Social and Economic Factors in the Adoption by Industry of Water Pollution Control Measures in Minnesota

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FOREWORD

This Bulletin is published in furtherance of the purposes of the Federal Water Resources Research Act of 1964. The purpose of the Act is to stimulate, sponsor, provide for, and supplement present programs for the conduct of research, investigations, experiments, and the training of scientists in the field of water and resources which affect water. The Act is promoting a more adequate National program of water resources research by furnishing financial assistance to non-Federal research.

The Act provides for establishment of Water Resources Research Centers at Universities throughout the Nation. On September 1, 1964, a Water Resources Research Center was established in the Graduate School as an interdisciplinary component of the University of Minnesota. The Center has the responsibility for unifying and stimulating University water resources research through the administration of funds covered in the Act and made available by other sources; coordinating University research with water resources programs of local, State and Federal agencies and private organizations throughout the State; and assisting in training additional scientists for work in the field of water resources through research.

This Bulletin is number 67 in a series of publications designed to present information bearing on water resources research in Minnesota and the results of some of the research sponsored by the Center. This Bulletin is concerned with the industrial change in water use through the incorporation of new knowledge and technology to reduce the pollution of Minnesota's waters. Results of the research provide an analysis and further understanding of the social dimensions of pollution control and the underlying conflicts that are influencing the direction of the quality of water resources in Minnesota.

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ABSTRACT

Change in industrial organizations is one of the elemental facets of change in modern industrial societies because of their power and the immense volume of waste, solid and liquid that comes from industrial production. Change is a complex phenomena at all levels of analysis; industrial changes in water use are preceded by general societal changes as to priorities and values regarding economic production as opposed to living quality or a clean physical environment. Numerous agencies and organizations, private and public, now exist for the sole purpose of changing and regulating private and public water use. The conservation ethic has been part of society for some time but it gained power only in the last decade to the point where fundamental issues related to the organization of industrial production have come to the fore. Any study of industrial change, therefore, has to consider the relationship that industrial organizations have to such groups. Under the model of development emphasizing economic growth per se, there was little if any pressure upon industries to consider the affect of their production on external factors like water quality. There is pressure now and the pressure can be expected to continue.

Water has always been one of man's most vital resources and its importance has increased as industrial and agricultural development began to accelerate. Water is, at the same time, basic to human health and consumption, a basic ingredient of agriculture, of public recreation, and, of course, a principal input to industrial production of all kinds. Industry uses more water as direct and indirect input to production than any other single source. As a result of its many uses and the mutual dependence of various groups upon water but with decidedly different goals and responsibilities, water use has become a focal point of controversy and change. Fundamental change is in the offering in terms of past and current debates about the relative responsibility of industry to clean public water after they use it in vast quantities and usually at rather low economic cost. Certainly, there are now differences among groups calling for changes in industrial water use and within industry itself as to what kinds of changes are to be made. There is, however, one constant factor. Industry and other groups, private and public, can no longer use water as they have in the past.

This study is an attempt to further understand the process by which industrial organizations change the way they dispose of waste. Substantively, the relationship of organizational characteristics to rates of change in waste procedures is of interest. A general model of change is envisioned. The two major forces creating change in industrial organizations are the internal pressures within the organization that result from such factors as the complexity of its division of labor and production technology, and the kinds of pressure the organization faces as the result of powerful and aggressive regulatory agencies and other groups. Finally, the nature of dependence the firm has upon water affects change.

To test hypotheses and find answers to questions, a comparative study of firms in different industrial categories was made. Each category was selected because of its dependence upon water as a production input and by the importance of its operation for water pollution. Industries were studied at two points in time. In the first phase, the primary interest was in measuring the internal characteristics of the organization - how complex their structure was, the nature of their production technology, and the rates of change they had experienced in water use and production over the last ten years. The principal investigator then waited a year in order to measure the degree of change that the company experienced in water use and waste procedures for that year. The nature of the relationship of the organization to outside pressures such as regulation was also measured in the second phase. The study, therefore, estimated changes in the company by production managers over a ten year period prior to contact and the changes they report for a single year.

One hundred and twenty-eight organizations were studied in the first phase. They were selected systematically but not randomly. It was, in other words, a purposive rather than a probability sample. One hundred and two organizations were chosen from the original 128 to be included in the second phase of the analysis. Industrial firms selected had high volumes of waste water, high bio-chemical oxygen demand because of their wastes, and produced substantial amounts of settleable and suspended solids. Twenty-eight of the firms studied could be categorized as producing food and kindred products. Eight industries produced paper and allied products. Twenty-nine of the companies could be classified as producers of chemicals or allied products. There were seven petroleum companies and thirty others that could be included among manufacturing categories of machinery and transportation equipment.

In the first year of the project, the principal investigator visited several firms of various sizes and problems with water use in order to pre-test the data collection procedures. As a result of this experience a standardized interview schedule and questionnaire was developed and administered to executives in each of the firms studied. These interviews along with company and public records were the study's primary source of data. The interview schedules were highly standardized using many items modified from other studies of industrial organizations. After searching the literature dealing with industrial organizations in numerous academic fields, visiting firms and speaking with their managers, and with professionals acquainted with industrial organizations, the following categories were used as the basis for measure of change: product design and manufacture; training and qualifications of employees; allocation of capital resources; use of scientific and engineering consultants; waste processing and equipment; and marketing.

The model of organizational change developed includes as its primary ingredients the structural attributes of organizations, pressures from the social environment, and use of physical resources. Since natural resources are obviously important to industrial production, changes in the quality and supply of those resources ultimately generate changes in the organization that uses them. Conclusions reached as the result of model studies are as follows:

Industrial change is a multi-dimensional variable. Changes in waste disposal procedures or pollution abatement methods are related to changes in other dimensions of the organization's structure. Employee training and development is an important part of pollution abatement as new practices introduced into production or the adoption of new equipment require employees to change work practices or learn how to operate and repair new machines. In many cases, new chemical tests are needed for the detection of harmful chemicals, minerals, or bacteria. The work of biologists, chemists, bacteriologists, chemical engineers, hydraulic engineers, civil engineers and other professionals are basic to adequate industry waste disposal techniques. Professional consultation and scientific knowledge has been a key point in deciding pollution issues and will continue to be so. Product quality control is related to waste disposal programs, as is actual manufacture of the product, product design, and allocation of capital resources. In short, industrial organizations are systems and like all systems the parts are inter-dependent to the degree that changes in one dimension produces changes throughout the system. Companies are more receptive to change as they increase in size and structural complexity. The latter refers primarily to the rates of consultation with professionals, how specialized the company is, and the complexity of work procedures. Industry-agency relationships also make a difference. The degree of regulation, pressure and frequency of contact are all associated with rates of general change and change in waste control procedures. The activity of executives in their local communities is also related to change as is the way in which the industry uses water and disposes of waste.

Frequency of contact between industries and public agencies emerges as one of the most important variables in understanding changes in industrial pollution control practices. Although industries may have the resources to reduce their pollution, they are not likely to do so unless there is consistent contact and pressure from public agencies. Industry-agency conflict over environmental regulation is now everyday news. There is no question that state and Federal bureaus have grown in power with respect to their ability to establish and enforce regulations. Company executives generally support environmental regulation by these agencies. It was found that an active role by state and Federal regulatory agencies is subscribed to by most company executives. Overall, executives prefer that state and Federal governments establish policy while local governments enforce such policy. Companies need certainty in order to plan for the future and deal with present circumstances. As a result, efforts to control events that would effect their production and profits are to be expected. When policy is formulated at the state or Federal level, there is a greater probability that such policy will last than if it were locally legislated. Additionally, competitors in other states or regions will be subject to the same regulations. This was the logical framework upon which executives from large companies based their judgements. Some small companies also felt more secure with state and Federal regulation than local as they expressed concern over the ability of large companies to influence local decision-making.

Company participation in local affairs has become even more important since the rise of the environmental movement and public concern about water and air quality. Challenges to local firms that pollute water as a result of their operation has become increasingly commonplace. Furthermore, changes that are suggested by public and private groups effect methods of operation and production. Although local private groups have formed in many instances to challenge firms, the most common strategy of these groups has been to pressure local government, state and Federal bureaus to legislate industry behavior or enforce existent legislation. As a result, government at all levels has become an active participant in environmental management, state and Federal more so than local. Although company executives are active participants in local affairs, they are somewhat dubious about the depth of local support for their company's poistion on pollution control. Furthermore, they communicate as much or more with state and Federal officials, other companies, business and trade associations than they do with city and county officials. Finally, local government is given a very minor role in the establishment of policy. Local government is, however, strongly supported by the same executives as enforcers of policy. If past research showing that industries and business generally dominates local decision-making is correct, it is clearly in the interest of local business to have city and county officials be responsible for enforcement as business should be able to influence the judgement of these officials more so than representatives of state and Federal bureaus. Companies want regulatory policy to be consistent over time. Since policy developed at the local level can be overturned by state and Federal agencies, company preference for state and, especially, Federal control in policy-formation is logically understandable.

Water use and waste disposal are basic linkages between industries and local communities. Companies get most of their water from community wells and dispose of most of their liquid wastes in city and county sewers. For this reason, it would be expected that companies will work so that their viewpoints will be represented in policy-formation about water systems, sewer systems, tax rates and long-range planning about community water resources.

INTRODUCTION

Innovation or change in industrial organizations has long been of interest to social scientists, economists, and policy-makers. Especially now, such change is a critical variable since most of our problems, including water pollution, involve industrial firms, large and small. Rapid economic growth and the development of technology for the purposes of increasing production has had the unexpected consequence of widespread water pollution and other kinds of ugliness. Estimates vary but most professionals now agree that industrial effluent is the foremost cause of water pollution in the United States and the industrial world. As a result, the problem is not just domestic but international in scope. Industrial change in water use is our primary focus. One hundred and two water using industrial firms in Minnesota have been intensively studied over the past three years at two different points in time. By change we refer to the process by which an industrial organization is inclined to search for, develop, store, and use knowledge to accomplish its goals. Further, whether it has the inclination to change and use new knowledge even if the capacity to do so exists.

For the sake of efficient operation as well as survival, industrial firms must search for new ideas and general knowledge. They need information about themselves and what is happening in their environment. The environment includes not just the physical but also and, perhaps, more importantly the social environment or the powerful groups to which they must relate in order to function. Surely, one of the problems that any administrator faces in his firm is simply finding out what is going on, how the production line is working, whether employees are doing what they are supposed to be doing, how the divisions in the company are working together and, of course, what the competitors are planning, the nature of the market, and the emerging policy of regulatory agencies. Although firms vary considerably in their ability to get the information they need and in their ability to use knowledge once they have it, knowledge is a constant requirement. Incorporation of knowledge about one's own company, the social, and physical environment is one of the most basic aspects of company functioning and administration and, certainly, the basis for change and innovation.

There is also the problem that knowledge seeking by organizations is substantially influenced by their main goals. In this case, we are speaking of profit-maximization and production growth. An organization can be highly innovative with respect to production goals and know little about the consequences of its production technology for environmental quality nor care. This tendency is partially offset, however, by the accompanying goal of surviving. All companies work within socially defined constraints. One could argue that in order to stay in business, firms must reduce the extent to which they pollute the environment. Certainly, staying in business is an important a goal as is profit-making and production growth. On the other hand, firms are also powerful enough to considerably influence the nature of the constraints under which they must operate. Because of their influence, they are often able to sway public decision-making about pollution, and, therefore, are able to in-

fluence how the problem is defined and the kind of solutions to be sought and implemented. In general, then, we are concerned with the social process by which environmental quality is defined, solutions conceived, and implemented. The social process, from our perspective, is that involving the interaction of powerful groups, private and public, all vitally interested in water use but with different ideas about the relationship between industrial production and water quality. An important part of the overall process is industrial change in water use or the incorporation of new knowledge and technology to reduce the extent to which they pollute public water.

We will argue, in this report, that the underlying social processes are very important to understanding the relationship of industrial production and environmental quality. Truthfully, we assume that knowledge of the social processes is as important as the search for and existence of material technology (which is also a social process). If there have been any breakthroughs in the ability of the United States and the rest of the world to deal with an emerging pollution problem in the past few years, they have been the establishment of complex management systems designed to regulate water use locally, nationally, and internationally. The success or failure of our efforts to reduce pollution and create a world with a desirable environment will come from the ability of administrative forces to marshall knowledge, define the problems of pollution, set standards for water quality, and follow through with programs that change the way we use water.

The development of technology and knowledge necessary to reduce industrial pollution is more rapid then its use by industrial firms and industrial societies, generally, as has been the case with other problems of social development. The application of medical knowledge to treat illness and the use of knowledge about agricultural crops and yield have shown the problems inherent in creating the kind of administrative structure where problems can be affectively met even if the knowledge exists to technically deal with a specific condition. The basic objective underlying the more specific purposes listed below is to better understand the correlates of industrial change in water use and waste control.

This report has been subdivided in the following manner:

1. In the first chapter, we will present the overall conceptual model exemplifying the background, concepts, and ideas with which we are working and why the research took the direction it has.

2. Chapter II will deal with the research design and the general research strategy.

3. Chapter III will present data comparing one-hundred and two companies according to how much change they have experienced in waste control and the relationship of production and waste control changes. Also, attitudes of industrial managers about public regulation of industrial and community water use will be discussed. Data include executive attitudes about level of government involvement and which level should be most active as well as the specific role and the nature of the relationship between the company

4. Chapter IV will attempt to explain the varying rates of change to be found among the companies we studied. Each of the independent variables discussed in our theoretical model will be related to change.

CHAPTER I. - BACKGROUND

Mastery or understanding of nature is one of the prerequisites of organized social life. In turn, the social organization of a given society influence the relationship of the society with the natural environment. The discovery of natural laws and the consequences of using such knowledge are sometimes contradictory as one result of advanced industrial production has been serious environmental pollution. In this report, we attempt to understand current problems of water pollution and its resolution by analyzing the cultural priorities of modern industrial societies and the factors influencing the relationship of the industrial firm to the natural and social environment.

The rapid growth of our industrial technology and the emergence of heavily populated urban areas have placed serious strains on the quality of our natural resources. Water, for example, is a basic ingredient of industrial production, and when not a specific input the resource is often used for the elimination of waste.[1/] At the very time the public needs an ever increasing supply of good quality water, it has experienced decline in both quantity and quality. Accordingly, water pollution has become socially unacceptable and its occurrence a focal issue in the relationship of public and private interests, industrial organizations, and their com-

1/ Industry is the largest withdrawer of water in the United States and its total water use can be expected to increase. Industry, in addition is the major producer of waste that potentially pollutes public water. Pollution from industrial production far exceeds that from domestic use. According to the 1969 report from the American Chemical Society, the overall volume of waste from industrial production is at least 2 1/2 times the volume from municipalities and other domestic uses, the waste from industry has about three times the BOD requirements as does waste from municipalities, and suspended solids put into water by conventional domestic uses is about 1/2 that contributed by industries. (See "Chemical Basis for Action," Report of the American Chemical Society, 1969). Given the normal functioning of the U.S. economy, both the absolute quantity of water used and the liquid wastes produced by industry will continue to increase as we experience economic growth (Bower, 1965).

munities.[2/] Industrial organizations are simultaneously faced with a deteriorating resource, water, upon which they are highly dependent and an increasingly hostile social environment in which powerful groups are attempting to regulate the industrial use of water and challenging, in many respects, the traditional decision-making autonomy of industry.

A fact of life for industrial organizations is that their goals and behavior both influence and are influenced by the physical and social environment. Current logic suggests that the behavior of industrial organizations is heavily influenced by the nature of their internal characteristics or social structure and by their goals, namely, profit-maximization and growth in production. By characteristics of the social structure, we mean, for example, something such as the degree to which interpersonal relationships within the organization are subject to specific written rules or bureaucratized, the complexity of the work in terms of the kind of technology or knowledge that is utilized for production, how specialized or subdivided the work is. These variables and others have been found to be important factors in explaining the ability of an organization to search for knowledge and change. Industrial organizations, as all other social units, attempt to control their environment so that their main goals can be met at the highest level possible. Environmental constraints exist, of course, and the organization is, therefore, required to relate to outside groups such as regulatory agencies so that the pursuit of profit and production does not, among other things, pollute water and air. Such constraints, however, are negotiable and the quality of the relationship between agencies and industries is important in determining how much regulation there is.

The physical environment refers to air, water, land and all other natural resources upon which industrial production is dependent. Industries and man, generally, live in a physical environment and employ material technology in adapting to it (Duncan and Schnore, 1959:134). The social environment includes values and the power structure prevailing in the society. For example, an important aspect of the current social environment for water using industries are the public and private organizations seeking to influence industrial water use. The social environment responds to the manner in which industries use material technology

[2/] The quality of the natural environment remains an important public issue even with the current concern for new energy and the possibility of an economic recession. Survey respondents no longer rank the issue as number one but it continues to be in the top ten when people are asked to list their current concerns. There is also the fact that the environmental movement has matured and has been institutionalized to a large degree. That is, it is no longer a hot, new issue but one centered in the context of large regulatory agencies responsible for pollution control and regulation of industrial and community water use. To a large degree, the American public has accepted environmental quality as an institutional goal and concepts such as closed systems of production are becoming increasingly popular. Agencies at all levels of government are trying to get industries to essentially recycle their liquid wastes so that the same water is used over and over again. Obviously this is more feasible for some industries than others, mining and gravel washing as opposed to slaughtering and meat packing or the dairy industry.

to meet production and profit goals. Therefore, industrial dependence on the physical and social environment are not separate factors. Production is quite dependent on the availability of a continued flow of natural resources. And, production, in its requirements for standardization, also functions best when there is a constant and regular resource flow. When changes in the resource base change or when new definitions emerge, past standards have to be devised and there is some disorder in production.

An analysis of industrial change, therefore, requires that attention be given to the cultural values of the societies in which they function, the internal structure of industrial organizations, and the nature of their contact with other organizations, public and private, that are trying to change the way industries use water. Finally, a relationship that students of complex organizations have generally overlooked is the ultimate dependence of all human groups on the inanimate environment. The latter has increased importance given the existence of three contemporary conditions: (1) although the extent is not fully determined, serious damage has been done to the natural environment as the result of advanced industrial production; (2) to a considerable degree, the technology and the scientific knowledge needed by industries to reduce their pollution is available, and (3) the current debates over the definition of a quality environment and the general rules for the use of the physical environment directly involves industry and has far reaching consequences for the role of industrial production in contemporary society. The general question of interest is "When do industries search for information?" The question is more than one of public image for industries. The future role of industrial organization and environmental quality is at stake. Their capacity to change the way they use natural resources is important to understanding the association, conflictive or cooperative, between industries and other groups also dependent on the natural environment.

Culture, Society and Industrial Use of Water Resources

The value patterns of American culture and similar western industralized nations are generally compatible with the needs of an expanding industrial system and the goals of science. Mastery of the physical and social environment has been the consistent objective and recurring theme of the industrial and scientific communities. Extensive exploitation of natural energy and social order are basic requirements of industrial development. As a result, the political, educational, and economic institutions are intimately related. The political institution insures order and support for long-term industrial investment and the educational institution is a primary source of scientific manpower and knowledge that contributes greatly to the sustenance and expansion of production technology. Finally, the behavior of the individual firm reflects the values and priorities of industrial societies. The resistence of industrial organizations to adoption of available pollution control technology can be explained partially as a product of the value hierarchy of an industrial economy, one where economic growth, increasing per capita income, and full employment are accepted public goals.

As rational structures, industrial organizations, as do industrial societies, see the physical environment as a means to an end - production and economic growth. By and large, natural resources are valuable only when they can be transformed into capital or material goods. This is very consistent with general public and official goals. In truth, few objectives have been embraced more fervently than has economic growth and its compliment, full employment. Technological innovation is valued to the degree that it contributes to economic growth and stability. Therefore, the mature corporation innovates in the direction that seemingly contributes to its growth and power while other concerns are given less importance. With reference to water use, Bower (1965:143-144) contends that industries have given little consideration to: (1) the substitution possibilities among the components of industrial water utilization systems, (2) the relationship of water to other factor inputs to the production process, and (3) the impact of technological changes on industrial water utilization.

If natural resources, e.g., water, are seen primarily as commodities, (Burch, 1970), the pollution problem has its roots partly in the contemporary organization of economic activities. Industries find that the price of everything they use - land, labor, material supplies, time - is increasingly dear. The power position of labor in industrial societies is, of course, related to industrial priorities. But clean water, though now deemed precious by some powerful groups, is still largely left out of the pricing system, and is still relatively free of charge.[3/] The current pricing system works against the conservation of natural resources. Not surprisingly, techniques for the conservation of water and the adoption of available technology have progressed very slowly. The effect of omitting nominally free resources from the pricing system and our overall model of economic development has made the economy as a whole, namely, the public, pay a considerable subsidy to those activities that result in environmental deterioration. In short, contemporary economic organization reflecting the cultural values of an industrial system strongly oriented to constantly increasing its income and production levels has provided a huge, if unintentional, market incentive to pollution.[4/]

3/ Industries that use water as an integral part of their production process, e.g., the brewing industry, do pay for water. The point that we wish to make is that in comparison to other costs, water as a direct input is very low. Furthermore, any discussion of industrial water use must consider the use of water, lakes, rivers, for taking industrial effluent. The widespread dumping of industrial effluent into bodies of water magnifies many times the overall importance of water to the industrial process. In general, industries in the past have not had to pay for water used by them for effluent purposes, except indirectly through paying taxes for municipal water plants and sewage disposal, see Bower, (1965).

4/ We are speaking here of industrial systems or societies and not capitalist as opposed to socialist economies. Although the pricing system differs among the two as well as the concept of the market place, increasing levels of national and individual income is a prominent goal in both. (Schumpeter, 1942; Galbraith, 1967). Environmental pollution in the socialist countries is a serious problem for substantially the same reasons as in the United States. Worldwide, envirionmental quality and concern for health hazards that result have been given much less consideration than economic growth.

New concepts began to emerge in the last decade that have challenged the traditional model of economic growth. Arguments range from curtailment of growth altogether (Commoner, 1972) to revising the traditional model so that environmental quality is a societal and industrial goal equal to increasing income (Heller, 1972; Heilbroner, 1972). The environmental movement has matured and expanded in power and scope (Morrison, Hornback, Warner, 1972). From the earlier goals of preservation and conservation have emerged the concept that if modern man and his civilization are to survive, administration of man's environmental context must become a major task of government (Caldwell, 1971:xii). Environmental administration has become prominent and is the province of large and potentially powerful agencies at all levels of government. The meaning of environmental administration, according to Caldwell (1971:xiii), is "the control of human action in relation to the environment." Consequently, control of industrial production became an important objective since most water pollution, at least, is the direct result of industrial production. The role of private industry in reducing pollution has become the issue and promoting change in industrial water use has become the prominent goal of public regulation.

The interaction of pressures from the physical and social environment is important to consider further at this point. Because of their reliance on physical resources, change in the nature of those resources or their availability requires changes in production, planning, and marketing. According to Hawley (1968): "a system founded on nonreplacable resources is faced with "imminent change"; sooner or later it will either pass into decline or shift perforce to a different resource base. Such, for instance has been the experience of innumerable mining communities; in a similar manner agricultural communities often alter the soil composition of their lands by the uses they practice, with the ultimate result that the lands will no longer support the systems as they are constituted." Inevitably, industrial organizations must respond to drastic changes in the quality of the physical environment when those changes threaten to disturb their production process. They must also react to the demands of powerful conservationist groups and government agencies. It may be argued that the disparity of power between groups promoting conservationist values rather than strictly economic goals is decreasing as public support for their activities grows. Issues fundamental to the role of industry in a modern capitalist state are directly involved, e.g., the right of industries to be relatively autonomous in decisions about their standards of production. And, since industry is not dedicated to environmental quality as a main goal, resistance on their part can be expected.

Another source of resistance is an economic one. Establishment of standards for industrial waste control inevitably requires some revision of core production technologies. We are speaking of major changes. It is nothing less than the internal reallocation of resources and standards of production and not just the removal of heavy metals like mercury or solids from industrial waste that is at issue. Changes being called for constitute what Dunn (1971) considers as paradigm shifts. Paradigm shifts are changes that require a modification of goals and an extension of the system's boundaries or responsibilities. The system has to become more complex by the inclusion of more goals, or by reducing the priority of one goal relative to another. Economic organizations are being asked

to adopt non-economic goals. For the short run, at least, allocation of capital to pollution abatement procedures can reduce production growth and profits. The impact, of course, varies according to the size and economic health of the industry. Such changes are not likely to be generated internally as the industries structure is geared to search for knowledge to meet economic and not conservationist goals.

Fundamental changes of the sort we are outlining will appear only in the presence of outside stimulus. Specifically, the power of outside groups such as regulatory agencies or community groups bouyed by public interest and support or legislative mandate. Declining water quality per se is not enough unless these social groups define existing water quality as undesirable and isolate industry's role. Quality is a negotiable concept where decisions made result from the interaction of industries, agencies, private groups and the local community.

Industries and Agencies

We have argued that water resource quality is not a main goal of industrial firms. Preserving water quality after using it for production or disposal of wastes is, in fact, often contradictory to the main goals of the company, profit-making and production. As a result, the company has little motivation to change its water using procedures except in the circumstance of intense outside pressure by groups more committed to preserving water quality than stimulating economic production and profit-making. Mobilization and unionization of labor in the 1930's is the most dramatic evidence of how outside organizations can influence firms to take action that is foreign to the classical model of economic self-interest. However, it must be added that such decisions were made only when labor organizations had sufficient power to curtail economic production entirely. Furthermore, large industries now are quite dependent upon large, highly centralized labor unions. It is much easier to deal with a single powerful organization than numerous splinter groups and wildcat strikes. Economic self-interest is certainly part of the reason that large firms have accepted labor unions as legitimate.

There is an analogy between changes in labor laws and pressure by public and private groups put upon industry to change the way they use water. Decisions require a concern for water quality that is not entirely consistent with economic self-interest. Since the public has largely accepted the goal of improving environmental quality and large public agencies have emerged to regulate industrial water use, there is little question that industrial firms have been and will continue to be under constant pressure to reduce the degree to which they pollute water. Industrial use of water resources is now subject to a great deal of regulation in the form of laws and inspection by professionals in regulatory bodies. A very complex public management system has developed that is directly related to water resource problems. Numerous agencies exist at the county, city, state, regional, and federal level (see Walton, 1972; Walton and Hills, 1971). In such a situation, the public sector expands in power because the problem seems to be beyond the private sector,

in this case private industry, to deal sufficiently with the problem. The objective is to bring about changes that the company, because of its main goals, would not voluntarily engage in or would actively resist.

When the rules for use of a basic industrial resource are changed, some disorder is the inevitable result. Order is very important to the business enterprise as Dubin (1954:41) points out: "To management the business operates in an orderly fashion when it exhibits (1) continuity with its past, (2) controlled direction and amount of change in the present, and (3) predictability in the future," When predictability is upset for a period of time, production suffers especially when long range planning is essential to production and marketing. Dubin (1954:45) has also outlined three elements of disorder: "(1) Disorder designed to halt the regular functioning of the enterprise. (2) Disorder designed to be disruptive while the organization continues to practice. (3) Disorder directed at redefining an existing institutional practice to the advantage of the party creating the disorder." Although Dubin's analysis is intended for union-management relationships, there is considerable relevance for understanding agency-industry interaction and industrial change in water use.

Disorder and conflict are basic elements of change. This is as true of efforts to reduce pollution as it was a part of the early labor movement or indistrialization itself. There is always a degree of disorder in dynamic societies. Conflict and disorder, at a certain level, assures that new information enters decision-making that otherwise would be restricted (Donohue, Tichenor, Olien, 1972). In the presence of conflict over pollution standards, for example, professional scientists and engineers are used by both parties in the dispute to publicly present evidence to support their claims. When fundamental issues are at stake, industrial autonomy in setting production standards, disorder and conflict, as we have witnessed, does occur. As Bower (1965) pointed out, industries have never, until recently subjected to pressure, considered water quality part of their responsibility and certainly not a goal.

There is also the important point that conflict among agencies, lack of coordination among agencies at different levels of government, and differences in standards are important to an understanding of industrial change or the lack of it. The industry can sometimes find itself in the position of having contradictory directives from two different agencies each having the power to considerably affect the company's operation. In such a circumstance, the company is willing to change in one direction or the other but is unable to do both. Contact between the industry and the agency may, in such a circumstance, retard industrial change in water use rather than stimulate it.

In an examination of regulation and its relation to change across many different industries, only the most general statements can be made. Westfield (1971) found that various types of regulation will result in technological innovations by firms if demand is elastic and the firm tries to maximize profits. The firm must innovate both with respect to production and to absorb the costs of new labor practices, water pollution tech-

nology, and the like. Hughes (1971) found in a study of the electrical industry that change has resulted from regulation but of a continuous sort rather than by large jumps. Other studies have shown that industrial changes have not been highly related to public regulation (Phillips, 1971). However, other studies in economics and political science suggest that public regulation has stimulated industries to undertake certain kinds of changes, in many cases at public expense, that they otherwise would not do on their own accord (Scherer, 1971: chapters 16-22).

There is also evidence that industries actively seek to control the regulators and are, by and large, successful. According to Scherer (1971:528): "There is a propensity in public regulation for the regulators to be co-opted by those they regulate, coming to share their values and growing wary of boat-rocking. This is in part the result of living with common problems year after year. But in addition, regulatory boards often depend upon the firms they regulate for political support, and to punish inefficiency too harshly could endanger support." One of the principle sources of power in the relationship of two or more organizations is knowledge. To the extent that regulatory agencies are dependent on the given industry for information about its production, nature and volume of waste material, and solutions to the problem, it is inevitable that the industry will come to dominate agency policy. Furthermore, there appears to be a general life-cycle in the agency-industry relationship. In the first stage, according to Edelman (1964), public agencies appear as the result of a public outcry because of conditions such as water pollution. An agency is formed, goes to work, and the public is mollified. Eventually, the public and private organizations devoted to the problem turn to other issues or the voluntary organizations dissolve. The last stage is the growing influence of the regulated industry. In other words, the regulators come to be controlled by those industries that are supposed to be regulated.

Public regulation of industrial and community water use is comparatively new when compared to other kinds of regulation, regulation of commerce, trade, labor practices, transportation, and, as a result, has not yet reached the last stage. Although the public outcry has significantly decreased over the past two or three years, it is still substantial. Consequently, it is reasonable to suggest as a research hypothesis that contact between industries and public agencies will lead to changes in industrial water use as well as attempts in co-optation and conflict. One of the reasons for stating the hypothesis in this manner is that there is evidence of conflict between private industries and regulatory agencies. If co-optation were successful then there would not be conflict to the degree that now exists. Although this could be only a short run phenomena, it is reasonable to state the following hypothesis:

> I. The greater the contact between industries and public regulatory agencies, the greater the inclination of those industries to seek knowledge about alternative ways of using water and change the way they use water.

Industries and Communities

The research on community decision-making finds that the controlling group within the community is drawn from business circles. There have been very few studies that have failed to show active political participation and control by businessmen in local decision-making. The involvement is also very disproportionate to their numbers in the whole population. In consequence, according to Martin et al. (1961) "the only distiction that can in fact be observed among community power structures is that between systems which the business community exercises significant power and systems in which the business community shares power with other social groups." There is also research evidence to suggest the existence of rather significant power elites in most communities dominated, by and large, by businessmen (Hunter, 1953; Perrucci and Pilisuk, 1970). The local power elite is not interested nor involved in every community issue but when common interests are at stake, e.g., local drives against pollution, the group has sufficient resources or power to control policy-formation.

Pollution is an issue that has excited local interest in normally dormant communities all across the United States. One would expect, therefore, that local business, large and small, would vigorously participate in local decision-making. Company executives have numerous reasons for local participation. They can represent their company and further its interests as well as their own career. One would certainly expect active company involvement in important issues such as pollution where economic interests may be directly threatened.

Since all social units attempt to control their social environment, we would expect the same of industrial organizations. The research showing that industrial organizations actively seek to influence local decision-making is substantial. There is also evidence of the active involvement of local industry through court cases, political lobbying, and other means to influence environmental decision-making. Industrial organizations, according to our theoretical model, will not easily allocate resources to functions such as pollution control when this is not their main goal. They will do so, however, when outside groups become powerful enough so that they run the risk of going out of business or losing more than if they were to use the suggested technology. Maintenance of their own structure becomes important in such a period and bargaining between industries and outside groups can be observed.

Contradictory logic and evidence complicates the presentation of a single hypothesis about business involvement in the local community and change in water use by industries. On the one hand, active involvement by business represents the traditional attempts and perceived necessity by businessmen of influencing local decision-making. On the other, such involvement may also be a recognition that local conservation groups, in league often with state and federal regulatory agencies, have power and that the business must begin to bargain and change to some degree rather than face protracted conflict. Nevertheless, logic and research lead to the following hypothesis:

II. The greater the involvement water using organizations have with the local community, the less likely are they to seek knowledge about pollution abatement and the less the change.

In other words, industries, as the result of their economic goals will try to dominate local decision-making so that changes in water use will be forestalled or minimized.

Our arguement thus far has been that industrial organizations will not eagerly seek knowledge about something that has little relevance for its main goals. Traditionally, industrial societies have defined water primarily as a commodity. Its most valued use was as an input to economic production. Although values have changed somewhat, there is still the fundamental question of what responsibility industry has for preserving water quality. Industry, except when there is outside pressure, tends to define that role rather narrowly. Even with outside pressure, however, there is very great variability among organizations in their capacity to develop and use new knowledge even if they are so inclined. We turn now to a discussion of this point.

Industrial Capacity for Change and the Use of Water Resources

Organizations of any type do not readily change their structures or their technologies. The change requires considerable reorientation and cost. The rational behavior of industry is, therefore, directed to develop the type of relationship with the environment that will not require frequent and extensive change. It seeks to control its environment so that internal change can be minimized. Thompson (1967:22) proposes that industrial organizations attempt to control their environment so that a compatible relationship between input activities, output activities, and technological activities will prevail. The importance of a compatible balance of these factors is seen to be the following:

> To the extent that environmental fluctuations are unanticipated, they interfere with the orderly operation of the core technology and thereby reduce its performance. When such influences are anticipated and considered for a particular period of time, the technical core can operate as if it enjoyed a closed system.

Rational organizations, therefore, seek to buffer environmental influences from the core technology. Technology is of two types: (1) the tools, machines, instruments involved in the production process and (2) the body of ideas and knowledge which express the goals of the work (Dubin 1967:467). As long as the organization is not dependent upon an immediately diminishing resource, e.g., the fishing industry or oil, the influence of the physical environment can be relatively ignored. If the production process is relatively routine, then procedures can be standardized so that the core technology can operate as if it were a closed

system. In such an instance, innovativeness is not critical to the operation of the core technology and a norm for innovativeness or the search for new knowledge is not likely to appear.

Innovativeness should be most characteristic of organizations where the work process requires continual attention to exceptional events or cases (Perrow, 1967), and where there are few or no programmed solutions to the exceptional cases. A critical problem for organizations frequently faced with exceptional or relatively uncontrollable events (nuclear power plants, hospitals) is to search for ways to standardize operative procedures. One answer to this problem is the creation of innovative sub-systems for research and development. The protection of the core technology is, therefore, based on the development of new technology or ideas about the principle input leading eventually to standardization. The functioning of the core technology and its revisions to meet changing conditions make the organization highly dependent on scientific knowledge. For example, there is a great deal of uncertainty as to the impact of nuclear power production on the physical environment. In order for industries to apply nuclear energy to their production process, considerable research is required to predict the multiple consequences of utilizing nuclear energy (Barnaby, 1970). Therefore, organizations using scientific knowledge to solve one set of problems could, perhaps, use knowledge to deal with other problems more easily than less complex organizations.

We have already established that water is a principal input to industrial production. Industrial organizations do have water quality standards for the operation of their production process, and they sponsor and conduct research themselves to further understand the relationship between water type and their product. Process and production engineers, with the advice of production personnel, are the arbiters of water quality in each industrial plant. There are several different minimum qualities for various processes including: product mix, heat exchange, barometric condensing, fire protection, dilution, sanitation, boiler makeup, material transport. According to a publication of the National Association of Manufacturers:

> Deciding what kind of treatment to give which portions of water intake is an engineering and economic decision: By far the most common problems are turbidity and hardness, and both are amenable to relatively inexpensive treatment by conventional methods.

Industries, therefore, engage in the filtration of water, softening, demineralization, settling and sedimentation, chlorination, distillation, etc. The internal logic of the core technology will not be interrupted when there is knowledge about the water condition that is most appropriate to its functioning. When the production process is complex, i.e., a large range of products with many different types of processing units, then the search process could be expected to include the research expertise of scientists and engineers. Other things being equal we would expect that organizations that are highly dependent on scientific knowledge for their functioning will be more innovative or have the capacity

to be more innovative in their use of water than organizations without such a knowledge base. Thompson and Bates (1957), define the adaptability or "innovative capacity" of an organization as "the extent to which the appropriate mechanics, knowledge, skills, and raw materials can be used for other products." The capacity of an organization to adapt to a deteriorating water supply should also be related to its knowledge base.

Generally, quality requirements of the production process direct industrial innovations. Scientific research when it concerns water, has traditionally emphasized the relationship of water quality to production requirements rather than the water polluting consequences of production. Extensive quality control over industrial effluents could disrupt seriously the core technology. For example, one of the means of reducing the polluting effects of production is to modify the production process itself by speeding up chemical reactions, manipulating chemical composition, or giving up certain lines of production. When the production technology is relatively standardized as the result of considerable research and investment, there will be resistance to change for the sake of purifying wastes, an interest that was not present in the early stages of standardizing procedures. The point is that the effluent process cannot be separated from the functioning of the core technology, if we are to effectively study the use of water pollution control technology by industry. Although innovative structures have a knowledge base that allows them to make a sophisticated search for ideas and alternatives to reduce their pollution, it is also the case that the requirements of the core technology are powerful internal stimuli that influence the industrial search for information and the research of industrial scientists and engineers. Although we have to recognize these qualifications, our third hypothesis is:

> III. The greater the organization's knowledge base, the greater will be its inclination to seek knowledge about alternative ways of using water and change the way it uses water.

Social Structure

Information or cybernetic theory classified formal organizations as learning or innovative structures. This is, as bodies capable of gathering information about their environment, storing the information, recalling past experience, and applying it to present circumstances, (Cadwallader, 1968). Organizations are adaptable to change, according to this perspective, when their structures are organized so that feedback from the environment readily enters the organization's structure and influences decision-making. Burns and Stalker (1961) found, in a survey of British electronic firms, that in the adaptive firms there was a social structure that readily reacted to market fluctuations. Technological or market information flowed from the research and development departments directly to those parts of the production department where the information was needed to re-program the routine operations. Other students of organization substantiate the conclusions by Burns and Stalker with their findings that the rate of program change is greatest in organizations high in complexity, low in centralization and formalization. In different studies, Price (1964) and Blau (1968), found that the use of new knowledge was most likely in organizations where the responsibilities of scientists and administrative decision makers were highly integrated.

Past research has demonstrated that such internal characteristics as complexity is related to rates of change. The more complex the organization, the more it must engage in knowledge seeking activities and the more capabile it is of realizing there is a need for new knowledge and applying it when it becomes available. Therefore, our fourth hypotheses is:

> IV. The more complex the organization's internal structure, the greater the capacity to search for and utilize new knowledge and change.

In chapter III, we will see that knowledge and complexity are multidimensional variables and several indicators are used to measure them.

Company Size

Size has always been considered as an important contextual characteristic of an organization. Large organizations obviously have more power than small ones. Communities and the society has more to lose from a large company closing than when a smaller one does. There is considerable debate, however, as to the importance of change for size. Some researchers have found size to be importantly related to how an organization structures its work, how many divisions there are, and, overall how specialized the work is (Pugh, et. al, 1968);(Blau and Schoenherr, 1970). Others contend that complexity of operation and the complexity of the product, nuclear power as opposed to meat packing, is more important than absolute size. Scherer (1971) suggests that large organizations enjoy many advantages over small ones such as speed of market penetration for new products but that increasing size beyond a certain threshhold is not importantly related to change. Indeed, beyond a certain size, the rates of invention and innovation decline. It is true also, that if organizations decide to resist changing the way they use water, larger organizations with a solid economic base are more capable of doing so than smaller ones.

Recognizing the opposing schools of thought about the importance of size for change in organizations, there is more evidence that change is positively related to size because of the latter's relationship with the kind of knowledge base firm is likely to have and to structural complexity. Both of these variables have been shown by research to be important factors in an organization's capacity for change. Therefore, our hypothesis is that:

> V. The greater the company size, the greater the ability to use new information about waste control and change.

Size is measured in three different ways; number of employees, sales volume, and marketing area.

Size is also a very important factor in the relationship of agencies and industries. To some degree, regulation results in the consolidation of production in that small companies are likely to find using new waste control procedures much more economically burdensome than larger ones. Since small companies are more likely to be economically marginal than larger ones, the rates of failure for small companies has been higher than the rates of failure for larger industries. Small companies simply haven't the economic and political resources that large industries have in relating to regulatory agencies, to decision-makers or using the courts to fight a decision or standard they feel is unfair. Furthermore, it is much simpler for regulatory agencies to relate to a few large companies than it is to several small ones. An implicit consequence of the environmental movement has been an increase in the horizontal and vertical integration of manufacturing. Small companies with limited resources are always at a disadvantage when there are times of economic stress and social change.

Water Use

How much water a company uses and the way it uses water is an important part of our overall model. To this point, we have stressed the importance of social groups outside the industry for industrial change in water use. However, it is reasonable to expect that when an industry's production requires high quality water or when the volume of water that is used is quite large, the industry will be more sensitive to the problems of water quality than would otherwise be the case. In such a circumstance there are interacting factors that preclude the presentation of a straightforward hypothesis without qualifications. One response by an industry that uses a great deal of water but is not dependent upon high quality water would be to resist any change or try to restrict a general discussion of the issue since required changes would be more costly for it than an industry that is highly dependent upon water quality. Or, an industry that severly pollutes water as the result of its production wastes would be expected to resist changes more so than a company whose production has minimal affect on water quality.

Malik and Van Ness (1962) suggest that we view the environment, including physical resources, as it affects the organization we are studying and to treat it as information which becomes available to the organization, via search activity. We expect that more sophisticated information about water and water use becomes available to administrators when they have professionals in their employee whose interest is water use or professional scientists and engineers per se, as part of the knowledge base.

Information about water, about the affects of production on water quality would be used by organizations both dependent upon high water quality as an input, subject to regulation and pressure from regulatory agencies and private groups, and having a high change capacity. Recognizing the qualifications we propose that:

VI. The more dependent the industry is on water, volume or quality, the more likely will they seek information about waste control and change the way they use water.

Summary

Water has always been one of man's most vital resources and its importance has increased as industrial and agricultural development began to accelerate. Water is, at the same time, basic to human health and consumption, a basic ingredient of agriculture, of public recreation, and, of course, a principal input to industrial production of all kinds. Industry uses more water as direct and indirect input to production than any other single source. As a result of its many uses and the mutual dependence of various groups upon water but with decidedly different goals and responsibilities, water use has become a focal point of controversy and change. Fundamental change is in the offering in terms of past and current debates about the relative responsibility of industry to clean public water after they use it in vast quantities and usually at rather low economic cost. Certainly, there are now differences among groups calling for changes in industrial water use and within industry itself as to what kinds of changes are to be made. There is, however, one constant factor. Industry and other groups, private and public, can no longer use water as they have in the past.

Change in industrial organizations is one of the elemental facets of change in modern industrial societies because of their power and the immense volume of waste, solid and liquid that comes from industrial production. Change is a complex phenomena at all levels of analysis, and we recognize that industrial changes in water use is preceded by general societal changes as to priorities and values regarding economic production as opposed to living quality or a clean physical environment. Although power is an important dimension of this process, so is knowledge. Indeed, the two are closely related as we have discussed. Industries must and do use knowledge and information about themselves as well as the social and physical environment. We have proposed that the relative capacity of organizations to use knowledge is a central factor in organizational change.

Although the capacity to use knowledge is basic to our model, change in water use has not originated with water using firms. Whether or not an industrial organization has the capacity for creating and developing knowledge that leads to change does not mean they will take actions that are seemingly contradictory to their main goals. The dominant model of industrial development used worldwide has concentrated on economic growth to the general exclusion of environmental and living quality. This is the central problem and not just economic growth. Economic growth is a respectable goal and most economists feel that it is necessary. However, economic growth and industrial production without consideration for the affects of unlimited growth on environmental quality has, as we now see, been a mistake. A mistake of the dimensions that declines in environmental quality can seriously forestall further economic expansion, as well as having the obvious impact on health and living quality.

Pressures for changing the way we use water have come from outside the industrial system. The precise source of the environmental movement is not our concern here but we have to recognize the impact it has had.

Numerous agencies and organizations, private and public, now exist for the sole purpose of changing and regulating private and public water use. The conservation ethic has been part of our society for some time but it gained power only in the last decade to the point where fundamental issues related to the organization of industrial production have come to the fore. Any study of industrial change, therefore, has to consider the relationship that industrial organizations have to such groups. Under the model of development emphasizing economic growth per se, there was little if any pressure upon industries to consider the affect of their production on external factors like water quality. There is pressure now and the pressure can be expected to continue.

CHAPTER II. - RESEARCH STRATEGY

This study is an attempt to further understand the process by which industrial organizations change the way they dispose of waste. Substantively, we are interested in the relationship of organizational characteristics to rates of change in waste procedures. As discussed in the first chapter, we envision a general model of change. The two major forces creating change in industrial organizations are, we believe, the internal pressures within the organization that result from such factors as the complexity of its division of labor and production technology. Secondly, the kinds of pressure the organization faces as the result of powerful and aggressive regulatory agencies and other groups. Finally, the nature of dependence the firm has upon water.

To test our hypotheses and find an answer to our basic question, we made a comparative study of firms in different industrial categories. Each category was selected because of its dependence upon water as a production input and by the importance of its operation for water pollution.

One hundred and twenty-eight organizations were studied in the first phase. They were selected systematically but not randomly. It was, in other words, a purposive rather than a probability sample. As a result, it is appropriate for us to generalize our findings to other industrial firms on a substantive basis but not a statistical one. The organizations were also selected from across Minnesota in rural as well as urban areas. One hundred and two organizations were chosen from the original 128 to be included in the second phase of the analysis. The 102 organizations that were part of both phases of the research are those to be examined.[1/]

The Minnesota Directory of Manufacturers was a primary source for listings of manufacturers in Minnesota from which we chose subject firms.[2/]

Industrial firms were selected from categories delineated by the American Chemical Society[3/] as having high volumes of waste water, high bio-

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1/ Some firms were not included in the final analyses because of their size and operation was different than that described in the directory we used for choosing our sample.

2/ Minnesota Directory of Manufacturers. Minnesota Department of Economic Development; St. Paul, Minnesota 55102.

3/ According to the report of the American Chemical Society in 1969, industrial categories such as food and kindred products, paper and allied products, chemical and allied products were very important to the contribution by industry to water pollution. For example, in the chemical industry, the estimate of waste water generated by these producers in 1963 was almost 4 billion gallons, the standard biochemical oxygen demand for the chemical industry was almost 10 million pounds, while they were responsible also for almost 2 million pounds of settleable and suspended solids. See Cleaning our Environment; The Chemical Basis for Action. A Report of the American Chemical Society, 1969. American Chemical Society; 1155 Sixteenth St. N.W., Washington, D.C. 20036 (p.97, table 1).

chemical oxygen demand because of their wastes, and producing substantial amounts of settleable and suspended solids. Twenty-eight of the firms we studied could be categorized as producing food and kindred products. These included dairy processers, meat packers, and canning companies. Eight industries produced paper and allied products. Twenty-nine of the companies could be classified as producers of chemicals or allied products. There were seven petroleum companies and thirty others that could be included among manufacturing categories of machinery and transportation equipment. As mentioned, we systematically selected firms on the basis of their size, sales volume, market distribution and region-rural or urban setting. The organizations used in the final analysis were those that fit our qualifications as to water use, size, waste characteristics, and location.

Contacting the Firms

In the first year of the project, the principal investigator visited several firms of various sizes and problems with water use in order to pre-test the data collection procedures. As a result of this experience a standardized interview schedule and questionnaire was developed and administered to executives in each of the firms we studied. These interviews along with company and public records were the study's primary source of data.

The firms we chose were contacted first by phone. We had the name of the production manager and the chief executive in each of the companies from the Minnesota Directory of Manufacturers. We were very careful in the selection of the person to be interviewed in that he or she would be the primary source of our data about the organization. In the larger organizations we were also concerned about whether the executive with which we were dealing had sufficient knowledge of the technology of production and the general division of labor within the firm so that he or she could speak fluently about it. Woodward (1965: 65) notes that, in her research, she found that in many firms the top executives responsible for making decisions about policy had only a limited knowledge of the manufacturing process. With her experience in mind, we were careful in selecting executives who were knowledgable of production as well as the pressures and contacts that the organization had with regulatory agencies and other groups. Our focus was, then, on the chief executive in charge of production. In most of the cases, we found that the executive in charge of production was well informed about production technology and the problems of production and waste as well as pressures from the outside about waste control procedures. However, if the executive did not have the information we sought, other executives in the firm or company professionals were contacted and the information was derived from them. Interviews were taken with as many people as necessary in order to obtain the information about the firm that we sought.

The industries were studied at two points in time. In the first phase, we were primarily interested in measuring the internal characteristics of the organization- how complex their structure was, the nature of their

production technology, and the rates of change they had experienced in water use and production over the last ten years. We then waited a year in order to measure the degree of change that the company experienced in water use and waste procedures for that year. The nature of the relationship of the organization to outside pressures such as regulation was also measured in the second phase. We have, therefore, estimated changes in the company by production managers over a ten year period prior to our contact and the changes they report for a single year. The time for each interview session varied from one hour to two hours. The interview time overall varied, therefore, from a low of two to a high of four hours. One of the reasons for splitting the interview schedule was because of the length of time required to collect the necessary data. Extra time had to be added for searching company records to determine the number of their employees, volumes of water use, waste procedures or the time spent contacting other persons in the firm for the information we needed. In the larger firms, interviewers would often spend as much as a day before they were able to get the information they needed or go back to the company several times to talk with people or consult company records.

Measurement

The interview schedules were highly standardized using many items modified from other studies of industrial organizations (Kahn, et. al., 1964; Lawrence and Lorsch, 1967; Hickson, Pugh, and Pheysey, 1969; Hage and Aiken, 1970, Inkson, Pugh and Hickson, 1970). One of our most basic concerns was the measurement of concepts such as organizational change. A problem we had from the first was the development of a measuring instrument that could be used across many different organizations that would not misrepresent their rates of change. The first step in the development of the instrument was conceptualization of the dimensions and the specific material aspects of change. Obviously, change in the food industry is somewhat different in content than in the chemical industry. The machines used and the expertise required to maintain production are different as well as the market the organizations face. On the other hand, we assumed that change could be categorized according to the basic dimensions of operation such as manufacturing the product, marketing the product, use of new pollution control equipment, consultation with scientists and engineers about production or pollution problems, employee training and supervision, allocation of resources, and production quality. By using these dimensions of the firms operation, we could begin to measure change across many different organizations rather than studying only one or two cases. After searching the literature dealing with industrial organizations in numerous academic fields, visiting firms and speaking with their managers, and with professionals acquainted with industrial organizations, we proposed the following categories as the basis for our measure of change: (1) product design and manufacture, (2) training and qualifications of employees, (3) allocation of capital resources, (4) use of scientific and engineering consultants, (5) waste processing and equipment, (6) marketing. Items related to these specific dimensions of change will be observed in the next chapter.

The second concern we had was whether our scale was specific to one industrial category and could not reliably be used in others. Our assumption is that it was not. There are two reasons for this. First the measure of change was pre-tested with this in mind and few problems were encountered. The measure was general enough so that it was not specific to one industrial category. Secondly, when we compare average change across the industrial categories we studied, it is evident that there are no substantial discrepancies in one category as opposed to the other. The highest average rate of change over the last ten years was in the food processing firms we studied - 19.9.[4/] The lowest was in the petroleum processing firms - 17.3. It is clear from the average rates of change across the industrial categories that our measure is not industry specific.

Additional details about the research procedures used to collect our data as well as the presentation of the complete interview schedule is to be found in the Methodological Appendix.

4/ The scale for the derivation of this score is found in the next chapter. The score is the average rate of change for food processing firms over ten dimensions of change. For each dimension or item, the lowest score would be 0 and highest would be 5. If there were no change in a given firm on capital resource allocation, e.g., the score would be 0. A great deal of change would produce a score of 5. The maximum score for 10 items would be 50 while the minimum would be 0. A score of 19.9 means that rates of change in the food processing industry are about midway between these minimum and maximum levels.

CHAPTER III. - ELEMENTS OF INDUSTRIAL CHANGE IN WASTE CONTROL PROCEDURES

In our model of industrial change, we include as our principle elements the internal attributes of organizations, the nature of their social environment, and how they use physical resources. Water, for example. In this chapter, we will discuss more fully the importance of these dimensions for organizational change. Since change is the major dependent variable in our analysis, we will first show the extent of change, according to our measurement, across the industries we studied and its dimensions.

The analysis in this chapter will be analytical and descriptive. The first section will discuss change rates across the 102 firms we studied while the remaining sections will deal with the relationships that the firms have with regulatory agencies and other groups along with their relationship with local communities. Finally, we will see how they use water. In line with the conceptual model developed in the first chapter, we assume that change in waste procedures and change generally occurs as the result of internal and external pressures. Internal pressures generate change that is consistent with the economic goals of the firm while external pressures are more likely to be responsible for changes that are not directly in accordance with economic goals, e.g., change in waste procedures.

Change in Industrial Organizations

The industries we studied report a moderate degree of change. Our first measure of change or innovation is a ten item scale that asks the chief executive in each of the companies to indicate the extent to which their company has changed its mode of operation in the past ten years, along specific dimensions of change (See Table 1). As can be seen in the first table, the chief executives were to indicate the extent of change their company had experienced on a five point scale from "none at all" to a "very great extent". The second measure of change asks the executives directly to report specific changes their company had undertaken in the past year. These data will be reported in Table 3.

The most instructive comparison to make in Table 1 is in the category "to a very great extent." The table shows that 15.7 percent of the companies reported changes to a very great extent in dealing with the liquid and solid wastes of their production process. Accordingly, 10.8 percent of the companies reported extensive changes in use of waste processing and equipment. There were two other categories that were comparable-change in the overall design of the production (15.7 percent) and product quality control (24.5 percent.) Also, 9.8 percent reported a similar degree of change through the introduction of a new product line.

The companies report extensive change in four categories - waste processing, product design, product quality control, and the introduction of new products. Specific waste procedures included digging and expansion of settlement ponds, recycling process water or that used directly in the production process rather than for cooling or other non-consumptive use, hauling away various kinds of wastes rather than dumping them into the city sewers or into public waters, and chemical treatment of process water to lower levels

able 1. - Reported Change by Executives in 102 Companies across Ten Dimensions.
Extent of Change: Percentage in each Category

Dimensions of Change	Not at all	To a very little extent	To some extent	To a considerable extent	To a very great extent	TOTAL
			%			
In how you manufacture your product.	9.8	13.7	30.4	37.3	8.8	100.
In the qualifications, training, and technical skills of your employees.	7.8	11.8	38.2	34.3	7.8	99.9*
In dealing with the solid and/or liquid wastes of your production process.	17.6	18.6	22.5	25.5	15.7	99.9*
Change in the overall design of the product (e.g. retooling of production machinery, change in raw input).	10.8	12.7	30.4	30.4	15.7	100.
Change in the allocation of capital resources (e.g. shifting capital resources to projects or product lines).	9.8	22.5	27.5	34.3	5.9	100.
Introducing a new product line.	18.6	15.7	33.3	22.5	9.8	99.9*
Policy changes in employee training and development.	8.8	19.6	26.5	40.2	4.9	100.
Use of either scientific or engineering consultants.	19.6	18.6	30.4	24.5	6.9	100.
Product quality control.	5.9	6.9	25.5	37.3	24.5	100.1*
Waste processing and equipment.	22.5	20.6	16.7	29.4	10.8	100.

* Percentages are not equal to 100 because of rounding.

of acidity, remove heavy metals, nutrients, and bacteria. The relevance of these changes and others in dealing with waste products is the impact they have on the company's production. There are essentially three alternatives that companies have in the treatment of water. One is putting liquid wastes into the city sewer systems and pay taxes for the city to remove whatever harmful substance exists in that waste. The second is to treat process water before it leaves the company and, thirdly, to change the production process itself so that the acidity level of the water or the level of bacteria is lowered. Actually, any change in waste procedures will have an impact upon the production process so we are speaking of differences in the degree of impact, for most companies, rather than whether or not there will be a relationship between waste procedures and production.

The relationship can be more clearly seen in Table 2.

In the first chapter and, in this one, we have argued that changes in waste procedures and changes in production are related. There are logical reasons for this argument. For one thing, industrial organizations are systems made up of composite parts. A change in one part of that system creates change in another. Waste control changes due to the importance of water for production can affect it substantially. Cut backs on production or fundamental changes in product mix, quality, and output can result when changes must be made in company waste control procedures.

Below, we try to assess the impact of pollution control measures on the organizations we studied. As a result, we need to know the empirical correlation between items whose content explicitly deal with waste control practices and change items related to other aspects of change.

Table 2 illustrates the validity of using a system model for understanding industrial waste control and its impact on the firm's structure. Both waste control scales are related to manufacturing, product design, and especially, product quality control ($r = .50$ and $.49$, respectively). It is clear also that waste control changes are associated with employee education, general training and development, and the use of scientific and engineering consultants ($r = .39$ and $.37$, respectively). The employment of scientific and engineering consultants lends support to our earlier hypothesis about the importance of knowledge use in organizational change. Industries having access to professionals either through consultation contracts or as employees have a significant advantage in adjusting to problems of pollution abatement. Such changes that are in accordance with legislation or agency policy usually have to be certified by engineering firms or expert consultants in waste management. Reduction of pollution usually requires use of technology or knowledge unfamiliar to a company.

Professionals and technicians who command such knowledge find industries dependent on their work. Product quality control is most strongly affected by waste control changes. This is due to the problems that industries encounter when they have to change their product mix or production process to meet anti-pollution measures while maintaining product quality in a manner established before pollution was considered a problem. The change tends to be cumulative in that when effluent standards are made more stringent, the production process is affected which in turn requires changes in procedures associated with product quality techniques. Chemicals to reduce

Table 2. - Inter-item Correlations among Independent Change Items.

Pearson Product Moment correlation between Extent of Change in Waste Control Items and Other Change Items

Waste Control Items: Degree of Change

Other Change Items; Degree of Change	Dealing with the liquid and solid wastes of production	Use of new waste control equipment
Manufacture of product.	.22*	.19*
Training and qualification of employees.	.34*	.25*
Product design.	.24*	.23*
Allocation of capital resources.	.23*	.22*
New product line.	.16	.16
Policy changes in employee training and development.	.34*	.33*
Use of scientific and engineering consultants.	.39*	.37*
Product quality control.	.50*	.49*

* Correlations are significant at the .05 level or below.

levels of bacteria in food processing, for example, can pose a problem when they must be removed from liquid wastes. The same can be true with anodizing and electro-plating as the introduction of acids and other chemicals that are basic to standardizing the process creates problems when companies or central sewage systems are required to remove such substances from public waters.

The first measure of change includes items that are directly related to production, research and development, and long range planning as well as pollution reduction. It is our rationale that since water is such a basic ingredient to industrial production, changes in water use or the pressure put upon companies by outside groups to change the way they use water would have an affect upon production to isolate changes in waste control without a general consideration of the concomitant changes in production that result would provide us with a very narrow perspective on industrial waste problems. This point will be expanded as the analysis continues.

Analysis of industrial waste procedures as well as change in general requires a long and short term perspective. On the one hand, it is important for us to know the accumulation of reported change over the past ten years. On the other, we also need to know the nature of recent change. We re-studied 102 companies to determine what changes had occurred a year after we had initially contacted them. The executives were asked in the second interview to list the specific changes the company realized in the past year. Table 3 shows that 28 percent of the companies reported changes in the handling of liquid and solid wastes along with the use of new pollution abatement technology. Another major aspect of change was that due to occupational safety and health. This is understandable due to the recent legislation concerning occupational safety and health. In conclusion, The data show that in the year following our first contact with the companies, reported change in waste control procedures was higher than production oriented changes.

Six percent of the companies reported important changes in the nature of their product line and general manufacturing while five percent said they had experienced important changes in sales techniques or marketing.

Although our measures show that rates of change in industrial waste control procedures are occurring and, in some respects, more so than production oriented techniques, we cannot illustrate the degree to which levels of pollution are lowered. Companies can undertake numerous changes that decrease the harmful consequences of their waste by 10 percent, yet this may not be enough to adequately deal with a given pollution problem. Furthermore, the change rates in pollution compared to those in production can be somewhat deceiving as we would expect the rates of change in waste control procedures to be greater now than with production changes because of the relatively recent necessity of many firms to reduce harmful wastes in order to satisfy minimum standards. For example, a study of the fluid milk process says that it has changed little since 1950 and is not expected to change very much through most of the current decade.[1/] Pollution abatement changes would,

1/ According to a report by the Federal Water Pollution Control Administration in 1967, fundamental measures related to processing butter, cheese, condensed and evaporated milk, ice cream and frozen desserts, and fluid milk has changed little since 1950 and extensive change was not predicted. This is not to say that other changes have not occurred in the dairy industry. Most notably, the concentration of production into a relatively few operators.

Table 3. - Percentage of Companies Reporting Changes in Production and Waste Control Dimensions.

Type of Change	Percent*
In product line.	6 %
In manufacturing the product.	6
In how the product is sold.	5
Training and qualification of employees.	6
Dealing with liquid and solid waste.	28
OSHA**	38

* The percentages do not add to 100 percent because a single company can report more than one kind of change.

** Changes in occupational safety and health were frequently mentioned by the respondents as most of the companies were faced with a vigorous agency trying to implement the OSHA Act.

therefore, be among the most significant changes that the dairy processing industry might face.

There is another consideration as well. Investment in production equipment and resources is enormously greater than investment in waste reduction. Growth rates in pollution abatement technology and investment in pollution control research has a much smaller base than does production, obviously.

This section was devoted to an examination of change and the interrelationship of change dimensions.

Tables 1 and 3 showed that the rates of change in water pollution control are generally comparable to other aspects of company operation. On the other hand, in Table 3, we found that industrial executives and managers reported that among the changes their companies experienced during the last year (1972-73), changes in dealing with liquid and solid wastes was among the most significant. Twenty-eight percent of the companies reported that they had experienced important changes in pollution control during the year in question. In Table 2, we observed the relationship between items dealing directly with waste control practices by the industries and items measuring other aspects of organizational change such as production line, product design, employee training and development, and consultation with scientists and engineers. In general, we found that changes in waste control practices are importantly related to the other areas of change. We have to be very careful, however, in our interpretation. Although we found there are consistent correlations between these dimensions of industrial change, we cannot say that changes in waste control practices are responsible for changes, say, in product quality control. However, they are related. We could, for example, make the opposite assessment that as the organization searches for and uses new knowledge for the purposes of changing its production process to keep up with new developments and requirements, such an organization will be more capable of using new knowledge to reduce its pollution. The focus of our investigation is the predisposition of the company to use new knowledge.

There are two important parts of the process whereby knowledge is sought and used for change by organizations. One is, as we have argued, the nature of the organization's social structure-its complexity, employment of professionals to name two of many characteristics. We are mainly interested in whether it has the resources to gather and use knowledge about itself and its own productive resources, market place, and, of course, the policies and probable actions of regulatory agencies and other organizations. Secondly, since the main goals of the industrial firm are profit-maximization and growth in production, it is natural to assume that changes in the company will be directed primarily toward these ends. Having the potential for changing water use and waste disposal does not mean that firms will be eager to make such changes especially when committment of resources to pollution control have to be taken from resources used for economic objectives.

We have to remember that a manifest condition such as water pollution comes to be considered as a problem only when powerful organizations or the public, in general, begin considering the condition as problematic. Indeed, we now consider water pollution as serious when, in actuality, our water may be in better condition now than it was in decades past when, as a society, we were not concerned about water quality. According to recent polls, the

public now considers environmental quality to be less important than having enough energy. There has been some shift in public attitudes about environmental pollution and its relative importance. Pollution is still present but the public seems to be less committed to clean-up and preservation than before difficulties in buying home heating oil and gasoline were experienced.

Problem definition is relative to the prevailing social conditions and to the primary goals and power of groups and organizations. This is certainly true with respect to industrial firms. Industrial firms with their committment to economic goals can be expected to resist changes that, in the short run, stand in the way of these goals. The question, as outlined above, is when do organizations with avowedly economic goals chose to make changes that are not entirely congruent with economic pursuits? We proposed that industrial firms would vigorously do so only with pressure from outside organizations such as government regulatory agencies.

The point is this. The relationship that industries have with regulatory agencies and other groups is, perhaps, more important to change, than its internal attributes and use of water. In the former, we are dealing with capability for using knowledge to implement change. In the latter, we are referring to external pressures that seek to influence how and in what direction the organization changes. Hawley (1969: 332) speaks directly to the issue:

> As the reliance on exchange advances, the social environment actually displaces the natural environment as the critical set of influences. A population is never emancipated from its dependence on physical and animate matters, but the importance of locale declines with increasing involvement in a network of intersystem relations; the natural environment is extended and diffused, and contacts with it are mediated through a variety of social mechanisms. Hence, the functions that link the social system to the social environment come to occupy the key position.

What Hawley is speaking of is collective decision-making. Water policy decisions are, of necessity, collective decisions involving many different groups and organizations having different needs and goals but all vitally interested in water use (Walton and Hills, 1971; Walton, 1972). Water policy particularly is made in a complex network of public and private organizations where decisions about water use and waste disposal are made. Understandably, the kind of relationship that an industry has with regulatory agencies, the community, and other groups is an important factor in change.

Industry, Agency, and Community Relationships

A basic variable in the relationship of organizations is the degree to which one organization legitimates the role of the other. Given the emerging power of regulatory agencies, industries by law must allow their production facilities and waste procedures to be inspected and certified. This is a complex process, however, and the voluntary submission by industries is essential if water management is to develop without constant court tests of

agency authority. The extent to which industries legitimate the function of regulatory agencies is then a significant variable in water resource management.

Executives support an active role by regulatory agencies as is evident from the data in Table 4. Seventy-nine percent agree to a "considerable" or "very great" extent that public agencies such as the Minnesota Pollution Control Agency should be involved in the enforcement of water quality standards. Forty-four percent believe that state agencies should have control over most industrial and community water use. We need now to look at attitudes about government regulation at all levels. For example, how much support is there for Federal activity? (See Table 5).

Table 5 shows that the executives are more likely to support the activity of state and Federal agencies in the regulation of industrial and community water use than local government. The differences are not very great, however. We are still asking them whether they think government agencies, whatever the level, should regulate industrial water use. Other data in our study show that these companies are regulated. Sixty-six percent of the companies said that government agencies monitored or at least regularly inspected their use of water and how their liquid wastes affected public water. Assuming that for most companies, regulation is an established fact, we find that 54 percent of the companies said that the federal government should have the most power with respect to industrial water use and waste control. Only 5 percent of the company executives felt that local government should have the most power. Twenty-one percent of the company executives said that state agencies should have the most power. Eleven percent indicated that some combination of state and Federal control would be favored by them while only 2 percent wanted a combination of local and Federal control and 4 percent would support joint action by city and state agencies. Only 2 percent said that all levels of government should be equal in their power to regulate industrial water use and waste control.

Thus far our analysis indicates that industrial executives support public regulation. Responses suggest that the state should be involved in setting policy and enforcing established regulations. We saw also that the executives generally supported regulation by all levels of government. However, when we asked them which governmental level should have the most power in the regulation of waste and water use, it was clear that the Federal government has a much stronger mandate than does the state and local level. Five percent said that local agencies should have the most power whereas 21 percent endorsed state agencies and 54 percent felt that the Federal level should have the most power.

We now have the role that executives assign to government agencies at all levels and not just the state as in Table 4. Executives clearly prefer Federal agencies to establish regulations and have local and state governments be responsible for enforcing them (See Table 6). The executives were asked to report what role each governmental level should play in the management of water resources. Seventy-three percent said that Federal agencies should set regulations while 54 percent said that local governments should enforce them. A reason for this finding is that since business firms tend to dominate local

Table 4. - Responses of Executives in 102 Companies about the Role of Minnesota Agencies Responsible for Regulation of Industrial and Community Water Use.

Extent of Support for each Suggested Role: Percentage in each Category

Suggested Agency Role	Not at all	To a very little extent	To some extent	To a considerable extent	To a very great extent	TOTAL
			%			
Research function only-collecting data for industries and communities when they want it	63.7	5.9	20.6	6.9	2.9	100.
Consulting - helping communities and companies identify and resolve water problems when they feel they need it	24.5	3.9	17.6	34.3	19.6	99.9*
Planning with communities and companies in the establishment of programs, facilities, and standards for water pollution control	10.8	3.9	12.7	39.2	33.3	99.9*
Enforcement of water quality standards	2.9	4.9	14.7	36.3	41.2	100.
Control over most industrial and community water use	13.7	8.8	34.3	17.6	25.5	99.9*

* Totals do not equal 100 percent because of rounding.

Table 5. - Judgments by Executives in 102 Companies as to the Authority of Different Government Levels in Water Regulation.

Specifically, to what extent should different levels of government regulate industrial water use and waste control? Percentage in each category.

Response Category	Government Level		
	City and County	State	Federal
Not at all	12.7 %	1.9 %	7.8 %
To a very little extent	16.7	9.8	17.6
To some extent	26.5	30.4	23.5
To a considerable extent	18.6	38.2	23.5
To a very great extent	22.5	17.6	24.5
No Response	2.9	2.9	2.9
TOTAL	99.9*	99.9*	99.8*

* The percentage total does not equal 100 percent because of rounding.

Table 6. - Judgements by Executives in 102 Companies as to the Specific Role of Government Levels in Water Regulation.

Percentage in each Category.

Suggested Agency Roles by Executives	Government Level City and County*	State*	Federal*
Research function and information source.	2.9 %	5.9 %	4.9 %
Consulting and planning with industries and communities helping.	9.8	7.8	2.9
Establishment of regulations.	25.5	45.1	71.6
Enforcement.	52.9	56.9	19.6
Liason function. Use the city government to get to the state level.	2.9	9.8	-
Provide facilities and maintain facilities.	6.9	1.96	1.96
Other.	20.6	18.6	24.5
No Response.	0.9	0.9	0.9

* The percentage totals add to more than 100 percentage because each company could mention more than just one role for regulatory agencies

** There was one case that had to be labeled as a non-response.

decision-making, companies would prefer to have enforcement power in the hands of local officials where their influence is very great than centralized in Federal agencies. On the other hand, regulations set at the regional, state, or Federal level would assure companies that competitors in other regions or states would be subject to the same degree of regulation they are.

In summary, our executives want the Federal government to establish regulations but prefer enforcement to be undertaken at the local level. Seventy-three percent said that the Federal level should be responsible for establishment of regulations whereas 26 percent felt that local governments should do this and 46 percent would give this power to the state.

The principal findings in this section are that the industrial executives we studied supported agency regulation of industrial and community water use. Indeed, a total of 79 percent of the executives said that agencies such as the Minnesota Pollution Control Agency should regulate industrial water use to a considerable or very great extent. Forty-four percent said that such agencies should have the same level of control over most industrial and community water use. Most were in favor of the MPCA actively consulting with companies and communities in dealing with water related problems.

We found in Table 5 that company executives supported the regulatory activity of state and Federal governments somewhat more than local governments. They were asked, as in Table 4, to what extent should different levels of government regulate industrial water use and waste control. When we asked the question in a different way as to how much power each of the three levels of government should have with respect to industrial water use and waste control, striking differences began to appear. The Federal level is supported to a much larger degree than is local and state activity. Only 5 percent felt that local governments should have the most power while 54 percent said that the Federal level should and 21 percent supported state functions.

The most interesting results are those in Table 6. Seventy percent of the executives felt that the Federal level should be responsible for establishing regulations while only 26 percent said that local governments should do this. When we turn to enforcement, however, the percentages are almost reversed. It is clear that executives favor Federal establishment of regulations but want local control as far as enforcement is concerned.

One of the most basic assumptions of our theoretical model has been that industrial organizations, as are all other social units from individuals to societies, are strongly motivated to control their environment. By exercising control over the social environment, other organizations, groups, and the community, the degree of internal change can be reduced. This is particularly important to industrial pollution control. When industrial organizations have to allocate resources to reduce their pollution,production, to some degree, also must change, and new strategies for reaching economic goals must be developed. However, profit-maximization is always undertaken within recognized constraints.

Constraints include regulations as to domestic and foreign trade, competition, and, of course, more recently, legislation designed to reduce industrial pollution. It is not particularly surprising that companies are

resigned to the fact that water use will be increasingly regulated and, perhaps, should be regulated by government agencies. This, however, takes us only part way in the analysis. There is quite a difference in the establishment of regulations and their enforcement. Comments from our interviews strongly suggest that larger companies prefer federal or regional government agencies to regulate water use so that competitors in other states or, at least, in their region or state will be subject to the same constraints they are. When companies are faced with extensive regulation at home, they want to be sure that their competitors are facing the same. This can be guaranteed only when there are regional or Federal regulations that apply to all companies. On the other hand, when it comes to enforcement, companies have more influence at home than they do on the state and national level. As a result, they prefer to have local governments responsible for enforcement. If not the local government, then the state government as can be seen in Table 6. They have an advantage over their competitors if they are able to get delays or evasions in enforcement at the local level if the other companies are not doing the same. Companies have many reasons therefore, for being active at the state and Federal levels of government as well as locally. We turn now to this point.

Industry-Community Relations

Industrial organizations are aware of the impact of the community on their well-being. This is especially true with the growth and maturity of the environmental movement. Local groups and individuals often forming coalitions with state or nationwide environmental organizations have become increasingly important to the relationship between industries and their communities, especially local politicians. The industry-community tie is fundamental to company operation and, of course, communities are quite dependent upon local business and industry. Miller and Form (1964: 786) point out that business and industry has traditionally dominated local politics and government in the United States. A great deal of control is exercised through the participation by company executives in local politics, local service and social clubs where company representatives interact directly with government officials and professionals responsible for decision-making. Another important source of influence is through financial donations. According to Miller and Form (1964: 786); "Apart from such formal control devices, the participation of business in local government has been so traditional as to lead many to believe that to contest this control was to fight legitimate custom". As we have argued previously, industries, as other social groups, attempt to control their social environment so that their goals can be pursued at a minimum of cost and disruption. At the very least, companies are actively engaged in keeping abreast of local developments while at the other end of the spectrum they dominate local decision-making.

There is little question that business and industry organize to influence and sometimes dominate communities. They are apt to be very powerful because of the resources they control-capital, service, social status and employment. At the same time, they find themselves objects of control. Communities do vary in the subservience of local government to business interests and in communities with a pluralistic base of power, other groups - professionals, labor, political, environmentalists - are able to exercise

a considerable degree of influence. Therefore, by engaging itself in local affairs, a company executive or the owner of small business enhances their ability to influence but also find themselves subject to some degree of control and influence.

In this section, we present data related to local participation by company owners, managers, and executives. And, their involvement and communication with groups outside the community.

The environmental movement has accentuated the importance of local communities to industrial firms because local sewer systems supported by public funds and business taxes are the basic source for company disposal of liquid wastes. In our study, 62.7 percent of the companies disposed of their liquid wastes in this manner. Only 15.7 percent got rid of their own wastes without the aid of community sewer systems and about 12 percent used both city and county systems and private means. Most companies dispose of their solid waste privately. It is not surprising, therefore, that 90 percent of the executives we interviewed said that it was very important for companies to participate in community decision-making. The reasons for company participation varied but one of the most frequently mentioned by the executives was that the company needs to know what is going on in the community for the sake of doing business; another was to create a positive public image while others said that business firms have a responsibility to their communities as communities have a responsibility to them. Executives from other companies said that local participation by their firm was not important as the community was so small and most of their business was with outside interests. Participation varies according to size. Smaller companies are more likely to be interested in local affairs because local decisions stand to influence their business more than larger companies. Local decisions about taxation, road and street construction and repair, sewer systems, and other projects are of greater concern to small than to large business' especially when the latter are absentee-owned. However, the environmental movement has functioned to increase the interests of all companies in local affairs as community groups form in response to air and water pollution coming from local industry. As a result, companies have been forced to deal with local people as well as government agencies about pollution abatement. The relationship changes from attempts at dominance, to bargaining, to the reluctant acceptance of court decisions. Our assumption is that the relationship is basic to decisions by industry to seek knowledge and change their waste and water use procedures. It is probably the case that industrial firms, including large absentee-owned firms, have increased their involvement in local affairs as the environmental movement has grown. Companies have found that their traditional role of providing jobs to the local community was not enough. Although we do not have data to reflect upon this statement (no one does), we do have data as to the local involvement by executives of the companies we studied, and the support they feel they have from groups inside and outside the community.

Table 7 illustrates that executives are rather reserved about how much support they have in their communities. We asked the executives to estimate how much local and outside groups would support their position on pollution control. About ten percent felt that the city and county governments would support their position while about 14 percent said that local civic groups

Table 7. - Judgements by Executives in 102 Companies about Extent of Support they could expect from other Groups for their Position on Pollution and its Control.

Selected Groups	Extent of Expected Support: Percentage Responding in Each Category						
	Not at all	Very Little	Some	Considerable	Very Great	No Response	TOTAL
	%						
City & County Officials	3.9	23.5	26.5	33.3	9.8	2.9	99.9*
State and Federal Officials	4.9	22.5	36.3	24.5	9.8	1.9	99.9*
Farmer's Organizations	21.6	26.5	33.3	10.8	6.9	.9	100.
Mass Media (T.V., Newspapers, radio)	16.6	21.6	36.3	15.7	8.9	.9	100.
Business Firms	4.9	6.9	18.6	42.2	25.5	1.9	100.
Business and Trade Associations	3.9	3.9	23.5	41.2	26.5	.9	99.9*
Pollution Control Agency	5.9	7.8	31.4	34.3	17.6	2.9	99.9*
Civic Groups (Lions, Kiwanis, Rotary)	5.9	14.7	39.2	23.5	13.7	2.9	99.9*

* Percentage totals do not equal 100 percent because of rounding.

would be very supportive. Interestingly, close to 18 percent said that the Minnesota Pollution Control Agency would be supportive of their position on pollution control to a "very great extent." Still, most support, according to their perceptions, comes from other business firms and the business and trade associations to which many belong. The local community seems to be less important as a source of support than other firms both inside and outside the community along with business and trade associations. The executives do perceive somewhat less support from state and federal agencies than from city and county governments although the difference is not substantial. Altogether, these businessmen felt that their principle source of support was from other business firms and their trade associations along with the Minnesota Pollution Control Agency rather than the local community.

Secondly, we asked the executives the extent to which their company communicated or maintained contact with these groups (See table 8). There is more contact by these companies with other firms and trade associations than with local officials and community civic groups. Once we remove communication among business groups, however, the Minnesota Pollution Control Agency and local officials emerge as important points of contact and communication. Thirty-four percent of the executives reported that their company communicated with the Minnesota Pollution Control Agency to a "considerable extent" or to a "very great extent." Communication varied from phone calls to the agency asking for directives about pollution legislation, information about how to deal with certain kinds of problems, plant inspections, face to face contacts, written communication and legal hearings. Again, we find that contact and communication with local groups, especially local civic groups is less important, from the point of view of these executives, than are contacts with other businessmen and one of the most powerful and active state agencies involved in water resource regulation and planning.

We found that the rates of participation by company executives is relatively high. (See Table 9). Most companies report that their executives belong to two or more trade associations. There is somewhat more company involvement at this level than in the local community as according to their reports 77.3 percent of the companies had executives that were members of two or more trade associations whereas 59.8 percent were involved to this degree in the local community. It is not possible for us to assess the relative importance of membership in local groups as it is likely to be the case that executives need only belong to one or two civic groups in a community in order to know what is going on and to influence policy. On the other hand, we do know that local participation by company executives is an important source of information for industrial firms and one of the principle ways in which policy can be influenced. It can also be a means for influencing company policy depending on the orientation taken by the group in question. Usually, however, the experience of communities has been that local groups recruit executives from local companies and they become influential participants and legitimator's of club activities. Such participation by executives is, therefore, a means for gaining information about community affairs, influencing policy to the best interests of the company, presenting a positive public image for the company, and, of course, the personal expression of interest and felt responsibility.

Table 8. - Judgements by Executives in 102 Companies about Extent of Communication between their Companies and Selected Groups.

Selected Groups	Extent of Communication: Percentage Responding in each Category					
	Not at all	Very Little	Some	Considerable	Very Great	TOTAL
			%			
City and County Officials	4.9	17.6	41.2	29.4	6.9	100.
State and Federal Officials	11.8	27.5	41.2	15.7	3.9	100.
Farmer's Organizations	50.0	24.5	10.8	9.8	4.9	100.
Mass Media (newspapers, T.V. and radio)	23.5	32.4	31.4	10.8	2.0	100.
Business Firms	1.0	9.8	38.2	39.2	11.8	100.
Business and Trade Associations	2.9	9.8	30.4	41.2	15.7	100.
Pollution Control Agency	17.6	27.5	21.6	24.5	8.8	100.
Civic Groups (Lions, Kiwanis, Rotary)	11.8	31.4	40.2	13.7	2.9	100.

Table 9. - Reported Involvement by Executives in 102 Companies in Voluntary Associations.

Association	Number of Groups Which Executives report Membership: Percentage in Each Category									
	0	1	2	3	4	5	6	7 or more	No Response	TOTAL
					%					
Community Service Groups	12.7	22.6	13.7	16.7	15.7	5.9	6.9	0.9	4.8	99.9*
Business and Trade Associations	3.9	14.7	24.5	24.5	11.7	6.8	5.9	3.9	3.8	99.9*
Social Groups	15.7	25.5	20.6	9.3	2.9	3.9	0.9	0.0	20.6**	99.9*
Political Groups	52.0	11.8	8.8	2.0	0.9	0.0	0.9	0.0	23.5**	99.9*

* Percentage totals do not equal 100 percent because of rounding.

** There were rather high levels of non-response in these two categories as some executives felt the questions were improper to ask.

Since industrial firms try to influence policy that is significant to their operation and are, as a consequence, subject to influence by others, we turn now to the contact that industrial firms have had with specific pollution control organizations, public and private (See Table 10). When we asked executives to list the pollution control groups with which their company had related, public agencies were mentioned mostly. Local agencies and officials concerned with taxation and regulation of sewers, sewer boards, city engineer's and other local professionals as well as government officials were included. State wide agencies such as the Minnesota Pollution Control Agency were prominent. Federal and national organizations included the Corps of Engineers, Environmental Protection Agency, and other agencies that are part of the U.S. Department of the Interior. Few private conservation organizations were mentioned. This is somewhat surprising due to the large number of organized groups in Minnesota, e.g., MECCA, and numerous ad hoc organizations. Interaction between public officials and private industry was much more frequent than contact between industries and private groups.

Most of the companies did not report any contact with private conservationist groups. There was at least no ongoing relationship at the official level. As far as we could determine, there was little informal contact either. On the contrary, about one-half (51 percent) of company contacts with public agencies at all government levels was face-to-face personal contact or by phone. Eleven percent of the companies had departments whose primary task was interpreting agency policy and seeing that the company's point of view was represented. Seventy percent of the companies had corresponded with public agencies by mail while 38 percent had made indirect contact through trade associations. Local Chambers of Commerce and the mass media were less important sources of information about agency policy.

These data illustrate our original assertion as to the prevalence of environmental administration. Caldwell's (1971: xiii) point should be remembered in that environmental administration refers to the process by which human action in relation to the environment is controlled. Government and public administration is the primary means for doing this. It is true as well that companies attempt to influence agency policy and are often successful in doing so. High levels of contact between agencies and company illustrates a context where mutual influence is taking place and not agency domination.

Industrial executives felt that environmental groups and local officials should have relatively little influence in environmental decisions as can be seen in Table 11. It must be remembered, however, that previously in Table 6 we saw that the executives did not want local officials involved with policy formation but most preferred that these officials be primarily responsible for enforcement of regulations established by state and Federal agencies. We asked executives to rank the following groups according to how much influence they should have in environmental decisions: (1) scientists, (2) local government officials, (3) state government, (4) Federal government, (5) company leaders, and (6) environmental groups. These data show that scientists are most highly supported by the executives with Federal agencies second, company leaders third, and state government fourth. Contrary to what we might predict, company executives were more likely to support scientists and Federal officials than other company leaders. This result is

Table 10. - Reported Company - Pollution Control Organizations Contact by Executives in 102 Companies.

Pollution Control Groups	Percentage reporting contact according to number of contacts in the past year.						
	0	1	2	3	4 or more	No Response	TOTAL
	%						
Local							
Public	35.3	44.1	14.7	2.9	0.0	2.9	99.9*
Private	89.2	6.9	0.9	0.0	0.0	2.9	99.9*
State							
Public	32.4	48.0	15.7	0.0	0.9	2.8	100.1*
Private	95.1	0.9	0.0	0.0	0.0	3.9	99.9*
Federal							
Public	37.3	37.3	15.7	0.9	4.9	3.9	100.0
Private	95.1	0.9	0.0	0.0	0.0	3.9	99.9*

* Percentage totals do not equal 100 percent in some cases due to rounding.

Table 11. - Judgements by Executives in 102 Companies as to Who Should have the most Influence in Environmental Decision-making.

	Degree of Influence Percentage Reporting in Each Category				
	Least	Moderate Degree	Most	No Response	TOTAL
	%				
Local Government	8.8	70.6	8.8	11.8	100.
State Government	0.9	72.5	15.7	10.8	99.9*
Federal Government	10.8	54.9	25.5	8.8	100.
Scientists	5.9	53.1	28.4	12.7	100.1
Company Leaders	4.9	67.6	16.7	10.8	100.
Environmental Groups (e.g. MECCA, Sierra Club)	55.9	29.3	2.9	11.8	99.9*

* Percentage totals do not equal 100 percent because of rounding.

reasonable if we continue to apply the model of environmental administration we have been developing. One reason for the finding is that certainty is a basic element in company operation. Rather than relate to ad hoc environmental groups or private conservationist groups, even if they are well organized, companies would generally prefer to deal with established, on-going public agencies who have the power to make decisions and enforce them. As a result, decisions can be made and the matter resolved. The company can accept or fight the constraint but at least it can influence policy development and predict future agency action by maintaining extensive contact with the agency. It is true as well, that the history of government regulation in the United States shows that eventually industries that are subject to regulation come to control the regulators.

The public agency is, indeed, an important means by which the company can deal with the pressure of environmental groups. However, in our study, we found very little contact between industries and conservationist groups, direct or indirect. This is a likely consequence of the strategy of environmental groups to work through established government agencies to stimulate them to enforce policy rather than extensive direct communication with polluting industries. In the presence of established regulations, companies can tell private environmental groups that since they are subject to official regulation, the focus of the group's pressure should not be upon them but the agency responsible for policy-formation. The agency, therefore, becomes an important means by which a company brings certainty into its environment and operation. Using the same logic, relating to other company executives can be more difficult than negotiating with state and Federal agencies. Companies can trust other firms to try to maintain any competitive advantage they have and voluntary acceptance of standards can be somewhat lax as a result. Overall, it is probably easier for companies to bargain with powerful state and Federal agencies than with environmentalists or business competitors.

Scientists, in our culture, enjoy very high status and a great deal of credibility is attributed to scientific research. Scientific evidence is seen in this culture as a basic ingredient of rational decision-making. Furthermore, scientists have been importantly involved in environmental decision-making already. Scientific evidence, no matter how uncertain it is, almost always influences court decisions and public attitudes. More importantly, if scientific evidence can provide some resolution or basis upon which "rational" decisions can be based, then the company can get on with the pursuit of its economic goals.

The above point can help us to explain why local government is given a rather minor role in the establishment of policy. From the point of view of the company, it is better to have decisions and regulations that will persevere rather than policy that will be rejected by higher officials. The trend toward regionalization and control by state and Federal governments along with the decline of local governments in their authority to manage local affairs from civil rights to pollution control is a question to keep in mind. Communities are relatively impotent in the establishment of policy and regulations as state and Federal agencies have the legal resources and

employ professional scientists and engineers far more extensively than do most communities,even very large ones. State and Federal agencies have more power than city and county governments through state and Federal legislation, and they have considerably more access to other resources upon which they can build policy initiatives. These factors provide a substantial base of power relative to the position of community governments.

Profit-maximization is a fundamental goal of economic organizations. However, profit-maximization occurs within a set of constraints. Fair trade laws, anti-trust legislation and a complex of statues limit the actions that a company can take to maximize its profits. Because legislated constraints are such a basic attribute of company function, it is important to the firm that regulations are established in a manner that they are well defined and enduring. Otherwise, long-range planning becomes very difficult. Since government regulation has become a fundamental part of business function, the consistency of policy is, therefore, critical to the ability of a firm to operate. Community governments haven't the power to create policy that is likely to last without the sponsorship of state and Federal agencies. As a result, the need of industrial firms for certainty is basic to the executive support of state and Federal policy-making rather than local governments.

The contrary is true when we come to the enforcement of policy. Because of the relative weakness of local agencies, executives are likely to favor community officials rather than those at the state and Federal level. Regulatory enforcement is a more difficult function than is policy-setting. Indeed, agencies often depend on a regulated company to provide them with the information so that decisions can be made as to whether it is within prescribed standards. This puts the company in a very powerful position relative to the personnel and other resources that an agency is able to devote to field inspection. Generally, it is the case that community agencies have fewer such resources than state and Federal agencies. Finally, firms will find it easier to sway judgements by local officials and professionals than those from agencies that are not part of the community. Two processes can be related: (1) the dominance of business in community decision-making and (2) the preference of companies for regulatory enforcement by local officials. The firm needing certainty for planning and operation would logically favor policy-making at the state and Federal level and regulation at the local level.

Business leaders usually have a great deal to say about local community affairs. There are good reasons for this. Community business is a basic source of income and employment. Business is highly regarded in our society as the result of the value we place upon economic well-being and growth. It is also the case that industrial firms seek to influence social and political affairs in order to insure their profits and growth in production. Consequently, local business is a major source of influence and, as a result, attracts the attention of other community groups wishing to influence policy.

The relationship of local business to community affairs has been challenged recently more than it has been for some time. Since most of the pollution in our communities comes from industrial production, the environmental movement at some point had to focus on this fact as well as the ability of local governments to deal with pollution problems. It seems clear now that most of the power to deal with pollution problems is to be found at the state and federal level. These agencies set standards and assume the major responsibility for enforcing them. Consequently, local officials become less and less important to the whole process and often find themselves in the position of carrying information between state and Federal agencies to local business and the reverse. Local officials may be the advocates of this or that position but their real power to influence decisions made in their own communities about pollution and numerous other problems has declined. The recent trend has been for power to flow from communities to regions, state, and the Federal government. It is not difficult to understand in this context why industrial leaders focus on policies established by state and Federal agencies rather than local governments. Local officials simply haven't the power to make policy that will endure. Even though local officials would likely be more sympathetic to an industry with a pollution problem, it is unlikely that these same officials would be able to resist the pressures of outside agencies or, by law, the state and Federal governments can overturn decisions made at the local level.

The role of community governments in pollution control is brought into question by these data. It is important,yet what is the nature of its importance - as an ally to state and Federal agencies against a local concern faced with changes or the reverse? Moreover, what is the importance of this relationship for firm's changing their waste control procedures. We hypothesized earlier that industry-community contacts would have a conservative function. However, the above data show that business leaders feel they have less support in their own communities and less contact in some instances than they do with higher level governments.

Local officials are influenced substantially by business and industrial organizations in their community. The relative degree of influence depends, however, upon the size of the community and the economic base. Obviously, single industry communities are more likely to be dominated by business interests than are communities more pluralistic in nature. The more pluralistic the community, the more we would expect that contact with the local community would generate change in waste procedures by pollution industries rather than the reverse. In pluralistic communities, local leaders are likely to be as dependent on professionals as they are business leaders in developing policy. Similarly, contact between industries and local governments can be influenced greatly by pressures upon local officials for changes in industrial waste procedures, hiring practices, and other changes. Local officials have been under considerable pressure from voluntary conservation groups as well as state and Federal agencies to deal with these problems. As a result, local officials are sometimes pressured to take a more independent stance than they would like or to initiate policy that they feel is detrimental to the economic health of their community. The relationship of industry-community contacts to industrial change will be presented in the next chapter. Next is a short discussion of how industries in our sample used water.

Industrial Water Use

Industry dependency upon water is important to our model of organizational change in that as water quality deteriorates, we can expect interested groups and organizations to increase pressure on the firms in question to change their waste control measures. In general, the model posits that whenever the environment changes, physical or social, internal changes will be generated within the firm. Environmental quality is uniquely social in character as quality is very much a social definition. Social definitions of quality can differ radically from physical definitions. Muddy water may not be physically harmful but is not pleasing to look at. Public appraisal of water quality as well as the physical use of water by industry are elements basic to industrial changes in water use and waste control procedures.

Industries using large volumes of water or having substantial volumes of waste will be subjected to more pressure by public and private conservation groups than other firms. For this reason, industrial water use is part of our theoretical model.

The firms we studied used water in a variety of ways - cooling, as a product ingredient, for plant utilities, as a rinsing or cleaning agent, and as a product container. Sixty-four percent of our companies used water extensively for cooling purposes while 59 percent used the resource directly as a product ingredient. Seventy-four percent used water in large amounts for rinsing and cleaning products or production areas.

Water use among the industries we studied ranged from 5000 gallons to around 2 million per day. This is water used for cooling or as a basic ingredient to production. Seventy-eight percent of the companies reported that their operation depended upon a steady flow of incoming water with the principle source of that water being a city or village well. About one-half of the companies reported that it was important to their manufacturing process that in-coming water be of a relatively high quality as the presence of certain chemicals or minerals would effect production.

These industries use large amounts of water, on the average, and are also quite dependent upon city water systems as a source of high quality water. It is also true that city sewer systems are the primary source for disposal of liquid wastes. The volume of liquid wastes for our sample of industries was relatively high-ranging from 500 gallons to over a million per day. About one-half reported liquid wastes over 5,000 gallons per day.

Forty-nine percent of the industries reported that water pollution was a problem to their company. Only 8 percent said that it was a very critical problem. Reasons for it being a problem included high sewage rates, costs of meeting water quality regulations, getting rid of certain kinds of bacteria, chemicals, or minerals that are by-products, and communication with government agencies. A major factor in one industry was a significant drop in business after much publicity that the company was disposing of raw effluent into Lake Superior.

Water use and disposal of liquid wastes are two core industry functions that tie them closely to their communities. When water quality becomes a social issue, the relationship between industries and their communities, local government and private groups, is subsequently affected. Since industrial effluent is a major factor in environmental quality, local industries are ultimately part of such controversies. Industrial changes in water use and waste disposal measures emerge as a focal issue.

Conclusions

Industrial change is a multi-dimensional variable. Changes in waste disposal procedures or pollution abatement methods are related to changes in other dimensions of the organization's structure. Employee training and development is an important part of pollution abatement as new practices introduced into production or the adoption of new equipment require employees to change work practices or learn how to operate and repair new machines. In many cases, new chemical tests are needed for the detection of harmful chemicals, minerals, or bacteria. Surely, the work of biologists, chemists, bacteriologists, chemical engineers, hydraulic engineers, civil engineers and other professionals are basic to adequate industry waste disposal techniques. Professional consultation and scientific knowledge has been a key point in deciding pollution issues and will continue to be so. (Rickson, 1973; Rickson, Tichenor, Donohue, 1973). We found also that product quality control was related to waste disposal programs, as was actual manufacture of the product, product design, and allocation of capital resources. In short, industrial organizations are systems and like all systems the parts are inter-dependent to the degree that changes in one dimension produces changes throughout the system.

Industry-agency conflict over environmental regulation is now everyday news. There is no question that state and Federal bureaus have grown in power with respect to their ability to establish and enforce regulations. Company executives generally support environmental regulation by these agencies. We found that an active role by state and Federal regulatory agencies is subscribed to by most company executives. Overall, executives prefer that state and Federal governments establish policy while local governments enforce such policy.

Companies need certainty in order to plan for the future and deal with present circumstances. As a result, efforts to control events that would effect their production and profits are to be expected. When policy is formulated at the state or Federal level, there is a greater probability that such policy will last than it if were locally legislated.

Additionally, competitors in other states or regions will be subject to the same regulations. This was the logical framework upon which executives from large companies based their judgements. Some small companies also felt more secure with state and Federal regulation than local as they expressed concern over the ability of large companies to influence local decision-making.

Our data show that although company executives are active participants in local affairs, they are somewhat dubious about the depth of local support for their company's position on pollution control. Furthermore, they communicate as much or more with state and Federal officials, other companies,

business and trade associations than they do with city and county officials. Finally, local government, according to our sample of executives, is given a very minor role in the establishment of policy. Local government is, however, strongly supported by the same executives as enforcers of policy. This is an interesting turn-around that we have previously discussed. If past research showing that industries and business generally dominates local decision-making is correct, it is clearly in the interest of local business to have city and county officials be responsible for enforcement as business should be able to influence the judgement of these officials more so than representatives of state and Federal bureaus. Establishment of policy is another matter as we have seen. Companies want regulatory policy to be consistent over time. Since policy developed at the local level can be overturned by state and Federal agencies, company preference for state and, especially, Federal control in policy-formation is logically understandable.

Water use and waste disposal are basic linkages between industries and local communities. Companies get most of their water from community wells and dispose of most of their liquid wastes in city and county sewers. For this reason, we would expect companies to work so that their viewpoints would be represented in policy-formation about water systems, sewer systems, tax rates and long-range planning about community water resources.

There is considerable incentive for company executives to participate in community affairs. Form and Miller (1966: 239) cite a few:

1. Obtaining and maintaining services which are essential for the economic operation of the company.

2. Obtaining and retaining a group of employees who are technically competent and loyal to the company.

3. Securing representation in community agencies so that the company can participate in determining future community action toward it.

4. Maintaining community good will or acceptance.

5. Encouraging the growth of local facilities harmonious with company and employee aspirations.

Company participation in local affairs has become even more important since the rise of the environmental movement and public concern about water and air quality. Challenges to local firms that pollute water as a result of their operation has become increasingly commonplace. Furthermore, changes that are suggested by public and private groups effect methods of operation and production. Although local private groups have formed in many instances to challenge firms, the most common strategy of these groups has been to pressure local government, state and Federal bureaus to legislate industry behavior or enforce existent legislation. As a result, government at all levels has become an active participant in environmental management, state and Federal more so than local.

The model of organizational change we have attempted to develop includes as its primary ingredients the structural attributes of organizations, pressures from the social environment, and use of physical resources. Since natural resources are obviously important to industrial production, changes in the quality and supply of those resources utlimately generate changes in the organization that uses them. In this chapter we have found that industries vary as to their rates of change and their relationship to state and Federal agencies responsible for water regulation. Also, companies vary in the participation of their executives in local community affairs and their view of the proper role of city and county officials as opposed to representatives from higher levels of government. Companies vary also in the way they use water, their volume of water use and liquid wastes. The next chapter will be devoted exclusively to an analysis of industrial change. We will see the degree to which our theoretical model is capable of explaining change.

the greater the rates of change. The other factors also contribute to our understanding of change. We would expect that the number of staff professionals, the level of executive education, and complexity of work procedures would also be related to change. Each are dimensions of overall complexity. Complexity of work procedures refers to extent that companies find it necessary to consult with and use professionals in their work force as well as to come up with new ideas about production and waste control, and marketing. Additionally, we measured how often companies experienced problems for which there seemed to be no immediate solution. All of these items were combined in an overall scale measure degree of complexity in work procedures.

Past research suggests that the degree of structural complexity in an organization is associated with its ability to create, process, and use knowledge about itself and the social and physical environment. The general finding is borne out with this research. Generally, the dimensions of structural complexity are more highly related to general change than they are with specific changes in waste. The change model we developed proposed that internal characteristics of organizations are more fully in line with changes promoting economic goals. Although we have two items in the general change scale that are directly concerned with waste procedure changes, the other items would measure change for purposes of increasing or changing production as well.

Our measure of formalization dealt basically with the ability of managers to know what was going on in their organizations. One of the principle problems of executives in all kinds of industrial firms is gaining access to knowledge about their own companies. The problem is highlighted by new managers coming into a company and discovering that he does not have the informal contacts necessary to adequately assess how the company's work is progressing or whether anyone is paying any attention to him. Although, the new manager or executive coming in from the outside is most prone to such problems they are not unique by any means. Change in organizations does require some degree of internal control. In other words, the executive must be able to know what is going on, who is doing what, where production is, and who can make changes if he or she is asked to do so. Consequently, general change is related to the degree of formalization but changes in waste procedures is not (See Table 12). Basic elements of the scale include formalized procedures for employee evaluation and job codification, determining the work production schedule, and where authority is within the firm.

When industries are rather tightly controlled with respect to work production schedules, or when employee evaluation is primarily tied to production, changes that are not directly related to production as is pollution abatement, in many cases, would not come easily. As a result, we have formalization of work procedures more highly related to general change than it is to changes in waste procedures. Standarization of work procedures provides a contrast to the above finding. We measured this variable in terms of whether the company had solved most problems related to production and pollution control to the extent that executives did not have to worry about them from one day to the next. The data regarding standardization suggest that when problems such as conflict among employees, securing financial resources, product quality, public relations, employee morale and

output have been partially resolved, at least, changes in waste control come mor easily than otherwise. Formalization of work procedures and standardization are different variables. A firm's operation can be highly standardized yet not be highly formalized with respect to written rules for employee conduct and work production schedules. Firms with a high percentage of professionals would be an example.

Table 12 also shows that size is an important variable in understanding change. The only dimension of change that is important, however, is the firm's number of employees. Economic factors such as average annual sales volume and range of marketing are not. The finding supports research showing size as a fundamental variable in studying organizations. Size is important to whether a firm can purchase costly innovations or undertake research programs, bear the costs of implementation; absorb failures, and explore new ideas in advance of actual need (Rosner, 1968). Business failures occur primarily among small firms which intensified the correlation between economic stability and size. Heilbroner, (1969: 12A), for example, suggests that resistance to innovations in our society in dealing with social problems comes primarily from coalitions of small interests who perceive inundation by taxes and control by the Federal government.

When water is essential to the core technology of an industry that is under pressure to change, large corporations find it easier to obtain loans than small ones. Small firms often find borrowing difficult even when they are profitable. When an organization is large and has some prominence, established relationships with financial sources tend to hold up. Innovation by the larger firm in its use of water may be supported by the availability of funds and its diversification that can ease the shock of new regulations and the necessity of employing new technology.

In the first chapter, we predicted that the type of relationship that industrial firms had with regulatory agencies would allow us to explain some portion of industrial change in waste control procedures. Table 13 shows that is to be the case. Agency power, frequency of contact, and clarity of agency expectations or standards are the best predictors. Agency authority as measured by the degree to which managers think public agencies like the Minnesota Pollution Control Agency should regulate industrial and community water use has a low relationship with change. We conclude, therefore, that the attitudes of managers is not enough to initiate change but requires the pressure and contact of regulatory agencies. In this case, the level of pressure perceived by executives to be coming from regulatory agencies and the frequency of contact does relate to change whereas attitudes about agency authority do not. Also, organizations are more likely to change when there are clear agency expectations. Many of the executives we interviewed said that their company would be willing to change the way they disposed of their waste or used water if they could interpret agency standards. To some degree, their perspective is borne out by the relationship between clarity of agency standards and change rates.

The correlations in Table 13 suggest that agency activity is effecting both production and waste control procedures. We would not expect otherwise since the two dimensions of industrial operation are associated. For example, degree of regulation of water use by public agencies, pressure

Table 13. Extent of Change and Properties of Extra-Organizational Relationship of 102 Industrial Firms.

Pearson Product-Moment Correlations of each Relational Property with Extent of Change

Properties of Extra-Organizational Relationships:	General Change	Change in Waste Procedures
Agency-Industry Relationships		
1. Attitudes of Executives to level of authority public agencies should have	0.09	0.15
2. Agency power		
a) degree of regulation experienced by industries	0.30*	0.24*
b) degree of pressure put upon industries to change their waste procedures	0.32*	0.34*
c) degree to which executives feel it is important their company satisfy agency standards	0.08	0.10
3. Degree of contact between industries and agencies	0.29*	0.25*
4. Clarity of agency standards as perceived by executives	0.19*	0.16
5. Estimate of agency expertise in water pollution matters by executives	0.09	0.06
Industry-Community Relationships		
1. Executive rates of participation in local affairs	0.37*	0.30*
2. Degree to which executives think it is important for companies to be involved in local affairs	0.45*	0.42*

Table 13. (continued)

Properties of Extra-Organizational Relations	General Change	Change in Waste Procedures
Industry-Community Relationships (continued)		
3. Communication with outside groups and organizations	0.40*	0.36*
4. Perceived support by executives for their company's position on pollution control	0.24*	0.20*

* Correlations are statistically significant at the .05 level or below.

from public agencies to change waste procedures and industry-agency contact are related to both types of change. Industries are more likely to change waste control procedures in the presence of agency pressure and increasing contact with agencies but changes also occur in production.

Table 13 shows that company changes increase as executives are more involved in local community affairs. It is also the case that the more importance that executives place on company involvement in local affairs, the more change there is likely to be in their firms. Our initial hypothesis was wrong. Generally, the more contact company's have with local communities, the higher their rates of change. Any kind of communication with outside groups including pollution control agencies, other firms, business and trade associations, local, state, and Federal officials as well as other groups and organizations apparently affects change rates. Contact with public agencies, State, local, and Federal officials is, however, more important to change than is contact with private conservation organizations. Again, we should emphasize the rather low level of contact between the industrial firms we studied and private conservation groups. This finding reflects the strategy of these groups to pressure government agencies to create or enforce legislation rather than any extensive direct association with companies. On the other hand, our data does not take into consideration the intensive contact that conservationist groups might have with one or two industries.

So far, the data show that the degree of complexity in a firm, and the extent of outside contacts are related to general change including changes in waste control measures. The theoretical reason for these associations has been spelled out in the first chapter where we discussed the concepts to be used in the development of a model of organizational change. The basic premise is that organizations will change when they have the knowledge base to do so and when they are pressured, cajoled or forced to make changes. The premise includes an assumption we should stress again. Companies with the knowledge base to make changes in waste control procedures will not necessarily do so as such changes can conflict with their economic goals. We found that, generally, the more complex the companies were, the more change they exhibited. It was also the case that the contacts and pressure that companies experienced from the outside with pollution control agencies, government officials, business and trade associations, and other groups and organizations were associated with rates of change. It is our conclusion that outside contacts enable the organization to be more fully aware of public concern for problems like environmental pollution and, if the capacity exists, they are more likely to change their operation than if contact and pressure from the social environment were very limited.

In the last hypothesis we presented, it was predicted that the nature of water use by a firm would be related to change. Table 14 shows that it is the volume of water used and the volume of waste that results from production that is associated with change. Dependency of the firm upon water for production and the degree to which pure water is important to production are not highly related to change. As we might expect, the nature of water use by the industry is more highly related to change in water pollution

Table 14. Extent of Change and Properties of Water Use and Waste Volume by 102 Industrial Firms.

Pearson Product-Moment Correlation Coefficients of each property of water use and waste volume with change

Water Use and Waste Volume:	General Change	Change in Waste Procedures
1. Volume of water use - overall	0.21*	0.33*
2. Degree to which company is dependent on steady volumes of incoming water for production	0.13	0.18*
3. Degree to which company is dependent upon pure water for production	0.07	0.10
4. Volume of liquid and solid waste	0.30*	0.38*

* Correlations are statistically significant at the .05 level or below.

procedures than to general change but the relationships are in the same direction. This suggests that general change and change in waste procedures are associated in a system context. As we have argued previously, changes in one aspect of the firms operation will lead to changes in other areas. The point is that when companies change the way they handle waste and water, production will be affected because of the importance of water for production and refined pollution abatement will often require adjustments in production.

As we have seen, companies are more receptive to change as they increase in size and structural complexity. The latter refers primarily to the rates of consultation with professionals, how specialized the company is, and the complexity of work procedures. Industry-agency relationships also make a difference. The degree of regulation, pressure and frequency of contact are all associated with rates of general change and change in waste control procedures. The activity of executives in their local communities is also related to change as is the way in which the industry uses water and disposes of waste.

The literature demonstrates that size consistently affects the structure of organizations. In this study, we have found that size (the number of employees) is associated with both general change and change in waste procedures. Through a series of statistical controls we found that size, complexity of work procedures, and frequency of industry-agency contact was consistently related to rates of general change and changes in waste control procedures. The same was true of industry-community relationships and the nature of industrial water use, especially volumes of water used and waste. Executive activity in the local community and the nature of water use are both variables that add to our understanding of change rates in industry.

The data illustrate the importance of structural complexity to change. We defined structural complexity to mean the facility possessed by an industry to search for knowledge and apply it to present circumstances. In this case, we mean changes in waste control procedures through the use of new waste processing equipment or other changes allowing the industry to deal with the solid and liquid waste of its production process.

Frequency of contact between industries and public agencies emerges as one of the most important variables in understanding changes in industrial pollution control practices. Although industries may have the resources to reduce their pollution, they are not likely to do so unless there is consistent contact and pressure from public agencies. The combined affects of complexity, size, and agency contact with industries is relatively high. When these factors are combined then rates of change in water pollution control technology by industry can be expected to occur. When we combine the effects of agency contact with volumes of water used by the industry and volumes of waste disposed of in the average work day, rates of change in waste control procedures are relatively high. The same happens when we combine the affects of these variables with company activity in the local community. Apparently, executive involvement into local affairs leads to change if the company has the resources to do so.

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METHODOLOGICAL APPENDIX

The material which follows is an attempt to give the interested reader a description of the questions asked in questionnaires and interviews. The measures of the independent variables not explicitly presented in the body of the report are given here. Industry size, the level of education among executives, proportion of professionals working in a company are straight forward measures that do not require further presentation. Furthermore, items used for the measurement of change rates, agency authority, role of public agencies in the regulation of industrial water use, involvement of company executives in local communities, and the nature of water use in the different industries are presented in Chapter II and will not be further discussed. Anyone who wishes a complete copy of the interview schedule and the questionnaire may receive one upon request. There are some measures that were not explicitly presented in the main body of the report that are given here. These include the items included in the measure of specialization or division of labor, complexity of work procedures, formalization, standardization, and automaticity.

Thirteen items were used to measure the degree to which work in a company was specialized. Executives were asked to respond to each of the items in the following manner:

> In your company, to what extent are each of the following tasks specialized. By specialization we mean a person (or persons) has these tasks as their main responsibility. After each item please circle the number under the appropriate heading.

	Not at all	To a very little extent	To some extent	To a considerable extent	To a very great extent
Planning	1	2	3	4	5
Public relations and advertising	1	2	3	4	5
Personnel managing	1	2	3	4	5
Transporting goods	1	2	3	4	5
Employment benefits (welfare services, social, sports, etc.)	1	2	3	4	5
Education and training of personnel	1	2	3	4	5
Record and control financial resources	1	2	3	4	5
Lobbying state legislatures or other political bodies	1	2	3	4	5

Sales and service customer complaints	1	2	3	4	5
Search for new ways of doing things (research and development).	1	2	3	4	5
Product quality control (testing, inspection of product).	1	2	3	4	5
Effluent quality (testing for the quality of solid and liquid wastes to meet regulatory requirements).	1	2	3	4	5

The complexity of work procedures was measured in the following way:

Please answer the following questions by checking either a yes or no response.

Yes___ No___ Does your company ever find it necessary to consult with engineers, scientists, management specialists in organizations youside your company?

Yes___ No___ Do you have personnel in your company responsible for coming up with new ideas about production, sales, waste control, etc.?

Yes___ No___ Is it common for members of your company to attend conferences dealing with problems of production, sales, waste control, or the like?

Yes___ No___ During the course of this company's operation, are there ever specific but important problems for which there don't seem to be any immediate solutions?

If so, what kind of problems are you referring to? (Get as specific an answer as possible.)

_____

_____

How often are there such problems in this company's operation?

_____ Once a year
_____ Once a month
_____ Once a week
_____ Once a day
_____ Almost constantly

Items and the manner of presentation for the measure of formalization are below:

How important are each of the following for running this company? After each item please circle the number under the appropriate heading.

	Not at all	Of very little importance	Of some importance	Of considerable importance	Of great importance
Written criteria for hiring and dismissal of line workers	1	2	3	4	5
Written criteria for hiring and dismissal of supervisors and administrators	1	2	3	4	5
Written criteria laying the job tasks for personnel	1	2	3	4	5
Organization chart laying out the hierarchy of authority given to employees	1	2	3	4	5
Work production schedule	1	2	3	4	5

Standardization of company operation:

To what extent have you been able to standardize each of the following factors? That is, you have sufficient control over the factors that you do not have to worry about them from one day to the next. After each item please circle the number under the appropriate heading.

	Not at all	To a very little extent	To some extent	To a considerable extent	to a very great extent
Sales	1	2	3	4	5
Keeping production going	1	2	3	4	5
Quality of raw inputs (spoilage, bacterial contamination, low grade	1	2	3	4	5
Final product quality	1	2	3	4	5
Making rules that employees accept	1	2	3	4	5
Coordinating the work of persons and departments	1	2	3	4	5
Defining authority for each person	1	2	3	4	5
Keeping down conflict among persons and/or departments	1	2	3	4	5

Work performance efficiency	1	2	3	4	5
Securing financial resources	1	2	3	4	5
Knowing what competitors are doing (or going to do)	1	2	3	4	5
Knowing what government regulatory agencies are doing (or going to do)	1	2	3	4	5
Keeping the good will of the public	1	2	3	4	5

Automaticity or the level of technological sophistication in the company:

To what extent do each of the following alternatives represent this company's production technology? After each item please circle the number under the appropriate heading.

	Not at all	To a very little extent	to some extent	To a considerable extent	to a very great extent
Hand tools and manual machines	1	2	3	4	5
Powered machines and tools	1	2	3	4	5
Single-cycle automatic and self-feeding machines	1	2	3	4	5
Automatic: machines repeat cycle	1	2	3	4	5
Self-measuring and adjusting machines: automatic feedback	1	2	3	4	5
Computer control: automatic feedback and control	1	2	3	4	5