</td>
<td>67%</td>
</tr>
<tr>
<td>1984</td>
<td>22.67</td>
<td>88%</td>
<td>9.50</td>
<td>47%</td>
<td>30.00</td>
<td>67%</td>
</tr>
<tr>
<td>1985</td>
<td>22.67</td>
<td>88%</td>
<td>9.50</td>
<td>47%</td>
<td>30.00</td>
<td>67%</td>
</tr>
<tr>
<td>1986</td>
<td>30.00</td>
<td>100%</td>
<td>9.50</td>
<td>47%</td>
<td>30.00</td>
<td>100%</td>
</tr>
<tr>
<td>1987</td>
<td>.</td>
<td>9.50</td>
<td>47%</td>
<td>30.00</td>
<td>100%</td>
<td>22</td>
</tr>
<tr>
<td>1988</td>
<td>.</td>
<td>9.50</td>
<td>47%</td>
<td>30.00</td>
<td>100%</td>
<td>22</td>
</tr>
<tr>
<td>1989</td>
<td>.</td>
<td>9.50</td>
<td>47%</td>
<td>30.00</td>
<td>100%</td>
<td>22</td>
</tr>
<tr>
<td>1990</td>
<td>.</td>
<td>9.50</td>
<td>47%</td>
<td>30.00</td>
<td>100%</td>
<td>22</td>
</tr>
<tr>
<td>1991</td>
<td>.</td>
<td>.</td>
<td>.</td>
<td>30.00</td>
<td>100%</td>
<td>22</td>
</tr>
<tr>
<td>1992</td>
<td>.</td>
<td>.</td>
<td>.</td>
<td>30.00</td>
<td>100%</td>
<td>22</td>
</tr>
</tbody>
</table>

NPDES Limits: 30-day concentration
LC: Local Control as % of Total Control
Unit: milli-gram per liter (mg/l)

---

**Table 4.10 Communities' Allowable Conventional Concentration and Local Control as Percentage of Total Allowable**

Table 4.10 shows local control as a proportion of the community's allowable concentration and amount of the substance that is allowed in the community. Discharges of both cities in this analysis are measured by 30-day concentration. In Columbus, the amount of biochemical oxygen demand (BOD5) allowable concentration changed from

---

59 30-day concentration is an arithmetic average of all the daily concentration made during the 30-day period; while 30-day loading is an arithmetic average of all the daily loading made during the 30-day period.
22.67 to 30 milli-gram per liter after 1985. As a result of the decreases in direct industrial discharges, Columbus’ local control as a percentage of total allowable concentration increased from 88% to 100%. Lima controls 47% of the total allowable concentration in the stream, while the direct industrial dischargers contribute the other 53%. Both municipalities were required to change their monitoring parameter from BOD5 to CBOD in 1988. The absence of BOD5 observations in Columbus after 1987 and in Lima after 1990 was in response to this requirement.

The same type of interpretation can be applied to the data in Table 4.10. The results show that Columbus consistently controlled a larger portion (73% ~ 100%) of its industrial wastewater, while Lima controlled a smaller portion (10%~47%) of its industrial wastewater. In Columbus, the total suspended solids (TSS) allowable were reduced from 37.67 to 30 mg/l while the local control increased from 73% to 100%. In Lima, the amount of Ammonia Nitrate (NH3-N) allowable discharge was reduced from 12.50 to 9.5 mg/l while local control increased from 16% to 21%. In sum, this table shows the local control as a percentage of total control to indicate the inclusiveness of local control over the total amount of industrial wastewater. In Columbus, the local government controlled all of its allowable concentration after the local control authority was established in 1986. In Lima, a greater amount of allowable concentration was not under the local government’s control. However, Lima’s local control as a percentage of total NH3-N increased from 10% to 21% after the local authority was established. In
sum, Columbus has a more inclusive control authority over its industrial discharges than has Lima.

<table>
<thead>
<tr>
<th>Year</th>
<th>BOD5 (kg/d) Columbus</th>
<th>Lima</th>
<th>TSS (kg/d) Columbus</th>
<th>Lima</th>
<th>NH3-N (kg/d) Columbus</th>
<th>Lima</th>
</tr>
</thead>
<tbody>
<tr>
<td>1980</td>
<td>25,565 100% 990</td>
<td>64%</td>
<td>36,468 100% 1,585</td>
<td>62%</td>
<td>650 43%</td>
<td></td>
</tr>
<tr>
<td>1981</td>
<td>25,565 100% 991</td>
<td>64%</td>
<td>36,468 100% 1,585</td>
<td>62%</td>
<td>651 43%</td>
<td></td>
</tr>
<tr>
<td>1982</td>
<td>25,565 100% 991</td>
<td>64%</td>
<td>22,742 100% 1,585</td>
<td>62%</td>
<td>651 43%</td>
<td></td>
</tr>
<tr>
<td>1983</td>
<td>25,565 100% 991</td>
<td>64%</td>
<td>22,742 100% 1,586</td>
<td>62%</td>
<td>651 43%</td>
<td></td>
</tr>
<tr>
<td>1984</td>
<td>25,565 100% 991</td>
<td>64%</td>
<td>22,742 100% 1,585</td>
<td>62%</td>
<td>651 43%</td>
<td></td>
</tr>
<tr>
<td>1985</td>
<td>25,565 100% 1,069</td>
<td>59%</td>
<td>22,742 100% 1,639</td>
<td>60%</td>
<td>844 33%</td>
<td></td>
</tr>
<tr>
<td>1986</td>
<td>25,565 100% 1,069</td>
<td>59%</td>
<td>22,719 100% 1,639</td>
<td>60%</td>
<td>609 46%</td>
<td></td>
</tr>
<tr>
<td>1987</td>
<td>1,069 59% 22,719 100% 1,639 60%</td>
<td>609 46%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1988</td>
<td>1,069 59% 22,719 100% 1,639 60%</td>
<td>3,405 100% 609 46%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1989</td>
<td>1,069 59% 20,428 100% 1,639 60%</td>
<td>3,405 100% 609 46%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1990</td>
<td>1,069 59% 19,754 100% 2,051 48%</td>
<td>3,292 100% 621 45%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1991</td>
<td>359 0% 19,754 100% 2,051 48%</td>
<td>3,292 100% 621 45%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1992</td>
<td>359 0% 23,637 100% 2,051 48%</td>
<td>3,292 100% 621 45%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

NPDES Limits: 30-day loading
LC: Local Control as % of Total Control
Unit: kilo-gram per day (kg/d)

Table 4.11 Communities' Allowable Loading and Local Control as Percentage of Total Allowable

180
Table 4.11 indicates the proportion of the community's allowable loading of substances that is under local control.\(^{60}\) Columbus not only has greater discharging amount, but also controls all of its directly discharged wastewater, while Lima has a smaller discharging amount and controls from 0% to 64%. In addition, Lima has decreasing control over loading for biochemical oxygen demand (BOD\(_5\)) and total suspended solids (TSS) after 1980, and the amount for Ammonia Nitrate (NH\(_3\)-N) has also decreased since 1986.

\(^{60}\) Loading is a product of concentration and flow and factor; it can be denoted as:

\[ \text{Loading} = \text{Concentration (unit)} \times \text{Flow (MGD)} \times \text{Factor} \]
<table>
<thead>
<tr>
<th>Year</th>
<th>Cu (kg/d)</th>
<th>Cr (kg/d)</th>
<th>Pb (kg/d)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Columbus</td>
<td>Lima</td>
<td>Columbus</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>LC</td>
<td>Total</td>
</tr>
<tr>
<td>1980</td>
<td>0.19</td>
<td>0%</td>
<td>4.55</td>
</tr>
<tr>
<td>1981</td>
<td>0.19</td>
<td>0%</td>
<td>4.55</td>
</tr>
<tr>
<td>1982</td>
<td>0.19</td>
<td>0%</td>
<td>4.55</td>
</tr>
<tr>
<td>1983</td>
<td>0.19</td>
<td>0%</td>
<td>4.55</td>
</tr>
<tr>
<td>1984</td>
<td>0.19</td>
<td>0%</td>
<td>4.55</td>
</tr>
<tr>
<td>1985</td>
<td>0.19</td>
<td>0%</td>
<td>6.35</td>
</tr>
<tr>
<td>1986</td>
<td>6.35</td>
<td>0%</td>
<td>.</td>
</tr>
<tr>
<td>1987</td>
<td>6.35</td>
<td>0%</td>
<td>.</td>
</tr>
<tr>
<td>1988</td>
<td>6.35</td>
<td>0%</td>
<td>.</td>
</tr>
<tr>
<td>1990</td>
<td>9.88</td>
<td>100%</td>
<td>1.10</td>
</tr>
<tr>
<td>1991</td>
<td>9.88</td>
<td>100%</td>
<td>1.10</td>
</tr>
<tr>
<td>1992</td>
<td>9.88</td>
<td>100%</td>
<td>1.10</td>
</tr>
</tbody>
</table>

NPDES Limits: 30-day loading
LC: Local Control as % of Total Control
Unit: kilo-gram per day (kg/d)

Table 4.12 Communities’ Allowable Metals Loading and Local Control as Percentage of Total Allowable

Table 4.12 indicates the allowable metals loading and the proportion that is under local control for each community. Both Columbus and Lima gain most of the control of Copper (Cu) and Lead (Pb) loading in the communities, while Columbus has a higher allowable loading. Before 1990, the State did not regulate metal discharge limits for either city’s POTWs. After 1990, in the case of Chromium (Cr), Lima controls 26% ~ 38% of community loading capacity, while Columbus controls all the community’s allowable loading. Similar conclusions also apply to allowable metals concentration,
shown in Table 4.13. The loading of 0.19 kg/d of Cr and 0.38 kg/d of Pb in Columbus before 1985 were contributed by Technegas, which had no emission from the main process outflow after 1985.

Both Table 4.12 and Table 4.13 show that the state did not regulate the final effluents of Cu, Cr, and Pb from publicly owned treatment works until 1990, and the local government was not liable for these discharges before that year. These tables also suggest that the establishment of local control authority, including conducting an industrial wastewater survey, educating the industry about allowable limits, and regulating the industry to pretreat its wastewater (which may contain mostly metal components) is helpful to the state in achieving these operable standards for the final effluence.
<table>
<thead>
<tr>
<th>Year</th>
<th>Cu (ug/l)</th>
<th>Cr (ug/l)</th>
<th>Pb (ug/l)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Columbus</td>
<td>Lima</td>
<td>Columbus</td>
</tr>
<tr>
<td></td>
<td>Total* LC</td>
<td>Total LC</td>
<td>Total LC</td>
</tr>
<tr>
<td>1980</td>
<td>.</td>
<td>.</td>
<td>250.00 0%</td>
</tr>
<tr>
<td>1981</td>
<td>.</td>
<td>.</td>
<td>250.00 0%</td>
</tr>
<tr>
<td>1983</td>
<td>.</td>
<td>.</td>
<td>250.00 0%</td>
</tr>
<tr>
<td>1984</td>
<td>.</td>
<td>.</td>
<td>250.00 0%</td>
</tr>
<tr>
<td>1985</td>
<td>.</td>
<td>.</td>
<td>250.00 0%</td>
</tr>
<tr>
<td>1987</td>
<td>.</td>
<td>.</td>
<td>.</td>
</tr>
<tr>
<td>1989</td>
<td>.</td>
<td>.</td>
<td>.</td>
</tr>
<tr>
<td>1990</td>
<td>15.00 100%</td>
<td>15.00 100%</td>
<td>23.00 100%</td>
</tr>
<tr>
<td>1991</td>
<td>15.00 100%</td>
<td>15.00 100%</td>
<td>23.00 100%</td>
</tr>
<tr>
<td>1992</td>
<td>15.00 100%</td>
<td>15.00 100%</td>
<td>23.00 100%</td>
</tr>
</tbody>
</table>

NPDES Limits: 30-day concentration
LC: Local Control as % of Total Control
Unit: micro-gram per liter (ug/l)

Table 4.13 Communities’ Allowable Metals Concentration and Local Control as Percentage of Total Allowable

Conclusions can be drawn from the above analyses about the inclusiveness of local control. That is, industrial discharge that is not under the control of the local government can still be damaging to the community, due to the substantial amount of concentration and loading; however, the local government does not have any authority to monitor or regulate these potential damaging behaviors. Differences in discharge amount and loading from before and after the establishment of local control authority are apparent. Before the establishment of the LCA, the local government was responsible for cleaning up industrial wastewater but with minimal knowledge of what and how much of the
waste stream was from industries. Although there were federal standards for these industrial users, the local government was not given authority to enforce these standards. In order to establish the LCA, the city first conducted its own industrial inventory survey to obtain this information. The city then established limits, educated industries, and required its industrial users to pretreat their wastewater as specified (Interview, March 15, 1996). In sum, the above analyses (Table 4.10 ~ Table 4.13) indicate that the inclusiveness of local control increases over time. These tables also show that after the local control authority was established, Columbus had the sole control of its industrial discharges, but Lima had only a small portion (up to 48%) of control to the community’s discharges of biochemical oxygen demand (BOD5), total suspended solids (TSS), ammonia nitrate (NH₃-N), and chromium (Cr) in loading and concentration. These findings indicate that Lima’s local government would rely on higher level governments to ensure its water quality, and does not have any legal authority to regulate and enforce desirable policy behavior of the non-locally controlled industrial pollution.

In sum, the analyses of the second task show that the increase in total personal income, population, per capita personal income, local and total wastewater treatment costs two year ago, and local and total sewerage capital costs two years ago are statistically related to the decrease in copper emissions. A longitudinal review of funding on wastewater treatment related costs indicate the increasing demand on the local government’s ability to raise funds. In addition, although local control on metal
parameters greatly increased after local authority was established, Lima still had a major portion of the community’s discharges that were not under its regulation. In sum, the second task established support for the relationship of the effects of contextual capacity on water quality improvement, and explained the importance of the inclusiveness of local control authority and the local government’s financing ability on the community’s water quality.

4.3 Establish a relationship between contextual capacity and local government’s adoption of design and operational criteria of local regulation

The third task of the data analysis was to identify the link between contextual capacity and local government’s adoption of design and operational criteria of local regulation and to further identify the effect of community-specific regulation. The first test was to identify the difference between the two cities.

Comparisons of Contextual Capacity of the Two Communities

Besides population as an indicator of the size of the two cities, diversity (inverse measure of diversity index; DIV), total personal income (TPI), per capita personal income (PPI), national average of per capita income (PP), scores of Moody’s bond rating (MBR), and total sewerage capital costs (TCC) are also indicators of a city’s contextual capacity. T-tests were performed on these contextual capacity variables, the test results are summarized in Table 4.14. These findings support the assumption that Columbus has

186
stronger contextual capacity than Lima, except for the variable of per capital personal income (PPI).

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Degree of Freedom</td>
<td>12</td>
<td>26</td>
<td>26</td>
<td>26</td>
<td>26</td>
<td>16</td>
<td>26</td>
</tr>
<tr>
<td>t Statistics</td>
<td>19.16</td>
<td>25.75</td>
<td>1.33</td>
<td>17.87</td>
<td>66.69</td>
<td>6.20</td>
<td>4.60</td>
</tr>
<tr>
<td>P value</td>
<td>0.00</td>
<td>0.00</td>
<td>0.19</td>
<td>0.00</td>
<td>0.06</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Statistical Significance (α=0.1, one tailed test)</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
</tr>
</tbody>
</table>

Note: C: Columbus, L: Lima

**Table 4.14 T-tests for Contextual Capacity Variables between Columbus and Lima**

Community-Specific Regulation

The link between contextual capacity and the local government’s adoption of design and operational criteria of local regulation is based on the assumption of community-specific regulation. That is, if the local community has stronger contextual capacity, the
regulatory relationships between a local government and industries will consist of higher local standards, more complex operational specifications, and more coercive enforcement methods. This assumption is illustrated by theoretical inferences regarding the strength of interest groups, derived from perspectives of economic/interest groups and resource dependency.\(^{61}\) That is, a community with stronger contextual capacity has a lesser degree of industry capture, and is more capable of designing, implementing, and enforcing programs that can achieve a successful implementation.

This study further used the following empirical findings to support the assumption of community-specific regulation. They are 1) content analysis of interviews, and a review of legislative and implementation documents, and 2) analyses of monitoring and enforcement activities from both communities. The information for their analyses is summarized in Table 4.15.

---

\(^{61}\) Theoretical inference from industry capture (Berry, et.al. 1982, Stigler, 1988, Peltzman, 1988, Mitchell, 1990, Mitnick 1993), bureaucrats, representative and voter's behavior (Buchanan and Tullock, 1969, Moe, 1980 and 1984, McCormick and Tollison, 1981, Tollison and Wagner, 1988, Tullock, 1989, and so on), agency's political and financial independence (Hall, 1991, and Oberman, 1993), are derived to model the behavior of agents, target groups and the agency. The basic premises are that 1) a negative relationship exists between economic diversity and the power of the groups and 2) a negative relationship of dependency exists between the implementing authority and contextual capacity. See detailed discussions in the Literature Reviews.
Table 4.15 Design and Operational Criteria of Local Regulation

From the analyses of city codes, response plans, and interviews, the local adoption of design and operational criteria of the regulation is found to be different between the two cities. Columbus has a higher number of metal parameters than Lima that are regulated and regulated more strictly than they are regulated by the federal regulation. Also, Columbus has more precise specifications than Lima regarding the operational procedures for agent and industry's behavior, e.g., inspections. Furthermore, Columbus
exercises more severe and more progressive punishments than Lima for the first and repeated offenses, and for industries that cause the city NPDES permit violations.

Content Analysis of Interviews

The following descriptive information is summarized from interviews with local pretreatment personnel. The interviews focused on the opinions of pretreatment personnel about operations and enforcement methods (these interviews were conducted in various sessions; see Appendix A ~ Appendix C).

The following summary is based on interviews with the Lima Pretreatment Coordinator. The coordinator stated that:

- Communication between the local authority and industrial users can improve industrial pollution behavior to a desirable level; the Pretreatment Coordinator believes that some violations are due to industries' misunderstanding of the local limits.
- Local limits follow federal initiatives (local limits are more strict in only two cases)
- The Pretreatment Coordinator believes that the city should be cost-conscious about testing toxic components
- Inspections and monitoring activities (in particular, of smaller industrial users) have been reduced because of cost-ineffectiveness
the local control authority has neither established formal nor informal mechanisms to interact with the other two direct dischargers, BP Oil and Arcadian LP

the Pretreatment Coordinator stated that the local election (near the time of the interview) might further inhibited long-delayed permit changes to Lima's industries

The following summary is based on interviews with the Columbus Pretreatment Manager:

- the Pretreatment Manager believes that some industries dropped out of Columbus because of their inability to comply with the local limits
- local limits are more strict than federal limits
- the economy is very diverse and competitive; the city is not worried about drop outs
- the Pretreatment Manager personally believes in the testing for toxic components to ensure the integrity and safety of the water
- the LCA proactively works with the OEPA to resolve some pollution related issues with Techneglas (i.e., the industry discharges via storm sewer); some judicial actions were taken at the time of the interviews; further information regarding these actions was not disclosed.

In addition to the above synthesis, significant terms in the regulations were also examined to more clearly perceive the differences between the two localities in support
of the hypothesis concerning community-specific adoption of design and operational criteria of local regulation.

**Context Analysis of Legislation and Documentation**

The following is a content analysis for the definitions of terms that are critical in the scope of violations and in the strength of regulatory actions.

**Significant Industrial Users (SIU)**

To determine if an industrial user is significant, both cities have similar ways of defining SIUs.62 Both define SIUs as 1) all categorical dischargers and 2) noncategorical dischargers with certain discharging capacity. The differences in SIU definition between the two cities are in the clauses regarding the Director's discretion to determine whether SIU is not significant. The clauses are as follows:

"*The director may at any time, on its own initiative or in response to a petition received from an industrial user, determine that a noncategorical industrial user is not a Significant Industrial User..."* (LCC, 1040.01(43)(b))

"Any noncategorical industrial user designated as significant may petition the Director to be deleted from the list of significant industrial users ..." (CCC, 1145.02.064 (C))

---

62 CCC, 1145.02.064 (A) and (B); LCC, 1040.01 (43) (a).
In other words, in Columbus, a significant industrial user may file petitions to become a non-significant user, while in Lima, in addition to petitions, the Director may also decide if an SIU is eligible. This implies that a formal petition mechanism is involved in Columbus; Lima on the other has more discretion. It is consistent with the assumption that Columbus has more specifications on the behaviors of the agents and the industries.

Significant Noncompliance (SNC)

To determine significant noncompliance, both cities also have similar specifications, with the exception of specifications on violations of discharge effluent limits and reporting.

(1) “Any other violation of a discharge effluent limit (daily maximum or longer term average)...” (LCC, 1040.142(f)(3))

“Any other violation of a discharge effluent limit (daily maximum or daily average)...” (CCC, 1145.02.065 (C))

(2) “Failure to provide, within 30 days after the due date, required reports such as baseline monitoring reports, initial compliance reports, periodic self-monitoring reports, and reports on compliance with compliance schedules;” (LCC, 1040.142(f)(7))

“Failure to provide required reports such as baseline monitoring reports, ninety (90) day compliance reports, periodic self-monitoring reports, and reports on compliance with compliance schedules...” (CCC, 1145.02.065 (C))
within thirty (30) days of the due date;” (CCC, 1145.02.065 (F))

(3)
“Failure to accurately report noncompliance;” (LCC, 1040.142 (f)(7))

“Failure to accurately and timely report noncompliance;” (CCC, 1145.02.065 (G))

Implications of the differences above are that the regulation in Columbus is stricter and that the industries in Columbus are more likely to commit significant non-compliance by these definitions.

Show-Cause Hearing

The following specifies show-cause hearing in the city codes:

1) “Such notice may be served on any principal executive, general partner or corporate officer.” (LCC, 1040.143 (b))

“Such notice may be served on the principal executive, general partner, or corporate officer, or authorized agent or representative to the person. The person listed as the company contact in a permit issued....” (CCC, 1145.81)

2) “Whether or not a duly notified industrial user appears as noticed, immediate enforcement action may be pursued.” (LCC, 1040.143 (b))

“Any person ordered by the Director to appear at a show cause hearing who fails to appear shall be deemed to have agreed to whatever action is taken
by the Director as the result of the show cause hearing.” (CCC, 1145.81)

3) No specifications about appeal for this section in LCC.

Appeals to the Director (CCC, 1145.82)

The hearings enable industrial users to show causes why a proposed enforcement action should not be taken. Both cities have similar clauses except that Columbus has clearer specifications regarding: 1) on whom such an order can be served, 2) conditions under which enforcement action takes place, and 3) procedures for the industrial user to appeal the director’s action.

Emergency Suspension

Columbus has an emergency suspension clause if a company which violates the permit standards causes Columbus to violate its Federal or State permit, while Lima does not.
"...the Director shall take such steps as deemed necessary, including immediate severance of the sewer connection, to prevent or minimize damage to the sewer system, its receiving stream, the environment, endangerment to any individuals or violation of any Federal or State discharge permit issued to the City." (CCC, 1145.84)

"...the Director shall take such steps as deemed necessary, including immediate severance of the sewer connection, to prevent or minimize damage to the POTW, its receiving stream, or endangerment to any individuals." (LCC, 1040.143 (d))

Termination of Services or Permits

Columbus has clauses to terminate services and permits, while Lima only specifies permit termination. In addition, Columbus has a clause to prevent the use of the sewer system by persons whose sewer services have been terminated. This clause empowers the Director with legal authority to “effectively” terminate services if necessary.

"The director may take whatever actions are necessary in order to prevent use of the sewer system by persons whose sewer services have been terminated. The director may terminate City water service to any premises in order to enforce any termination of sewer services to the same premises." (CCC, 1145.84)
Director's Orders

In addition to Administrative Orders, the Director of Columbus may issue orders, including but not limited to Consent Orders, Compliance Orders, and Cease and Desist Orders, that specify different degrees of severity and authority (LCC, 1040.143 c, CCC, 1145.13).

The content analysis of the significant terms of the local regulations further affirms that Columbus has stronger measures in its regulations, while Lima adapts a milder approach. Both the results of the interviews and the above content analysis are consistent with the assumption that Columbus is stronger in contextual capacity, has higher standards to regulate industries and is more comprehensive in specifying their behaviors.

Comparisons of Local Monitoring and Enforcement Activities

The following analysis presents t-test results of the two cities' measures of implementing these regulations. This analysis provides some evidence of the assumption regarding the relationship between contextual capacity and the stringency of the implementation of local regulations. In addition, a local government with a more coercive approach might yield a greater number of citation records. The information is collected from the cities' annual reports (1989 ~ 1995), which are submitted to the OEPA.
<table>
<thead>
<tr>
<th>Operational Measures: Monitoring, Significant Noncompliance, and Enforcement Variables</th>
<th>T-test</th>
<th>p values</th>
<th>Statistical Significance (α=0.1, one-tailed test)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$x_{ci} &gt; x_{li}$</td>
<td>0.43</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>$x_{ci} &gt; x_{li}$</td>
<td>0.49</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>$x_{ci} &lt; x_{li}$</td>
<td>0.04</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Monitoring Activities</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. # Control Document / # SIU, ($i = 1$)</td>
<td>$x_{ci} &gt; x_{li}$</td>
<td>0.00</td>
<td>Yes$^*$</td>
</tr>
<tr>
<td>2. # Inspection / # SIU, ($i = 2$)</td>
<td>$x_{ci} &gt; x_{li}$</td>
<td>0.02</td>
<td>Yes$^*$</td>
</tr>
<tr>
<td>3. # Samples / # SIU, ($i = 3$)</td>
<td>$x_{ci} &gt; x_{li}$</td>
<td>0.00</td>
<td>Yes$^*$</td>
</tr>
<tr>
<td>4. # SIU (categorical) / # SIU (categorical), ($i = 4$)</td>
<td>$x_{ci} &gt; x_{li}$</td>
<td>0.06</td>
<td>Yes$^*$</td>
</tr>
<tr>
<td>5. # SIU (non-categorical) / # SIU (non-categorical), ($i = 5$)</td>
<td>$x_{ci} &gt; x_{li}$</td>
<td>0.01</td>
<td>Yes$^*$</td>
</tr>
<tr>
<td>6. # Sample Violation / # SIU, ($i = 6$)</td>
<td>$x_{ci} &gt; x_{li}$</td>
<td>0.00</td>
<td>Yes$^*$</td>
</tr>
<tr>
<td>7. # Report Violation / # SIU, ($i = 7$)</td>
<td>$x_{ci} &gt; x_{li}$</td>
<td>0.01</td>
<td>Yes$^*$</td>
</tr>
<tr>
<td>8. # Compliance Schedule Violation / # SIU, ($i = 8$)</td>
<td>$x_{ci} &gt; x_{li}$</td>
<td>0.00</td>
<td>Yes$^*$</td>
</tr>
<tr>
<td><strong>Enforcement Activities</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. # Compliance Schedule, ($i = 9$)</td>
<td>$x_{ci} &gt; x_{li}$</td>
<td>0.22</td>
<td>No</td>
</tr>
<tr>
<td>10. # Compliance Schedule / # SIU, ($i = 10$)</td>
<td>$x_{ci} &gt; x_{li}$</td>
<td>0.00</td>
<td>Yes$^*$</td>
</tr>
<tr>
<td>11. # Administrative Order, ($i = 11$)</td>
<td>$x_{ci} &gt; x_{li}$</td>
<td>0.46</td>
<td>No</td>
</tr>
<tr>
<td>12. # Administrative Order / # SIU, ($i = 12$)</td>
<td>$x_{ci} &gt; x_{li}$</td>
<td>0.099</td>
<td>Yes$^*$</td>
</tr>
<tr>
<td>13. $x_{ci} &gt; x_{li}$</td>
<td>0.999</td>
<td>Yes$^*$</td>
<td></td>
</tr>
<tr>
<td>14. $x_{ci} &gt; x_{li}$</td>
<td>0.00</td>
<td>Yes$^*$</td>
<td></td>
</tr>
<tr>
<td>15. # Violators (News), ($i = 15$)</td>
<td>$x_{ci} &gt; x_{li}$</td>
<td>0.47</td>
<td>No</td>
</tr>
<tr>
<td>16. # Violators (News) / # SIU, ($i = 16$)</td>
<td>$x_{ci} &gt; x_{li}$</td>
<td>0.00</td>
<td>Yes$^*$</td>
</tr>
</tbody>
</table>

**Note:**
Observations for all variables are annual data in OEPAR-2 forms, collected from 1989 to 1995 cities' annual reports.
The variables ($^*$) in Significant noncompliance and Enforcement Activities have zero values in all years in Lima.

**Table 4.16 T-tests of Measures of Implementing Local Regulation**

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Conclusions can be drawn from the analysis of the operational measures except for the monitoring activities. By observing the data, the sampling and inspection frequencies reported in the OEPA AR-3 report forms were average frequencies required for significant industrial users. After 1992, the numbers of the monitoring activities equaled the numbers of significant industrial users, except that the numbers of control documents for Columbus were greater than the numbers of significant industrial users. A limitation results from this reporting method. A higher rate of violations might induce higher frequencies of sampling of violators; however, average frequencies do not provide sufficient information on these higher violations. The information on such is not collected in this study, but is recommended in future studies. However, other operational measures are useful in indicating the stringency of the local enforcement activities.

The theoretical deduction of economic/interest groups and resource dependency theories support the hypothesis that Columbus has stronger contextual capacity and would have a more authoritative relationship with industries, and that the industries would have lesser degrees of influence or domination. Higher violation frequencies of implementation and enforcement measures of local regulations might be expected for the city that is willing to use coercion to enforce desirable implementation outcomes. An a priori assumption is that if both cities achieve the same level of wastewater treatment outcomes, the city that has stricter rules and is more willing to enforce these rules would have a greater number of citation records on these operational measures than the other.
The t-test results are supportive of this assumption. These t-test results show that Columbus has more Significant Noncompliance per significant industrial user (variables 4 ~ 8 in Table 4.16) than Lima.\textsuperscript{63} Columbus has higher dollar amounts of penalties per significant industrial user than Lima. Compliance Schedule, Administrative Orders, and newspaper reporting\textsuperscript{64} are a more severe form of censure for violations; therefore, it seems to be reasonable that these violations are not sensitive to size. In these severe measurements, Columbus also has higher violations than Lima. In sum, Columbus' greater numbers of citations indicate its willingness to exercise coercion to bring about desirable implementation outcomes.

The above analyses, content analyses of interviews, reviews of documentation and analyses of program operational measures provide some empirical findings to support the assumption that the regulation is community-specific. Columbus, with higher contextual capacity, adopts stricter standards, more comprehensive operational rules, and more coercive enforcement methods. Columbus also is willing to exercise these program measures. The following task, examination of the city's wastewater treatment outcomes, can further support the assumption that a community with higher contextual capacity employs more authoritative and coercive methods in designing and implementing local

\textsuperscript{63} Both cities have very few numbers of show-cause, civil suits, and criminal suits; therefore, they are not included in the tests.
regulation and thus ensures more desirable policy outcomes than a community with lower contextual capacity.

4.4 To identify the effect of community-specific regulation

To further examine the effect of community-specific regulation, two indicators for outcome valuation are used. The first is the water quality improvement in Copper and the second is the frequency with which the direct dischargers violated NPDES limits, an indication of wastewater treatment outcomes of these dischargers.

Water Quality Improvements in Copper Emissions

Copper is one the most commonly selected and representative metal parameters\textsuperscript{65} for water quality and pretreatment programs. Copper was also a major discharge component of the metal finishing industry which was the only categorical industry under Lima's control, and which was once 50% of the total categorical industrial users in Columbus. In addition, Copper was one of Lima's two parameters that exceeded federal standards (i.e., Copper and Lead). Thus, the reduction in copper emissions has a great impact on the city's water quality. The graphs below show the copper discharging patterns of Columbus and Lima from 1980 to 1992.

\textsuperscript{64} Severe violators were disclosed to the public by publishing the names of the companies in the city's major newspaper.

\textsuperscript{65} These parameters are Cadmium, Chromium, Copper, Lead, Mercury, Nickel, and Zinc.
In Columbus, Copper consistently decreased over time, except for peaks in 1983 and 1988 (Figure 4.9). In Lima, Copper decreased at a slower rate. However, after the establishment of LCA (using 1986 as an interrupted point), Copper discharge was lower than before (Figure 4.10). A peak can also be found in 1988. However, a drought occurred in 1988; unexpected decreases in the amount of flow might be the cause of the peak (Interview, April 30, 1997).
Figure 4.10 Copper Annual Discharge in Lima

Two indicators used to identify the effect of community-specific regulation are water quality improvement in copper and wastewater treatment outcomes. The following is a summary of decreasing rates in copper for both cities. The results are taken from the fitted error process models of monthly time series data from 1980 to 1992 (see Equations 5 and Equation 6, p. 146).
Table 4.17 Copper Discharge Improvements of Both Communities

<table>
<thead>
<tr>
<th>POTWs</th>
<th>Decrease After LCA</th>
<th>Comparison of Decrease</th>
</tr>
</thead>
<tbody>
<tr>
<td>Columbus</td>
<td>5.25</td>
<td>95.98% of 1985 average monthly discharge</td>
</tr>
<tr>
<td>Lima</td>
<td>4.2</td>
<td>54.8% of 1985 average monthly discharge</td>
</tr>
</tbody>
</table>

Columbus average monthly discharge in 1985 was 5.47 ug/l. The decrease of 5.25 is 95.98% of the 1985 average monthly discharge. Lima average monthly discharge in 1985 was 7.67 ug/l. The decrease of 4.2 ug/l is 54.8% of the 1985 average monthly discharge. The results indicate that in sum, Columbus has greater improvement than Lima in Copper discharges after the establishment of the LCA.

Community-wide, the copper discharge in Columbus consists of copper effluent (30-day concentration) from two POTWs (see table above) and with no other copper discharges from an industrial direct discharger. The copper discharge in Lima contains discharges from its wastewater treatment plant (see table above), and in addition BP Oil discharged 648 ug/l in 1991 and 172 ug/l in 1992. Due to the data skewness, the two data
points from BP are excluded from the analysis (If both data points are included, Lima would have a lesser degree of decrease in Copper discharge).

**Analyses of Direct Dischargers’ Wastewater Treatment Performance**

The second indicator of community-specific effect is wastewater treatment performance, which is measured by the frequencies and the deviation of discharge exceeding NPDES limits from all NPDES dischargers in each community.

To analyze the wastewater treatment performance of the direct dischargers, discharges by parameters are compared to the federal/state NPDES permit limits. The wastewater treatment performance is one of the indicators of pollution control effort of the local control authority. The more effective pollution control the local authority designed and implemented, the better the wastewater treatment outcome complied with the federal/state standards, and the better the community’s water quality became. The following provides analysis of the permit limits and discharges of metal parameters from 1990 to 1992. The charts indicate that the regulation of metal parameters is constant among all POTWs of the communities. However, metal discharges from the POTWs were found mostly improved after 1990 and were well below permit limits.
Jackson Pike: Cu, 30-day Loading and Limit

Limit = 3.41

Southerly: Cu, 30-day-loading and limit

Limit = 6.47

Lima: Cu, 30-day-loading and Limit

Limit = 1.1

Figure 4.11 Metal Loading and Limits of POTWs
Figure 4.11 (continued)

Jackson Pike: Cr, 30-day loading and limit

No Limit

Southerly: Cr, 30-day loading and no limit specified

Lima: Cr, 30-day loading and limit
In brief, the standards for the metal parameters were constant after 1990. That the loading of Cr and Pb decreased after 1990 supports a positive relationship between the
decrease of metal discharge and the establishment of pretreatment programs (Interview, OPEA). However, in 1992, there were Copper discharge violations in Lima; Copper discharge also peaked during 1992 in Columbus.

The following provides analysis of the wastewater treatment outcomes of each direct discharger. The method is to compute the frequencies and the deviation of actual discharge that exceeded the NPDES limits. 30-day concentration and 30-day loading of selected parameters are used in the analysis (Table 4.18). The three selected parameters are most commonly monitored among these dischargers either in a 30-day loading or 30-day concentration. However, due to direct comparability across industries and POTWs in both communities, parameters that are available both in permit and in effluent discharges are very limited.
<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
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<tbody>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LP</td>
<td>Nh3-N</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>TSS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cr</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BP Oil</td>
<td>Nh3-N</td>
<td>0.01</td>
<td>220.56</td>
<td>0.02</td>
<td>7.20</td>
<td></td>
</tr>
<tr>
<td></td>
<td>TSS</td>
<td>0.10</td>
<td>67.77</td>
<td>0.01</td>
<td>174.31</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cr</td>
<td>0.01</td>
<td>3.56</td>
<td>0.00</td>
<td>0.00</td>
<td></td>
</tr>
<tr>
<td>Lima</td>
<td>Nh3-N</td>
<td>0.03</td>
<td>101.28</td>
<td>0.00</td>
<td>0.00</td>
<td></td>
</tr>
<tr>
<td>POTW</td>
<td>TSS</td>
<td>0.11</td>
<td>1088.40</td>
<td>0.24</td>
<td>563.81</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cr</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jackson Pike</td>
<td>Nh3-N</td>
<td></td>
<td></td>
<td>0.00</td>
<td>0.00</td>
<td></td>
</tr>
<tr>
<td></td>
<td>TSS</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cr</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Southerly</td>
<td>Nh3-N</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td></td>
</tr>
<tr>
<td></td>
<td>TSS</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cr</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: 30-day loading data not available

* Violation frequency equals number of violations divided by total number of observations; Deviation per violation shows the magnitude of violation diverging from its standards.

Table 4.18 Frequency and Strength of Violation

The table above shows that no violations were found in Columbus. BP Oil and Lima POTW showed considerable violation records and some of the exceeding rates were outstanding. In brief, the violation frequencies for Lima in total suspended solids increased, but the strength per violation decreased after the establishment of the LCA.
Most of the discharge exceeding its limit decreased after 1986, except the total suspended solids discharged from BP Oil showed extensive violations.

Summary of Wastewater Treatment Performance by Community

T-tests are performed to identify the differences in wastewater treatment outcomes between the communities. The summary is provided below (Table 4.19).

<table>
<thead>
<tr>
<th>T-test</th>
<th>Between community</th>
<th>Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Frequency</td>
<td>Deviation</td>
</tr>
<tr>
<td></td>
<td>$\bar{x}<em>{Cfreq} &lt; \bar{x}</em>{Lfreq}$</td>
<td>$\bar{x}<em>{Cdev} &lt; \bar{x}</em>{Ldev}$</td>
</tr>
<tr>
<td>P value</td>
<td>0.03</td>
<td>0.04</td>
</tr>
<tr>
<td>Test of Significance</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>($\alpha=0.1$, one tailed test)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 4.19 T-Test of Wastewater Outcomes between Communities

The table above shows that Lima has a higher violation frequency and the deviation from the limits per violation is also higher. Conclusively, both water quality improvements in copper and wastewater treatment outcomes support that Columbus had
more improvement in copper discharge and has better wastewater treatment outcomes than did Lima.

4.5 Summary

Under the new trend of initiatives, local governments are given more responsibility and authority including designing and implementing regulations and programs that can meet or exceed federal guidelines. The analysis shows that the increased local involvement can affect the implementation outcomes of a national policy. A community’s contextual capacity has a positive effect on the implementation outcomes. Because it is highly related to the ways these regulations and programs are design and implemented locally. In addition, the community-specific adaptation of the national policy can affect the effectiveness of the national policy at the local level.

In brief, the four tasks used to test the four leading hypotheses of this study were accomplished in this chapter. First, the establishment of local control authority has positive effects on water quality. The effect of the local involvement was identified by comparing the water quality before and after the establishment of a local control authority. In addition to the visual displays of the decreasing trends of Copper emissions in both communities, time series models in equations 5 and 6 (p. 146) show statistical significance indicating a jump (i.e. a decrease in copper emission) in water quality
improvement after the establishment of the local control authorities. In addition, the equations also show some correlation of current water quality with the prior month’s emissions. By using the establishment of the LCA as an interrupted point, longitudinal exploration of policy development in municipal water pollution control revealed the differences in local government’s responsibilities before and after the establishment of the LCA. The main differences were that the local government became primarily responsible for 1) establishing local policy, water quality regulations and standards, and pollution control programs, 2) identifying industrial polluters and the amount and types of pollutant discharged, 3) establishing sanctions and assigning liability to polluting and undesirable policy behaviors, and 4) ensuring policy outcomes to meet/exceed federal/state guidelines and provide for local needs. Local government’s involvement in designing, implementing, and enforcing the water pollution control policy requires engineering, financial, and legal competence. The demands of engineering, financial and legal competence signify the importance of the contextual capacity of a local community.

To test the second hypothesis, the positive effects of contextual capacity on water quality, required statistical validation of the relationship between the local decreases of copper emissions and the increases in socioeconomic and financial ability of the community. The results of the statistical tests show that the increase in the level of socioeconomic and costs variables was related to the decrease in copper emission. In addition, the local contextual capacity was further explained by the diversity index.
derived from Gary and Lowery's studies (1992 and 1996). A lower index score indicates a more diverse economy. A longitudinal review on funding revealed the increasing demand on the local government's ability to raise funds over time. The implications of the inclusiveness of local control were also important. The lesser degree of inclusiveness of local control indicates that a higher degree of water quality would rely on higher level regulatory authorities and industries' self-conduct. These findings and explanations support a positive relationship between contextual capacity and water quality improvement.

The third hypothesis of this study was that the local community with a higher contextual capacity would support a more coercive regulatory relationship between its local government and regulated industry. Urban politics literature agrees that the profiles of cities appear to be related to the cities' capabilities in policy development. Economic/interest groups and resource dependency theories are used to add explanations to the incomplete theory of industry capture from socioeconomic profiles and agency's perspectives. Using these theoretical inferences, the third task identified a link between contextual capacity and the local government's adoption of design and operational criteria of local regulation. The results of content analysis of interviews, reviews of legislative and implementation documents, and t-tests of operational measures for monitoring and enforcement activities supported this hypothesized relationship. Columbus, which has a higher contextual capacity, employs stricter and more
comprehensive local limits, more complex operational specifications, and more coercive enforcement methods to regulate industries than Lima does.

The fourth hypothesis was that the community-specific regulations (i.e., a community with higher contextual capacity, demanding stricter and more comprehensive standards, requiring more precise operational specifications, and adopting a more coercive enforcement approach) have positive effects on water quality. To test for this hypothesis, the fourth task examined the effect of the community-specific regulations by examining 1) the amount of decrease in Copper and 2) the violation frequency of wastewater discharges and the deviation per violation of these discharges. Both examinations confirmed those expected results: Columbus, being one with higher contextual capacity and stronger regulations and programs, had greater water quality improvements than Lima.

The completion of the four tasks supported the theoretical hypotheses of this study: the increased involvement of the local government in designing and implementing national initiatives affect the effectiveness of the implementation at the local level. The effectiveness was positively related to the establishment of a local control authority that gave the local government the authority to define policy goals, establish standards, identify targets and target groups, and implement and enforce regulations to meet federal as well as local demands.
The local government's responsibilities were found to be in great demand of financial, engineering, and financial supports. This finding signified the relationship between contextual capacity and water quality improvement, in addition to a positive relationship found in statistical testing. Furthermore, the contextual capacity was found related to the ways in which the local government designed and enforced these local regulations. The context-specific regulations and enforcement contributed to the variability of effectiveness among localities.
CHAPTER 5

CONCLUSIONS AND SUMMARY

Policy instrument studies suggest that the selection of the proper tool contributes to policy success and that the selection of a tool is based on the evaluation of design criteria. Being the primary focus of the policy instrument studies, "tool substitution" (i.e., by replacing one tool with another) sometimes leads to the premature discarding of a tool. Hence, possible operational improvement of an instrument is left largely unexamined. If policy instrument scholars assume that a specific tool is the best tool to achieve certain policy objectives, then the scholars may overlook the context-specific difficulties of implementing such an instrument. Under these circumstances, the design and operational attributes and the value ascribed to them are likely to be omitted. Without investigating these missing components, the factors that would ensure the success of a policy tool are not thoroughly understood.

5.1 Theoretical Inquiries

As the role of local government expands to fill the gaps created by the reduction of federal government's involvement in designing national policies, it has become particularly important to understand the variability and limits of a local government's capacity to adapt these policies. Under this new trend, local governments become
increasingly involved in designing and implementing regulations and programs to adapt federal initiatives. This research has suggested that the variations in a local community’s effectiveness in adapting a federal policy are closely linked to the level of local contextual capacity and the local government’s adoption of locally influenced design and operational criteria of regulations and programs. In addition, this research has explored the behavioral variations of both the regulatory authorities and regulated industries from the theoretical perspectives of economic interest groups and resource dependency. These perspectives have led to several questions: What is the effect of contextual capacity? What constitutes contextual capacity? What relations exist between contextual capacity and the ways the tool is defined and operated? What is the effect of implementing the context-specific instrument?

A theoretical framework was developed to study these inquiries in a systematic fashion. This study has accomplished the following:

1. This study has identified the effect of the increased local involvement in policy formulation, implementation and enforcement on adapting a national policy, and has explored the factors contributing to this effect.

This study has analyzed the effect of the increased local involvement in policy formulation, implementation and enforcement on adapting a national policy by using the example of municipal water pollution control. This study has identified factors contributing to this effect by examining the differences in the local government’s responsibility before and after the increase of local involvement. The following resulted

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from the increased responsibilities: 1) the local government was directly responsible for ensuring the outcomes of the implementation to meet/exceed federal/state guidelines and to provide for local needs, 2) the policy design and implementation to adapt a national policy were local-specific, 3) policy targets and target groups were identified by the local government, 4) local regulations for liability and sanctions for undesirable policy behaviors were established, and 5) local government was authorized with policing power to enforce these regulations. These responsibilities were found to require financial, technical, and legal capability. The study has further specified that the contextual capacity of a local community positively affects the policy outcomes.

2. This study has provided an initial step in developing an operational definition of a local community's contextual capacity.

Contextual capacity is defined by the strength of the local economy and the resource independence of the local government. Socioeconomic profiles and the strength of the local economy are crucial to indicate the strength of interest groups and the local ability to demand as well as to develop public programs. In addition, the degree of inclusiveness of local authority indicates the degree of reliance of the local government on other parties (e.g., the higher level government, or the private sector) to ensure implementation results. The inclusiveness of local authority is positively related to local contextual capacity. Furthermore, the ability of the local government to attract funds from either local resources (e.g., taxes or issuing bonds) or from other governmental entities is also critical.
to public programs, especially when federal support becomes increasingly limited. These contextual capacity factors are strongly associated with the success of the policy outcomes.

3. **The study has identified a relationship between contextual capacity and the local government’s adoption of design and operational attributes of a policy tool.**

   The contextual factors can be used to explain the behavioral dimension of a policy instrument. A higher socioeconomic profile and a resource independent authority enable a local community to develop regulations for a broader range of pollutants with stricter standards and more precise operational procedures and greater power to enforce such regulations than a local community with a lower socioeconomic profile and a resource dependent authority.

4. **This study has evaluated the effect of a context-specific instrument on policy outcomes**

   The outcomes from local adaptation of a federal policy vary based on the contextual capacity and the ways the rules and methods are designed and operated. The local community with stronger capacity, which adapts more stringent and comprehensive standards, more precise operational specifications, and more coercive enforcement, can produce better policy outcomes.
Achieving these objectives supports the following: 1) A locally designed policy instrument affects the outcomes of adaptation of a national policy. A local government can be entrusted with design, implementation, and enforcement authority if it can demonstrate the ability to exceed/meet federal/state guidelines. 2) The policy outcomes of the locally designed instrument varies due to the level of local contextual capacity and the locally adapted design and operational criteria of the instrument. 3) Contextual capacity is positively related to the ways in which the instrument is designed and implemented. Therefore, by recognizing the significance of context-specific factors, enhancing local contextual capacity to suit the needs of the specific locality can improve the effectiveness of the locally adapted policy.

To achieve these research objectives, this study employed a longitudinal and exploratory case study of water pollution control. Water pollution control was studied because it not only provided the scenarios in which the responsibilities for policy formulation shifted from the higher level governments (including the federal and the state governments) to local governments, but also provided examples of the involvement of local governments in designing, implementing, and enforcing water pollution control. Columbus and Lima’s case background in water pollution control provide examples to describe the current federal initiatives and present substantial context to which this study applies.
The theoretical framework, as displayed in Figure 3.1 (p.80), was implemented by comparing the behavior of the local government and the industry in two communities that control water pollution. The framework consists of four empirical components 1) the involvement of local government in controlling water pollution, 2) the effects of local contextual capacity on water quality improvement, 3) the regulatory relationship between the local government and industry, and 4) the effect of the community-specific regulation.

By exploring and reviewing the water pollution control policy and the programs established to enact it in various periods from 1980 to 1995, this study examined two local communities and their adaptation of federal initiatives. By viewing the change in authority from the federal government to the local government as a major policy change, this study assessed critical differences before and after the local control authority was established. This assessment was done from the perspective of local policy formulation and implementation and how that affected the community’s water quality. In addition, this study used Lima and Columbus as examples of local government formulating and implementing federal policy to describe the relationship between contextual capacity and local regulations.

Quantitative and qualitative data were critical to this study, and various data collection methods and techniques were used. These included data retrieval from
agencies, databases from libraries, on-site record compilation, and telephone and face to face interviews. Information was collected from several divisions of the Ohio Environmental Protection Agency, local communities' auditing and utility departments and wastewater treatment plants. The data include 1) water quality data (measured over time) retrieved from state LEAPS database, 2) socioeconomic data extracted from REIS database, local sewer funds, Moody's bond rating, local industrial inventory, 3) regulatory information extracted from pertinent federal, state, and local legislation and policy documents, interviews, and local monitoring and enforcement reports, and 4) wastewater treatment outcome measures obtained by comparing NPDES Permit limits with LEAPS effluent data.

The statistical results from the testing of the four guiding hypotheses were further supported by bringing together insights from policy reviews and the experiences of policy practitioners. By building a comprehensive database linking water quality, socioeconomic profiles, and regulatory information, water quality measurements were used to demonstrate the changes in water quality and wastewater treatment outcomes. This factual evidence in conjunction with the premises derived from interest group and resource-dependency theories was used to explain how and why the involvement of local government was critical to the outcomes of adapting a national policy, and how and why the contextual capacity of a local community was related to the design and implementation of the regulation.
5.2 The Summary of The Four Tasks of This Study

The four tasks derived from the guiding hypotheses of the conceptual model were used to investigate the importance of local government's involvement and level of local government's contextual capacity in the success of implementing federal policy. The following discusses these hypotheses, analytical methods, findings, and explanations.

The first task identified the effect of local involvement by comparing the water quality before and after the establishment of local control authority.

The results of the quantitative analysis, including trend analyses and plots together with simple transfer function models, concluded that the water quality after the establishment of the local control authority was better than before, which supported the hypothesis that the involvement of the local government had a positive effect on water pollution control. The following table provides a synthesis of the quantitative finding in water quality improvement of both cities from various aspects.
<table>
<thead>
<tr>
<th></th>
<th>Water quality after LCA</th>
<th>Water quality of the two communities</th>
<th>Wastewater treatment outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Columbus</td>
<td>Improved</td>
<td>More improvement</td>
<td>Lower frequency and lower deviation in violation</td>
</tr>
<tr>
<td>Lima</td>
<td>Improved</td>
<td>Less improvement</td>
<td>Higher frequency and higher deviation in violation</td>
</tr>
</tbody>
</table>

Table 5.1 Evaluation of the Attainment of Policy Objectives

Qualitative analyses further gave support to this finding through interviews and reviews of legislation and agency reports. The differences in water quality improvement before and after establishing local control authorities were correlated with the changed roles of the local government. Exploration of the roles of the local governments in water pollution control before and after the authorization of local control authorities showed that these roles changed in the following three ways:

1. from a policy implementer to a policy developer
2. from a federal grant seeker to a loan solicitor
3. from a service provider to a mediator and a regulator

1) In changing from a policy implementer to a policy developer, the study found that before establishing the local control authority, local government did not have authority to
regulate industry in water pollution matters, nor did local government know what type, in what amount, and from which industry the pollutants were discharged into the city's publicly owned treatment works. After establishing the local control authority, local government conducted an industrial inventory to collect information on industrial pollution, to estimate allowable limits to meet federal and state standards, and to regulate appropriate levels of industrial discharges. The study also found that after establishing the local control authority, local government needed to educate industry as to what behaviors did and did not meet local regulations.

2) In changing from a federal grant seeker to a loan solicitor, the study also found that before establishing the local control authority, local government obtained greater amounts of financial assistance from federal and state governments. While local responsibilities and involvement in water pollution control increased, the proportion of federal aid (compared to total spending) dramatically decreased. The local government became reliant on issuing bonds as a major financial source. The ability to raise funds became critical to the local financing of water pollution control.

3) In changing from a service provider to a mediator and a regulator, the study found that before establishing the local control authority, the local government did not have jurisdiction over industrial users, although industrial discharges can be damaging to municipal wastewater treatment facilities and can be harmful to the community's water
quality and health. The role of local government was as a service provider to treat these industrial discharges. After establishing the local control authority, the local government not only regulated which, what and how much pollution an industry could discharge, but was also empowered with the policing authority to monitor industrial pollution and enforce pollution control.

In sum, the positive effect of the establishment of local control authority on policy outcomes occurred in part because the local government was able to 1) meet/exceed federal/state standards and provide for the local needs, 2) establish its own regulations and programs, 3) identify industrial polluters and pollutants that were specific to its community, and 4) establish punitive measures for undesirable polluting behaviors. This study further extended this finding by showing that the effectiveness of a local government’s adaptation of a national policy varied according to the contextual capacity of the local community. This research has also shown that as a local government is called upon to become an enforcer of federal government regulations, it needs a higher degree of technical, judicial, and financial competence. The ability of local communities to adapt these federal initiatives was dependent on its contextual capacity, measured by communities’ socioeconomic conditions and resource independence of local control authorities. However, contextual capacity was rarely examined by the earlier studies.
The second task provided evidence of the importance of contextual capacity

Based on the discussions from Olson's theory of interest groups and the resource dependency theory, a set of socioeconomic and agency variables was derived to test their relationship to water quality improvement. The significant finding here is that greater contextual capacity does have a positive effect on the water quality (i.e., the greater the increase in the contextual capacity, the greater the decrease in copper discharges.) Contextual capacity is represented by socioeconomic variables and resource-independence of local control authorities. The review of the cities' profiles, including the city's socioeconomic variables, economic structure, changes in industry, bond raising ability, and the inclusiveness of local control further supported this hypothesis. These reviews were in agreement with urban politics and resource dependency theories, and provided explanations of why a community's contextual capacity was crucial to the provision of costly public programs and the independence of local legal mechanism.

The third task examined the profiles of the cities and identified a link between contextual capacity and the local government's adoption of design and operational attributes of local regulation.

The research hypothesis was that a community with greater contextual capacity would have higher standards (i.e., including a broader range of pollutants and stricter standards), more precise and comprehensive operational specifications, and more coercive enforcement power to regulate the industry. To test this hypothesis, descriptive
statistics were used to indicate variations in city profiles over time. The finding showed that while Lima and Columbus shared some commonalities in increases in socioeconomic measurements and self-financing and spending in sewerage capital projects, Columbus experienced greater increases than Lima over the selected time frame. Columbus has several different types of industry, giving it a more diversified and stable economic base, while Lima's economic base rests primarily on one type of industry. The above findings support the assertion that a local community with greater contextual capacity is positively related to a diverse economic base, greater access to diverse sources of funding and greater capital spending ability.

Based on the evidence of the regulatory records, there were few changes in the State's water quality standards from 1980 to 1993. In addition, the majority of the state's standards for metal parameters for the municipal wastewater treatment plants was not established prior to 1990. Overall, a majority of the state's water quality standards was not changed during the time frame examined. The study also found that after 1986, while Columbus controlled all of its wastewater discharge both in terms of amount and strength of pollutants, Lima had a considerable amount of discharge that was not under its local control. This finding affirmed the assumption that a city with higher contextual capacity had more inclusive control over its polluters, and was less reliant on other authorities (i.e. the OEPA) to enforce desirable behaviors. The following is a synthesis of the quantitative analysis of the cities' profiles.
<table>
<thead>
<tr>
<th></th>
<th>Strength of local economy</th>
<th>Resource dependency of local control authority</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Economic Diversity</td>
<td>Socioeconomic factors</td>
</tr>
<tr>
<td>Columbus</td>
<td>High (light industry)</td>
<td>Higher</td>
</tr>
<tr>
<td>Lima</td>
<td>Low (heavy concentration in one industry)</td>
<td>Lower</td>
</tr>
</tbody>
</table>

**Table 5.2 Contextual Capacity of the Two Communities**

A difference in contextual capacity between the two cities was found, and is summarized in Table 5.2. The results show that Columbus has a stronger local economy, including economic diversity and socioeconomic factors, when compared to Lima. In addition, the local government of Columbus is less resource-dependent than Lima; Columbus has stronger financing ability and more inclusive control of its industries.

Based on the premise of Olson's interest group theory, socioeconomic factors were used as indicators of the strength of interest groups. In addition, the inferences from resource dependency theory were used. These suggest that agency independence works as an indicator of the agency's capability to control inter-organizational influences. This study found that with stronger contextual capacity, Columbus provided a diverse and
competitive environment for the industry; furthermore, its local government was resource-capable in formulating and executing its desired regulatory policy. Thus higher contextual capacity allows the local community and the local government to be less captured by the industry in the regulatory process. The hypotheses were that local communities with greater resources, more inclusive authority, more diverse economies, and stronger socioeconomic measures were more likely to formulate and implement more stringent standards, precise operational specifications, and coercive enforcement. These hypotheses were supported by t-tests result of measures of implementation of local regulation and by the finding of t-tests of wastewater treatment outcomes and water quality improvement.

In addition to indicating the degree of industry capture of the regulation and the implementation of the regulation, the findings also strongly suggested differences in the marginal utility of communities with different contextual capacities. Citizens' willingness to pay for and industry's willingness to accept regulation should be different between high and low capacity communities. Columbus has greater contextual capacity, can demand higher water quality and was found to have higher spending on wastewater treatment over the years. This finding is in agreement with Eyestone and Eulau's study (1968) that used a community's resource capability to indicate citizens' demands for government services. Furthermore, this study also found that Columbus has the ability to absorb a higher level of transaction costs incurred in the governmental activities of monitoring and enforcement. The analysis of local regulations and operational measures
was also found supportive of this claim. Presumably, the community that has greater contextual capacity will have a greater willingness to pay for governmental intervention, and the industries will have greater willingness to accept the costs and penalties. However, the price the community with greater contextual capacity pays would be lower than the price paid by a community with lower contextual capacity for the same level of water quality. This is because the lower contextual capacity community is less likely to achieve the same level of pollution control due to the effects of industry capture. These findings are supportive of the hypothesis that contextual capacity is a necessary condition for countering industry capture.

By examining the regulatory relationship between the local government and industry, the theoretical inferences drawn from the theories of interest groups and resource dependency are supported by content analysis of City Codes, Enforcement Response Plans, and interviews with city officials. The results of the analysis are summarized in the table below. The results confirm that Columbus has a higher expectation of regulating industry (i.e., more stringent standards and broader range of regulated pollutants), is more specific and comprehensive in specifying acceptable governmental agents’ and industry behavior, and is more likely to impose more severe penalties for noncompliance and more coercively enforce them.
<table>
<thead>
<tr>
<th>Contextual Capacity</th>
<th>Content comparisons: local government's adoption of design and operational criteria</th>
<th>Stringency and Comprehensiveness of standards on regulating target groups</th>
<th>Precision of Operational specifications</th>
<th>Coerciveness of enforcing behavioral change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Columbus (High)</td>
<td>Higher</td>
<td>More</td>
<td>More</td>
<td></td>
</tr>
<tr>
<td>Lima (Low)</td>
<td>Lower</td>
<td>Less</td>
<td>Less</td>
<td></td>
</tr>
</tbody>
</table>

Table 5.3 Community-Specific Regulation

In addition, support was also drawn from an analysis of program measures obtained from studying the implementation of local regulations. It was assumed that if two municipalities had the same level of performance, the municipality that had stricter rules and more comprehensive procedures and that was more willing to enforce these rules and procedures was more likely to have more violations in the programs than the other. T-test results of these measures showed that Columbus had more significant noncompliance violations per industrial user and had collected higher amounts in fines per significant industrial user than Lima. These test results give strong support to the hypothesis that the local regulations were more coercively implemented in Columbus. The empirical evidence of improvement in water quality supports the hypothesis that implementing such community-specific regulations brings about desirable policy outcomes.
The above findings and discussion of the third task (i.e., identification of a positive relation between contextual capacity and local government's adoption of design and operational criteria of local regulation) has pointed out and has explained variations in design and implementation of local regulations.

The fourth task identified the implementation outcomes of the community-specific regulation

The hypothesis was that community-specific regulation would be positively correlated with the discharge improvement and the wastewater treatment outcomes of the community. The study found that both communities demonstrated success in water quality improvement after the establishment of the local control authorities. However, Columbus, being stronger in contextual capacity, had a coercive regulatory relationship with industry and produced a higher degree of water quality improvement after the establishment of local control authority. Statistical test results also indicate that Columbus had better compliance records with fewer violations and lesser amounts of pollution per violation of the state's standards. The results support the hypothesis that strong context-specific regulation improves wastewater treatment outcomes and water quality. The finding concludes that a community that is comprehensive and specific in designing standards and impartially enforcing these standards has a positive effect on controlling its water pollution.
In sum, the findings of this study provide evidence of the following: 1) the involvement of local government in policy design and implementation of a national policy can positively affect the outcomes of the policy; 2) the effectiveness for a local government's adaptation of a federal policy is in part due to the context-specific design and operation of the regulations; 3) the legal authority of the regulators to enforce those regulations and the willingness of the regulatory authority to do so are all highly correlated with the socioeconomic profile of the local community and the agency's resource independence.

This study has extended implementation studies by examining factors that influence the success of policy implementation; it has added contextual capacity and design and operational components to the policy instrument studies by drawing discussions of agencies' and interest groups' behaviors from the theory of economic regulation, Olson's models and resource dependency theory. In addition, socioeconomic profiles and level of an agency's resource dependency have been used to examine the extent of industry capture and evaluate the implementation effects of local context-specific regulations. This study has also suggested that ineffective regulatory behavior may be the result of a lack of resources rather than industry capture. This study has shown a connection between contextual capacity and policy success.
This study also raises two major questions for future research. One, what can a federal or local government do to increase the contextual capacity of the local community to regulate industry? Two, how can a national policy be designed in such a way that the context-specific elements of the local community can be incorporated?

5.3 Limitations and Scope of This Study

There are limitations to this study. The analysis of industrial behavior was at an aggregated level. Individual firm behavior was not investigated. However, implications drawn from these aggregated analyses were appropriate for the study; in particular, the appearance of industry capture and the willingness of citizens to support regulation could be adequately explained at the macro level. In addition, as with most studies, data availability and completeness were problems. For example, the LEAPS database monitored different parameters at different times. As a result, it made the evaluation of water quality over time very difficult. The improvement of water quality was measured by using observations of metal discharges from the municipal wastewater treatment plants. The selection of representative parameters of industrial discharge relied on professional opinion (from state and local officials with engineering and technical expertise) and availability of these measures. Another complication came from the fact that effects of implementation were obscured over time and it was not always possible to explicitly link causes to effects.
Scope of This Study

This study addressed a local government's capacity to effectively adapt a national policy under the current trend of federal initiatives. This trend was characterized by: 1) decreased federal grants as a percentage of state and local revenues, 2) increased demands of state and local governments to take part in designing programs and punitive policies, 3) increased fiscal burden on state and local governments resulting from federal initiatives. This study provides examples of local government whose experience incorporates some of the characteristics of this trend. Both cities' municipal water pollution control was selected based on these characteristics. Some possible interfering factors of water pollution (e.g., non-point sources, regional impacts, human errors, or natural disasters) were either minimized by site selection, or the possibility of their occurrence is assumed to be indifferent to other sites.

However, one of the case selection criteria of city governments (i.e., the city has a publicly owned wastewater treatment work which treats at least 5 million gallons wastewater per day) has limited the application of the theoretical conclusions to other local governments (e.g., smaller cities and townships). These local governments, that primarily lack the scale to establish like authorities, can not be included in the group to which this study applies. These local governments may not experience similar demands from the federal government, and may have minimal influence from interest groups. Or, industrial effluence may pose a minimal threat to their water resources. However, these local governments represent a small minority in the population, and therefore lack representation.
Some limitations were brought by limited number of cases and the exploratory design of this study. First, although this study provided an initial step of operationalization of the concept of contextual capacity, the further refinement of this concept was limited by the two cases, and more indicators were needed to develop a fuller scope of classification. Like many other research using classification approach, expansion or refinement of classifications can be expected.

The second limitation was insufficient data to delineate possible collinearity among the contextual capacity indicators. For example, a positive correlation between socioeconomic profile and economy diversity can be identified; however, this relationship was not fully operationalized in this study. Furthermore, without fully operationalizing the contextual capacity indicators, the assignment of possible weights to the proxy measures of these indicators was not established in this study. For example, it is likely for communities to have similar scores of diversity index, but to have different types of industries. The magnitudes of industry influences between the communities are likely to be different, if the industries are very different (e.g., heavy polluting manufactures vs. service-oriented businesses)

5.4 Policy Implications

Lessons can be learned from the experience of the increased involvement of local government in adapting national policy. The local government can be entrusted with the authority to design and implement its own regulations and programs, as long as the local government has demonstrated the ability to meet/exceed federal guidelines. Entrusting
the local government with increased authority has the following potential benefits: 1) the policy design and implementation process can be simplified to primarily meet the local objectives and participants; 2) policy targets and target groups that are specific for the local community can be closely identified; and 3) local monitoring/policing authority can make target groups liable for their behaviors. Granting local government increased authority also brings the following challenges to the higher level governments: 1) establishing appropriate standards and guidelines for local adaptation of federal policy, 2) determining if a local government can meet these guidelines, 3) establishing an monitoring and enforcement mechanism to ensure local governments’ continuing compliance, and 4) establishing an assisting mechanism to help local governments with insufficient contextual capacity. The operationalization of contextual capacity makes possible a closer diagnosis of the contextual capacity of a local government and identification of the specific areas in need of improvement.

The conceptual framework developed in this study and its implementation helps bring theory and practice closer. By realizing a local government’s capacity to adapt a national policy, it has identified areas that higher level governments should consider in formulating policy and standards. Information derived from this study can be fed back to the higher level governments to incorporate context-specific attributes into policy design, to help decisions makers accurately assess local pollution problems, to help reconsider the allocation of resources and authority, and to foresee and plan for local actions.
Information from this study can be used to draw attention to the important role of local government in the area of intergovernmental policies. The study has brought attention to the increase of local government’s involvement in policy design, which was rarely discussed in the setting of intergovernmental policies. This study has shown that the local governments are not merely agents who carry out higher-level government mandates. Rather, the involvement of local government can positively impact the outcomes of the local implementation of intergovernmental policies. The concepts and factors contributing to the effectiveness of local implementation developed by this study are applicable to these intergovernmental policies. These concepts have been identified as follows:

a) Local governments can be entrusted with design, implementation, and enforcement authority when federal standards can be met or exceeded by the local governments.

b) Local contextual capacity interacts with the ability of the local governments to identify policy targets, define rules and standards, establish operational specifications for agents and target groups’ behaviors, and enforce these rules and standards.

c) The strength of the local economy and the resource independence of the local government are indicators of the local contextual capacity.

d) The interactions between the contextual capacity and the local adoption of design and operational criteria of the local policy positively contribute to the effectiveness of local adaptation of the national policies.
Enhancing Contextual Capacity

The local contextual capacity can be enhanced by increasing the strength of the local economy or by increasing the resource independence of local control authority. The indicating factors for both constructs include socioeconomic factors, economic diversity, financial ability, and the inclusiveness of local control. Although some of these factors are more difficult than the others to improve, the operationalization of these factors can provide useful information for policy makers to enhance the local contextual capacity.

For example, a local government can maintain (or increase) its economic diversity by providing incentives to attract business that can lower the score of diversity index, and strengthen rules and regulations governing industries that can increase the score of diversity index. However, attention is needed when new firms enter the local economy, because new pollutants might be introduced. The amount and extent of pollution may also be increased due to the increase of firms in certain categories. The local government needs to weigh the tradeoffs and consider its ability to regulate the pollution associated with the changes in local economy.

Local financial ability is one of the indicators of contextual capacity. The local governments that have lower financing ability should seek financial assistance from various external sources to become less reliant on local funding. The higher level
governments may also provide additional assistance to these localities to increase the local governments’ financing ability and to support the local wastewater treatment needs. For example, to increase a local government’s financing ability to support wastewater treatment needs, the assistance from the higher level governments may include providing additional or more accessible financial assistance (e.g., tax credits, lower loan rates, or higher federal costs sharing) to the localities that are resource disadvantaged.

To increase the inclusiveness of local control, one approach might be granting a greater degree of permit authority to the municipalities that can benefit from obtaining more inclusive control over polluters. In addition, a joint monitoring and enforcement mechanism may be established between the local authority and the higher level government to prevent (or decrease) industry capture and to increase the inclusiveness of local control. The degree of higher level government’s intervention can be adjusted according to the degree of industry capture in the community. The higher level government may help the local government to reinforce desirable policy behavior, while the local government may have some degree of liability for industries’ polluting behavior. Being in a better position of knowing its polluters and understanding its pollution problem, local government can provide the higher government information to set regulations and to bring direct dischargers to compliance.
To ensure local program quality, the federal government should establish appropriate monitoring and oversight mechanisms. For example, the federal government may develop means to suspend or revoke local authority if the local authority fails to meet program standards. Federal resources can also be allocated strategically. For example, more monitoring and enforcement emphasis may be placed on the polluters in these municipalities that are prone to be captured by industry.

Furthermore, the establishment of federal guidelines and standards is important and is crucial to determining if a local government is capable of designing and implementing its own program. For the localities that have poor contextual capacity (either have low socioeconomic profiles or high resource dependency) and that do not have the ability to meet federal guidelines and standards, the involvement of the higher level governments is necessary. The federal government may use the contextual capacity indicators to diagnose the municipalities' ability to meet federal standards. For example, for the municipalities that do not have the capacity to meet federal guidelines or standards, the federal government may need to provide a federally implemented program. For the localities that are capable but are unwilling to implement their programs, the federal government may be able to develop strategies to resolve the obstacles and to bring compliance.
By realizing communities might be insufficient in different areas and levels of contextual capacity, the higher level government can consider modifying its existing programs and allocating resources to assist these communities in need. However, research attention to develop methods that can foster local contextual capacity in the long run and evaluate the effectiveness of methods to encourage local economic diversity, provide incentives for multiple investors, financial assistance to communities, and strategies to increase the inclusiveness of local control should be a continuing objective for both the academic and public policy communities.

As discussed in the previous section, regarding the limitations of limited number of cases and exploratory research design, a refinement of the concept of contextual capacity can strengthen the insights gained from this study. Further operationalization including quantifying proxy measures of contextual capacity indicators is a useful step towards the attempt of the refinement. However, more research efforts are needed for operationalizing and quantifying these contextual capacity indicators.

Conceptually, further refinement or expansion of the concept of contextual capacity can be developed by adding classifications with communities having profiles different from the prototypes of the two cases. For example, a community with stronger socioeconomic profile, more diverse economy, stronger financing ability, and more inclusive control of industry is likely to use more coercive measures to regulate industries, and would have better water quality improvement. However, this refinement
can not be accomplished without identifying the interrelationships among the factors of
the strength of socioeconomic variables, the strength of local economy, financing ability,
and the inclusiveness of local control. For a follow-up study, this study suggests
inclusion of more refined variables and quantified measures to support each cluster of the
contextual capacity factors, and to identify the correlation and weights among these
factors.

The development of the measures of diversity index with weights on the types of
industry is suggested. For example, for the communities that have similar scores of
diversity index, a weighted measure on the type of industry can be applied. Using the
positive relationship between socioeconomic profile and the economic diversity as a
priori premise, it is likely that the strength of the industry capture from a wealthier
community with a minimal economic diversity is less strong than a poorer community
with a minimal diversity. It is assumed that the type of industry in the wealthier
community might not be heavy polluting industry, and hence might have less direct
interests and impacts on water quality regulations and wastewater treatment outcomes.

In the area of policy theory, by adding a behavioral dimension consisting of
contextual capacity and the local government’s adoption of design and operational
attributes of a policy tool, this study has identified and addressed potential deficiencies of
previous policy instrument studies. This study has also identified the importance of
contextual capacity that was previously ignored by policy instrument theory. By
establishing the relationship between contextual capacity and the local government’s

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adoption of design and operational attributes of a policy tool, this study has provided empirical evidence of the variability of operation and effectiveness of an existing policy tool that was left unexamined.

Although recent policy instrument studies have moved in the right direction that allows circumstantial evaluation of tool attributes, without arbitrarily suggesting the freedom of replacing one tool with another, the notion of substitution remains strong in these studies. For example, May and Burby (1996) evaluate the superiority of cooperative approach for a intergovernmental relationship, and Yu and others (1998) examine tool interaction, and suggest adding an informational tool to an authoritative one. At any rate, without examining why some attributes are adopted in one circumstance but not in another, policy scholars still operate in a normative arena in which the circumstances and causes driving the success of the policy are overlooked by the presumed superiority of certain policy tools (or attributes).

By analyzing contextual capacity from the socioeconomic and agency perspectives, this study has operationalized these concepts within the economic/interest group theory at the city level, a level rarely addressed in prior studies. This study has also suggested that the ineffective implementation of regulations can be a result of insufficient resources rather than industry capture, and that a community that has strong contextual capacity is less likely to be influenced by industry or a particular interest group.
5.5 Summary

In sum, this study has discussed the changing trends in the relationship between the local government and higher mandating governments, the context-driven regulatory relationship between the local control authority and the industry, and most importantly, the capacity and factors enabling a local community to effectively adapt a national policy. In addition, by combing qualitative and quantitative approaches, this study has demonstrated how some of the analytical problems of policy implementation can be overcome through the judicious use of multiple data sources and data types. Furthermore, the information derived from this study can be fed back to the policy making and scholarly communities for a better understanding of the capacity and the behavior of a local community in the policy process.

The study’s findings introduce new factors to be considered in evaluating the design of policy instruments. Instead of rational assumptions, this study operationalized prior theoretical concerns and offered empirical data to test theoretical assumptions described in this study. Contextual capacity is positively related to policy design and implementation, and is a necessary condition for the successful outcomes of policy implementation. This study has indicated the importance of context-specificity and has operationalized this concept. By providing the initial step of operationalization, it opens a dimension on how to enhance local contextual capacity. The study has also suggested new challenges to the research community to incorporate and develop capacity building
elements into policy instrument literature, and has also indicated that future policy instrument studies could be improved by providing analysis of the community’s capacity building elements identified in this study.
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APPENDIX A

LIST OF MEETINGS AND INTERVIEWS

The meetings and interviews are organized as planning and orientation, initial and
follow-up stages. This study is based upon a research funded by the OEPA to assess the
effects of environmental mandates on water quality. Data collections were conducted
conjointly with the Ohio State University (OSU) research team, led by Dr. Anand Desai
and assisting with a group of graduate students.

I. Planning and Orientation

The planning and orientation stage was to define research scope and data sources and to
familiarize the policy context

Time: December 6, 1994, 1:00pm -2:30 p.m.
Attendants: OEPA Steven Scoles, Greg Smith, Steve Snyder, and Chris Yoder and the
OSU team members
Location: OEPA, 1800 WaterMark Dr. Columbus, OH 43216
Summary: discussions of research scope and mutual interests

Time: April 5, 1995, 12:00pm-1: 45pm
Attendants: OEPA Theresa Heitzman, Bob Monserrat, Dave Reiff, Steve Scoles, and
Chris Yoder and the OSU team members
Location: OEPA
Summary: identification of tentative segments of streams, sites, and data sources

Time: April 17, 1995, 2:00pm-3: 15pm
Attendants: OEPA Theresa Heitzman, Meg Klepie, Dave Reiff, and Chris Yorder and
the OSU team members
Location: OEPA
Summary: discussions of scope of financial data and site selection

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Time: May 1, 1995, 1:00pm-3:00pm
Attendents: OEPA Gene Wright and the OSU team members
Location: OEPA
Summary: reviews of legislative history and federal costs sharing and the Ohio grants and loans programs

Time: May 5, 1995
Attendents: OEPA Gene Wright and the OSU team members
Location: OEPA
Summary: identification of funding sources to wastewater treatment capital projects

Time: May 12, 1995, 10:00am
Attendents: OEPA Gene Wright and the OSU team members
Location: OEPA
Summary: reviews of Ohio's funding mechanism and types of permits

Time: May 15, 1995
Attendents: OEPA Bob Heitzman and the OSU team members
Location: Program & Fiscal Management, Division of Surface Water, OEPA
Summary: reviews of Ohio surface water standards and implementation

Time: May 22, 1995
Attendents: OEPA Randy Bournique and the OSU team members
Location: OEPA
Summary: reviews of NPDES permits and enforcement

Time: May 31, 1995, 12:00-2:00
Attendents: OEPA Mark Stump and the OSU team members
Location: OEPA
Summary: reviews of the state's pretreatment and municipal NPDES permit

Time: July 10, 1995
Attendents: OEPA Bill McCarthy and Larry Korecko and the OSU team members
Location: Central District Office, 3232 Alum Creek Dr. Columbus, OH 43207
Summary: reviews of data availability from the office. Discussions on incremental factors that are associated with water quality variations.

Time: August 1, 1995.
Attendents: OEPA Theresa Heitzman, Bob Monsarrat, and Chris Yorder and the OSU team members
II. Initial Interviews

Initial interviews were to collect descriptive and background information on mandates and local regulations, financial data, LEAPS and NPDES permits.

Federal and state mandates and local regulations

Time: March 15, 1996, 1:30pm
Interviewee: Jeff Berkhart
Pretreatment Program Manager
City of Columbus
900 Dublin Rd
Columbus, OH
Summary: review of city pretreatment program, the evolving role of the city, and pertinent regulations and rules

Time: April 16, 1996, 9am
Interviewee: Mark Stump
Water Resource Management Section
Division of Surface Water
1800 WaterMark Dr.
Columbus, OH 43216
Summary: reviews of state pretreatment program, the State’s authority, and information sources. Discussions on selection of water quality indicators.

Time: April 24, 1997
Interviewee: Jerry Coffey
Lima WasteWater Treatment Plant
TEL: (419) 221-5190
Summary: request of historical information on Lima pretreatment program and of data collection assistance
Financial Information

Time: June 20, 1995.
Attendees: OEPA Gene Wright and the OSU team member
Location: OEPA
Summary: reviews of available in-house databases

Time: June 27, 1995.
Attendees: Columbus City Auditor Hugh Dorrian and the OSU team members
Location: Office of the City Auditor
90 West Broad Street
Columbus, OH 4315
Summary: seeking assistance on collecting financial data on WWT. Reviews of city funding and resources

Time: August 1, 1996, 10:00am
Attendees: Lima Jerry Coffey and Mike Bamhart and the OSU team members
Location: Lima Wastewater Treatment Plant
1200 Ft. Amanda Rd
Lima, OH 45804
Summary: reviews of expenditures on WWT and changes in water quality. Seeking assistance on data support.

Attendees: Columbus Karen Dusied, Suzanna Gussler and Director Jim Joyce, and the OSU team members
Location: Department of Public Utilities
City of Columbus
910 Dublin Rd
Columbus, OH 43215
Summary: discussions on data availability from the city, data format and identifier

LEAPS and Permit data

Time: July 28, 1995
Attendees: OEPA Sandy Kamper and Gene Wright and the OSU team members
Location: OEPA
Summary: reviews of the content and availability of in-house electronic data
III Follow-up Interviews

The interviews were to explore subject-specific information, and (or) to verify or clarify information collected from the initial interviews.

Financial information

Attendants: OEPA Sam Chekaro, Meg Klepic, Bob Monsarrat, and Gene Wright and the OSU team members
Location: OEPA
Summary: discussions on parameters and identifier of longitudinal financial data

Time: January 29, 1996 and January 30, 1996
Interviewee: Karen Dushied
Location: Columbus Auditor’s Office, (614) 645-7615
Summary: obtaining information on the city’s accounting methods

Time: February 9, 1996
Attendants: Columbus General Engineering Section Bob Hill and the OSU team members
Location: Southerly Wastewater Treatment Plant
Summary: seek data assistance on identifications on the projects and the spending

Time: May 20, 1996
Interviewee: Bob Hill
Location: (614) 645-7610
Summary: clarification on some financial accounts

Time: May 29, 1996
Attendants: Columbus Bob Hill and the OSU team members
Location: Southerly Wastewater Treatment Plant
Summary: reviews of the city’s definitions of types of spending

Time: October 24, 1996 11:08am
Interviewee: Mike Barnhart
Location: Lima Utilities Department, (419) 221-5294
Summary: clarification on city’s accounting methods on WWT spending
Local regulations
Time: March 18, 1996
Interviewee: Columbus Jeff Berkhart
Location: Columbus Surveillance Laboratory
Summary: reviews of changes on local limits, city codes, and enforcement activities. Information on annual reports and selection of water quality indicators

Time: April 9, 1996
Interviewee: Dan Rossi
Location: Columbus Surveillance Laboratory
Summary: collection of annual report consisting of OEP A AR2 ~ AR4 forms

Time: April 30, 1997, 2pm
Interviewee: Lima Pretreatment Coordinator Trevor Violet
Location: (419) 221-5190
Summary: reviews of Lima pretreatment program, changes of local limits, industry compliance, and enforcement issues

LEAPS and Permit Limits
Time: May 7, 1996, 10am
Interviewee: Dr. Tong Kim
Location: Water Quality Modeling Division of Water Quality Planning and Assessment OEP A
Summary: technical supports on selecting sites, stations, and parameters. Explanations on uses of LEAPS database

Time: June 6, 1996
Interviewee: Gary Stuhofauth
Location: Division of Surface Water, OEP A
Summary: verification on electronic database structure. Discussions on longitudinal tracking methods and selection of effluent stations.

Time: June 27, 1996.
Attendants: OEP A Maan Ossman, Eric Nygaard, and Ron Wamsley and the OSU team members
Location: OEP A
Summary: discussions on technical support on in-house data retrieval
Time: August 17 and 18, 1998.
Attendents: OEPA Meg Klepic and Gene Wright
Location: Phone Interview
Summary: information on states’ status of NDPES programs
APPENDIX B

SAMPLE QUESTIONS OF INITIAL INTERVIEWS
Request of Financial Information:
Wastewater Treatment Capital Projects
Lima, 1980-1994

As indicated in our telephone conversation, we would like to collect information on capital expenditures for wastewater treatment from 1980 to 1994. Very briefly, the purpose of this exercise is to estimate the costs imposed by pertinent federal and state mandates and the costs imposed by local demands. We would also like to link these costs to the improvement of water quality.

To obtain an understanding on the financing mechanism of wastewater treatment projects, we would like to collect information that can be used to address these three groups of questions:

1. **Purpose of capital projects**: What were the city’s wastewater treatment projects from 1980 to 1994? The focus is on capital improvement, for instance, building new sewers, upgrading facility for secondary or advanced treatment, expanding capacity for growth, etc.

2. **Amount and Sources of Funds**: Dollar amounts associated with these projects? What are the sources of these funds? Local, state, or federal? What are the types of funds? Loans? General obligation bonds? Revenue bonds?

3. **Sources of repayment**: What are the sources of repayment to the debts taken by these projects? Are the projects self-sufficient? How do the repayments work?

In particular, fields of the annual financial data are identified as follows:

- year
- project identification number
- name of the project
- brief descriptions of the purpose of the project
- sources of funding (including the names of specific funding sources)
- fund identification number
- brief descriptions of the funds
- types of funding
- dollar amounts of annual expenditures

Other information of interests from 1980 to 1994:

- annual spending, including operation and maintenance on water and sewer enterprises,
- annual clientele data receiving the city’s wastewater treatment service,
- annual census data including population and median income per capita of the city, and
- the city’s bond rating.
Information of Interests:
Local Government's Action on Water Pollution Control
City of Columbus and City of Lima

Please gives detail descriptions on the following inquires, focusing on the areas of local limits, monitoring and enforcement.

I. Descriptions on major changes of local limits and guidelines on monitoring and enforcement on industrial users throughout the years
   - when did the major changes occur? What are the changes in limits and enforcement activities?
   - what direction has it become? Milder? Stricter? Why?
   - identify the types of industry that are most common in the city
   - identify the types of industry that dropped out because of the program
   - has there been industry turned away because of the program

II. Descriptions on "actual" approaches when dealing with violations in first, second, or repetitive offenders
   - are they regressive? Aggressive? No differences?
   - were there unexpected in-house inspections? Why? What were the responses from the industries? Any disputes resulting from these types of action?
   - recall catastrophic (or major) events that the industry was quick to correct its behavior and the events that the industry failed
   - in terms of pretreatment effort, what is the most successful industry? and what is the most difficult industry to work with? Why? What are the parameters associated with these industries?
   - give a general evaluation of the program implementation
   - what areas of the implementation can be improved?
Request of Historical Information on
Lima Pretreatment Program

We would like to gather some information on your pretreatment program. The information can be grouped as follows:

**Background information, including:**
1. pertinent rules, regulations, and guidelines
2. history of the program
3. descriptions of operations
4. descriptions of enforcement and complacence

**Major changes of the program, including:**
1. the regulatory roles of the city government before and after the implementation of the program
2. major policy changes of the program regarding local limits, operation, and enforcement methods
4. what industry is most successful in complying with pretreatment? what industry is most difficult to work with? why?

**Selection of parameters:**
1. identification of parameters that are most damaging to the treatment plant
2. identification of parameters that are most affected by the pretreatment program
3. identification of parameters that are most commonly found in the users' discharges and are regulated by the program.

**Information and statistics, including:**
1. annual industrial users inventory
2. annual compliance information

*The detailed inquiry of annual information and statistics is organized in the attached spreadsheets, please use the space provided to fill out the information.*
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