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ENVIRONMENTAL DECISION MAKING IN INDUSTRY

By
PATRICIA L. BRADEN
and
FRANCOIS J. GROSSAS

MICHIGAN SEA GRANT PROGRAM

MICHU-SG-74-201

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IN INDUSTRY

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Graduate School of Business Administration
The University of Michigan

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Introduction to the Research Problem

The University of Michigan's Sea Grant Program is designed to study the dynamic process of water resource management in the Upper Great Lakes region. To accomplish this, the natural processes of chemical, biological, and physical renewal are modeled in an effort to represent accurately the environmental field within which man lives and works. Human effects on this system are represented by models of efforts to manage water resources politically and to control water use. Yet to date there has been little effort to understand the effect of water quality considerations on decision making in industry, perhaps the largest single component in the system responsible for water pollution.

Ideally, the output of a study of the relationship between industries and their water requirements would be a mathematical model of the net impact of industry trends on the use of an area's water resources. The financial constraints of the Sea Grant Program do not allow the implementation of such a model-building exercise. However, the question remains: to what extent can the future demand for water resources (forecasted on a trend basis) be altered by additional information inputs from experts participating in such programs as the University of Michigan's Sea Grant Program? If our current research can determine to what extent scientific information upon which businessmen can base their decisions is available and what scientific information businessmen perceive that they need, then providing such information may increase the amount of consideration given by industry to water quality.

Current Research on Pollution Control

Many of the research studies to date on the quality of earth resources have originated as reviews of successful community resource management programs or as treatises on the engineering requirements for pollution detection and control.

Technical requirements for pollution detection and control

Of the books and articles on pollution abatement, most have been justifiably concerned with defining exactly what levels of the various effluents constitute pollution and with devising means of tracing the effluent to the polluter. Modern Manufacturing (formerly Factory magazine) devotes an entire section of its

publication to pollution detection and control devices.¹ Conferences and seminars on technical progress toward meeting pollution standards have also resulted in reports and technical bulletins on progress within specific industries or geographic areas.² Typically, these books cover economic considerations only from the standpoint of the initial trade-offs between the cost and the effectiveness of particular devices designed for pollution abatement. They place little emphasis on the other alternatives considered while making the decision which the firm undertook when planning for resource conservation.

Community resource management programs

Sigurd Grava, in Urban Planning Aspects of Water Pollution Control, has developed a handbook for community leaders to follow when they consider instituting a community action program to police industry polluters.³ Although he thoroughly discusses the alternative enforcement methods and their effects on industry action to meet minimum water quality standards, he does not consider industry-initiated activity or the information that industry officials need in order to reach an educated decision on long-range company plans. Instead, his book is a guide for the inexperienced community leader who finds himself without an adequate political strategy to marshal resources against polluting industry groups. The lessons in strategy make useful reading for the industry executive, but they certainly contribute little of value for application within the company's internal organizational structure.

¹See, for example, "Industrial Pollution Control: A Monthly Section," ed. by Herbert F. Lund, Modern Manufacturing, June 1968, pp. 183-200.

²Typical of the writing done in this area are Lawrence Crockett and Ralph A. Berets, eds. Proceedings: Mich. Water and Air Pollution Standards (Ann Arbor: Industrial Development Division, Institute of Science and Technology, The University of Mich, 1970); and Economic Impact of Air Pollution Controls on Gray Iron Foundry Industry (Raleigh, North Carolina: National Air Pollution Control Administration, Environmental Health Service, Public Health Service, U.S. Department of Health, Education, and Welfare, November, 1970.)

³Sigurd Grava, Urban Planning Aspects of Water Pollution Control (New York: Columbia University Press, 1969).

Similarly, George Hagevik's frequently referenced study of the decision-making processes which are reflected in selected cities' water management experience emphasizes the decision-making processes applied to civic management rather than to industrial management.⁴ Hagevik's was the first work, however, to trace the decision processes of pollution control in any sphere and to relate those processes to theoretical models of decision behavior. He concluded that a novel approach was required to pressure existing industry into compliance with minimum standards. He broadly described the technical information requirements of the community group to assure that the restraints could be legally enforced, and he defined the state of information of the negotiating parties as imperfect. Yet he assumed, like others, that the corporate body is essentially a reactor and not an actor. He did not acknowledge the possibility that a corporation, given adequate information on harmful activities and on alternative remedies, would undertake independent control.

The Conference Board study

The first study to consider the firm as an actor in the field of pollution control was conducted on an international sample of North American firms by the Conference Board (formerly the National Industrial Conference Board).⁵ The activities initiated by 89 companies in pollution-prone industries were reviewed under four principal categories: pollution control organization, the executive and his responsibilities, pollution control policy, and future organization plans.

Pollution control organization. The Conference Board found that about half of the 89 companies reporting independent activity in this area had set up a special pollution control unit which they designated "environmental quality," "air and water pollution control," or "air and water conservation" units. Companies which did not identify special units assigned the responsibility for pollution control activities to other functional units. Manufacturing and engineering were the most likely units to assume control of pollution abatement activities. A few companies assigned the function to research and to other miscellaneous areas, but such unusual arrangements were generally explained by technical problems unique to the industry.

⁴Hagevik, George H. Decision Making in Air Pollution Control: A Review of Theory and Practice with Emphasis on Selected L.A. and N.Y. City Management Experiences. Praeger Special Studies in U.S. Economic and Social Development. N.Y.: Praeger Publishers, Inc. 1970.

⁵"Highlights for the Executive," Corporate Organization for Pollution Control, Conference Board Report, No. 507 (New York: The Conference Board, Inc., 1970).

The pollution control unit reported to different levels of supervision. The supervisor was most often a staff specialist, either a manager or director of a functional area, but frequently he reported to a line vice-president, and in a few cases he reported to the president. Since pollution control activities were so closely wedded to other controls within the production of the firm, it is understandable that they were assigned primarily staff status.⁶

The executive and his responsibilities. The Conference Board compared position guides and job descriptions of the executives in charge of pollution control to determine the duties assigned to them by their various companies. The Board found that most companies preferred to include the broader area of environmental quality in the executive's duties. Thus, noise reduction, solid waste disposal, beautification, and product safety were also assigned to the department in order to consolidate efforts to improve the environment.

Position guides called for the ideal executive to be competent in both "technical and administrative matters" as well as to be able "to communicate effectively with corporate and operating management."⁷ His duties most frequently included:

1. Coordinating divisional engineering and technical activities.
2. Coordinating and reporting on overall corporate programs.
3. Representing the company before governmental agencies and at legislative hearings.
4. Developing pollution control objectives and policy.
5. Handling relations with trade associations and with technical and other groups.⁸

Pollution control policy. The Conference Board found that, contrary to popular opinion, many corporations considered pollution control a necessary part of the cost of doing business and that they recognized a social responsibility to initiate controls to preserve the community in which they do business. However,

⁶Ibid.

⁷Ibid.

⁸Ibid.

a number of companies, in stating their position on environmental quality, called attention to the need for "realistic" and "economically feasible" standards and called for consideration of local and regional environmental quality standards rather than uniform federal standards, which they felt might be unnecessarily stringent in some instances. Establishment of equitable standards, in the opinion of some executives, requires continuing communication and close cooperation between industry and government.⁹

The pollution control executive did more than simply implement policies handed down from the higher echelons of management. There was considerable evidence that he helps to formulate policy as well. His recommendations are often accepted for implementation without revision.

Future organizational plans. Participation in policy formulation implies that the decisions of the pollution-control executive affect the company more fundamentally than was first supposed. The Conference Board reviewed only the plans of company officials to enlarge their pollution control activity as a department within the company. Although most companies envision this function as an area of increasing emphasis at the corporate level, none was asked to comment on the effectiveness of the department, its influence of the department of corporate planning activities, or the ability of the pollution control executive to effect company change.

The Wall Street Journal Study

Another study was conducted in June 1971 by the Market Research Department of the Wall Street Journal on a sample of 3,076 of the Journal's subscribers (companies¹⁰ and businessmen) who were actively involved in pollution control. The study was designed to get answers from businessmen about their companies' activities in pollution control, projected needs for equipment and services, and attitudes towards the implementation of pollution controls.

Company organization and anti-pollution efforts. One-third of the companies reported, that primary responsibility for pollution control rested at the corporate level, and almost half said that pollution control was handled at the plant level. There was a particular individual specifically in charge of pollution control activities in about one-third of the companies surveyed.

⁹Ibid.

¹⁰ Erdos and Morgan, Inc., A Nationwide Survey of Environmental Protection, Sponsored by the Wall Street Journal (N.Y.: Dow Jones & Company, Inc., 1972).

Generally, his major activities in this connection were:

1. Following new industrial developments.
2. Suggesting new procedures or improvements.
3. Coordinating engineering and technical efforts.
4. Keeping top management informed of the company's progress in the field.

Although the respondents were asked to indicate how many years of experience in the company this individual had, the survey did not probe the effectiveness of such a position or its influence and actual impact on the companies' pollution control efforts.

The main environmental problems reported by companies were air purification, water purification, and solid waste disposal. Mentioned most often as a source of help in solving environmental problems were manufacturers of specialized equipment. Increased expenditures for pollution control over the next three years were forecast by about two-thirds of the respondents, and almost half of the companies reported participation in joint anti-pollution efforts with community or industry groups.

Antipollution products and services. One-fourth of the companies on the Wall Street Journal survey said they provided pollution control devices and services to others. Twenty percent of this number provided such products to reduce water pollution. These products and services were offered to industry, government, and the general public.

Attitudes toward environmental protection. The Wall Street Journal study also found that a majority of respondents were of the opinion that government should play a major role in environmental protection and that the federal government should initiate, establish, and enforce standards for pollution control.

Many respondents held that industry and consumers should bear the cost of the pollution control programs. A large majority were very much concerned about pollution and, as members of the community, felt an obligation to share in the cost of improvements through the payment of higher taxes. Almost half of the respondents projected the length of time necessary to reach a desirable level of effluent control as five years or more.

Although it was reported that a great majority of respondents read books and articles on the subject of pollution control and that a few were members of groups on environment, the survey

did not inquire about the types and sources of information on pollution control that were used in industry and how useful they were to executives, either to those in charge of pollution control activities or to those simply concerned with environmental improvements.

The McGraw-Hill Study

A study released in May 1973 by McGraw-Hill showed that American business planned to spend \$6.2 billion in 1973 to control air and water pollution, 38 percent more than in 1972 and nearly double the 1971 figure. But this was hardly enough expenditure to keep pace with increasingly stringent federal regulations. The study reported that companies estimated the spending necessary to meet 1973 standards at \$22.3 billion. However, 9 of the 26 industries surveyed expected to spend less on pollution control in 1976 than in 1973, because the "catch-up" phase would then be over. The survey also showed that, although industry was spending more to curb air pollution (\$3.6 billion) than to curb water pollution (\$2.6 billion), for the first time, spending for water pollution control was rising faster than spending for air--a fact which "may reflect industry's reaction to the stiff 1972 Federal Water Pollution Control Act passed in November 1972." The survey concluded that "pollution control represents a major cost of doing business in the U.S." and that "American business is clearly committed to ecological improvement."¹¹

The Michigan Sea Grant Study:

Environmental Decision-Making Objectives

Current research sponsored by the Michigan Sea Grant Program has three objectives: 1) to identify the organizational structure designed to implement pollution control within Michigan firms; 2) to monitor the decision makers' attitudes and predispositions toward water pollution control; and 3) to evaluate the sources of information on which executives base their decisions. To achieve these objectives, it is important to identify those sources of information which influence decisions on water-quality concerns within the firm.

The attitudes and commitment of the chief executives may correspond directly to the amount and source of the information he uses; however, the chief executive may not be solely responsible

¹¹ Economics Dept. of McGraw-Hill Publications Co., reported in Business Week, May 19, 1973, p. 7.

for his company's decisions on water quality. It is expected that the responsibility to make decisions about effluent emission control will be somewhat diffused throughout the organization. The extent of this diffusion will depend upon the commitment of the entire firm to pollution control, as reflected by the number of participants in the decision process and by the firm's overall financial expenditures for pollution control. It is expected that the greater the diffusion and the firm's financial commitment, the less will be the influence of the chief executive's attitudes and predispositions.¹²

Instrument development

Organizational structure. The current survey adopts three of the main areas of inquiry on which the Conference Board questionnaire was based:

1. Does your company have a unit, section, department, or division with specific responsibility for pollution control?
If so, how long ago was this section established?
 - What is the size of this section?
 - What is the title of the person in charge?
 - What is his professional background?
 - What are his major pollution control activities?
 - What percentage of his time per month is spent on pollution control activities?
2. Are there persons other than the pollution-control officer who participate in pollution-control activities?
3. Do you anticipate any changes¹³ in your present organizational structure for pollution control?

As in the Conference Board survey, the questionnaire in the current research (see Appendix) was sent to companies primarily in pollution-prone industries, such as chemicals, electric utilities, food products, paper, petroleum, primary metals, rubber and plastics, and transportation equipment.¹⁴ Additional comparisons are made on such characteristics as products, main environmental problem, and employment size.

¹²Richard E. O'Brien, A Study of the Information-Gathering Techniques of the Small Businessman (Manufacturing), prepared under the Management Research Program of the Small Business Administration by the Missouri Division of Commerce and Industrial Development, (Jefferson City, Mo., 1964), p. 14.

¹³The Conference Board, Inc., Corporate Organization for Pollution Control, p. 2.

¹⁴See *ibid.*, pp. 2-3.

Company priorities and commitments. The questionnaire includes questions designed to identify management priorities attached to pollution control and to collect data on the company's expected financial commitment to pollution abatement. The following questions are among those used to measure the company's commitment:

1. How much lead time will be required for your company to install controls or change its process to reduce pollution?
2. How effective will such changes be in removing the harmful effects of the effluent?
3. What will it cost to reach the level of effectiveness indicated above?

Some of these questions were combined through the use of a simple additive model with equal weights to provide an index of the importance of control to any given company. The index is useful as a composite variable, since it allows development of a single measure to compare companies efficiently.

Attitudes and sources of information. The corporate executives are asked for their opinions on eleven statements related to water-quality considerations. A number of these statements were replicates of statements presented to citizens and legislators in other questionnaires. Comparisons will be made in the text where such data are available.

The executives are also asked to identify the types of information they use to make water-quality decisions and to indicate how easy or difficult such information is to obtain. In addition, the executives are asked how much information they obtain from each of fourteen different sources and how useful that information is.

The responses to these questions provide the Sea Grant Program with data on the specific levels of industry personnel who use water resources information to direct industry growth and development and they describe the dispersion of information on water quality through the company. This behavioral process can then be used as a tool for estimating the effect of water-quality information on the industrial sector of the Michigan economy and for helping Sea Grant personnel meet the scientific needs of the business community.

Sampling procedures

From among the firms located in Western Michigan which are active in polluting industries (chemicals, electric utilities,

food products, paper, petroleum, primary metals, rubber, and plastics), 456 firms were selected randomly. Questionnaires were sent once to all the 456, and a second time to those which had not replied. The final sample consists of 153 firms, representing one-third of the total polled.

In an effort to determine whether the composition of respondents is a biased portion of the original sample, two basic characteristics of nonresponding companies have compared with responding companies: the number of employees and the type of product manufactured. Non-responding companies tend to be smaller than responding companies, though the general distribution listed in Table 1 by size classes is similar.

When the companies are categorized by the type of product manufactured, as they are in Table 2, very few differences between responding companies and nonresponding companies are evident.

Air pollution is the most often mentioned environmental problem (34.2 percent of the responding companies). Chemical pollution of water (30.8 percent) and noise pollution (16.7 percent) are the next most often mentioned types of pollution.

Top-level executives (chairman, president, owner, or vice-president) comprise 75.5 percent of all respondents. Most respondents are presidents of their companies (59.4 percent). Other executives likely to respond are vice presidents (9.1 percent) and general or division managers (8.4 percent). Quality-control or technical directors represent a minority of 2.1 percent.

Most of the pollution control officers have the title of operations manager (21.6 percent). Administrative managers (18.9 percent) and presidents or owners (17.1 percent) are also frequently responsible for pollution control. It is interesting to note that no company delegates responsibility for pollution control to the head of the maintenance department. The professional background of the typical executive in charge of pollution control is in engineering (36.3 percent).

Limitations of the survey

As mentioned in the description of the sample, a large number of firms did not answer the questionnaire. Considering the conflicting aspects of water pollution control matters, a sparse response is not surprising. It may have biased the survey in ways other than those investigated here. For example, the companies which did not choose to answer may be significantly more or less responsible for pollution than responding companies.

Table 1

DISTRIBUTION OF SAMPLE COMPANIES
BY EMPLOYEE SIZE CLASS

Number of Employees	Percentage of Respondents	Percentage of Nonrespondents
100 or less	67.7	80.0
101-200	15.0	6.0
201-300	6.0	2.8
301-400	3.8	3.2
Over 400	<u>7.5</u>	<u>8.0</u>
Total	100.0	100.0

Table 2

DISTRIBUTION OF SAMPLE COMPANIES BY
TYPE OF PRODUCT

Type of Product	Percentage of Respondents	Percentage of Nonrespondents
Fabricated metal products	22.5	22.8
Machinery, except electrical	19.0	24.3
Primary metal industries	12.0	15.2
Chemical and allied products	12.0	16.2
Rubber and plastic products	8.5	6.6
Stone, clay, and glass products	8.5	5.0
Other industries	<u>17.5</u>	<u>9.9</u>
Total	100.0	100.0

Companies releasing low levels of pollutants may not have the information necessary to complete the questionnaire, while companies releasing high levels of pollutants may be concerned about reporting detrimental information. Although the letter sent with the questionnaire specifically said that the Michigan Sea Grant Program does not engage in litigation and that under no circumstances would data be reported by company name, a number of companies may have been suspicious about revealing their commitment and concern for pollution control.

The fact that many respondents did not answer several specific questions is a further limitation of the survey. Again, perhaps some companies did not want to commit themselves, especially on such matters as the lead time necessary to install controls and the cost necessary to reach a certain level of effectiveness. This would seem to be a reasonable explanation, since the respondents were more inclined to answer questions on their companies' organizational structure and on the types and sources of information they use than to answer questions requiring cost or efficiency judgments.

Measures used

In these findings, the data obtained from sampling was tested using a cross-classification procedure which compares the cell frequency of the table with the distribution of each of the two variables examined in the table to test whether or not the variables are associated uniquely. If the variables are associated in an unusual way, the chi-square statistic (a measure of the difference between the actual frequency in a cell versus its expected frequency) becomes quite large with respect to the degrees of freedom in the table (the number of rows minus 1 times the number of columns minus 1). The probability of this particular table occurring is given by the significance level of the chi-square statistic. When the probability (p) of the particular table occurring falls below ten percent (0.10), the association between the two variables is said to be significant.

Results of the Sea Grant Study

When asked how much lead time will be required to install controls or change processes to reduce pollution, most companies (81.5 percent) say they will require less than 2 years. The average lead time indicated is 1.78 years. However, one-third of the respondents did not answer this question. Similar confidence is expressed about the effectiveness of the changes and about the cost necessary to reach the expected level of effectiveness. Although 40 percent of the respondents did not answer these questions, 62 percent of those who did answer believe that

the changes will be more than 90-percent effective and as many as 60.5 percent of the respondents to the question feel that the cost of such changes will be less than \$50,000.

Company organization for pollution control

The person in charge of pollution control in most firms is described as an operations manager. The second most-mentioned title is administrative manager; only 5 percent of the companies surveyed use the title of environmental manager. Moreover, 34 percent of the respondents say they do not have a person specifically responsible for pollution control, and 13 percent say that such responsibilities are in the hands of the president or the owner.

As noted in 36 percent of the companies, the person in charge of pollution control has a professional background in engineering. Scientific backgrounds are also frequently mentioned. It is interesting to note that as many as 13 percent of the respondents mention "practical experience" as the background of the pollution control officer. Two-thirds of the companies identified the pollution control officer's major activities as "responsibility for implementation of policies regarding pollution." On the other hand, very few companies mention important activities--such as developing company policy on pollution control, proposing action to meet standards, participating in product planning and research, handling response to litigation, and responding to consumer pressures--as specific responsibilities of the pollution control officer.

The pollution control officer is rarely in charge of everything in the company's operations that is related to pollution control. In fact, very few companies report that the pollution control officer spends over half his time on pollution control activities, and very few assign him more than four duties. (Only 30 percent of the companies having a person responsible for pollution control report that he spends more than 15 percent of his time of pollution control activities.)

Only 12 percent of the companies report having separate pollution control units, and only 5 percent of the respondents anticipate changes in their present organizational structure for pollution control efforts (Table 3). It was generally found that the higher the title of the respondent the less the company organized for pollution control, as evidenced by the fact that higher-level executives report fewer separate sections or departments with specific responsibility for pollution control than do lower-level executives. Although the letter sent to chief executives requested that the questionnaire be answered by them and not passed to other company executives, it is more likely that the chief executives of those companies organized

Table 3
 PROBABILITY OF OBSERVED DIFFERENCES IN COMPANY ORGANIZATION AND
 POLLUTION CONTROL, BY TITLE, INDUSTRY, AND ENVIRONMENTAL
 PROBLEM

Company Characteristics	Title of Respondent	Industry Type	Main Environmental Problem
Have separate pollution control unit	.10	.025	.10
Organizational level of pollution control officer, if any	.005	n.a.	n.a.
Percentage of time spent on pollution control activities	.025	.90	n.s.
Size of pollution control unit	.90	n.s.	.05
Number of years since separate unit established	.95	n.s.	n.s.
Expected changes in organizational structure	.10	n.s.	n.s.
Lead time required to install controls	n.s.	n.a.	n.a.
Effectiveness of controls	.025	n.a.	n.a.
Cost of controls	.01	n.a.	n.a.

n. s. = no significant difference
 n. a. = not available

for pollution control would have passed the questionnaire to those in charge of pollution control or to their immediate supervisors.

As a matter of fact, in most cases the level of the respondent and the level of the person reported as being responsible for pollution control are very close (Table 3). Moreover, lower-level respondents reported a greater percentage of time spent by pollution officers on pollution control than did higher-level respondents. Among companies with separate pollution control sections, the sections reported on by lower-level executives, have more personnel than do the sections reported on by higher-level executives. The responses suggests that firms whose pollution control sections are more established tend to delegate the responsibility of reporting to a lower-level executive. Although most respondents say they do not expect any changes in the present organizational structure for pollution control in their companies, more lower-level respondents than higher-level respondents expect such changes.

Higher-level executives generally tend to sound more optimistic about the future success of pollution control efforts than do lower-level executives (Table 1). Though the relationship was not significant, when it was asked how much lead time will be required for the company to install controls or to change its process to reduce pollution, the higher the level of the respondent, the shorter his estimates. The higher-level executives' responses are also more confident about the effectiveness of controls. As the level of the respondent's title declines, the percentage of effectiveness of his forecast changes diminishes. Moreover, lower-level respondents' estimates of the cost necessary to reach the level of effectiveness are higher than the estimates of higher-level executives.

Chemical manufacturers and heavy manufacturers were likely to delegate responsibility for pollution control to lower ranks (operational), to have more people at lower levels involved in this activity and to spend a larger proportion of their time on it than do other manufacturers (Table 1). Heavy manufacturers report that their main environmental problem is not chemical pollution of water but air pollution. Chemical manufacturers report having more separate units with specific responsibility for pollution control than other manufacturers, and they have had these units for a longer period of time.

Companies which report that chemical pollution of water is their main environmental problem spend much more time than other polluters on pollution control activities (Table 3). They also are more likely to have separate pollution control units and have had these units for a longer time. Companies which report that thermal pollution of water is their main environmental

Table 4
 PROBABILITY OF OBSERVED DIFFERENCES IN MANAGERS' ATTITUDES,
 BY TITLE, INDUSTRY, AND ENVIRONMENTAL PROBLEM

Statements of Opinion	Title of Respondent	Industry Type	Main Environmental Problem
Talk about pollution is a waste of time. Water quality is becoming more of a problem.	n. s.	n. s.	n. s.
We are all responsible for pollution. Big business is the major cause of pollution.	n. s. .90	.05 .005	.90 n. s.
Business should alter harmful products. Industry should set regulations. Government should set regulations. Cost of pollution should be covered by product tax.	n. s. n. s. n. s. .90	n. s. n. s. n. s. n. s.	n. s. .005 n. s. n. s.
Cost should be allocated by harmfulness of effluents. Government should close plants which pollute.	n. s.	n. s.	n. s.
No one should be allowed to pollute, even if he pays for it.	n. s.	.10 n. s.	.10 .05 .05

n. s. = no significant difference

problem, however, express greater concern for pollution than other manufacturers and expect more changes in their organizational structure to accommodate pollution control activities.

Management attitudes toward pollution control

When asked to give their opinions on a number of statements related to water quality considerations, respondents show a great concern about pollution, much greater than their companies' involvement would indicate (Table 4). Very few respondents (8.4 percent) agree that talk about pollution is a big waste of time, and a majority (86.6 percent) express the view that water quality will become more of a problem. Obviously, the executives who responded are likely to be concerned about pollution and water quality. However, the lower-level executives generally voiced more concern than the higher-level executives: a larger proportion of lower-level respondents say they disagree with the statement that all the talk about pollution is a waste of time and agree that water quality will continue to become more of a problem. Companies that report thermal pollution of water disagree much more strongly than other polluters do with the statement that talk about pollution is a waste of time. They also agree more strongly that water quality will become more of a problem and that we are all responsible for pollution.

A large proportion of executives (93 percent) agrees or strongly agrees that we are all (the public at large) responsible for pollution (Table 4). Lower-level executives also agree more strongly than higher-level executives do that we are all responsible for pollution. Significantly fewer respondents (14.1 percent) feel that big business is the real cause of pollution in this country. Higher-level executives are less likely than other executives to feel that big business is the real cause of pollution in this country, although few executives of any level agree with this statement. Of all the types of manufacturers represented in the sample, software manufacturers are least likely to feel that big business is the real cause of pollution.

Significantly more executives (75.5 percent of the respondents) agree rather than disagree that business should alter products within the production process if the end use of such products is harmful to the environment (Table 4). Companies with thermal or chemical pollution problems agree more strongly that harmful products should be altered; companies with noise pollution problems do not agree as strongly.

Regardless of their position in the firm, a majority of the respondents (61.2 percent) disagrees with the statement that industry should set regulations for water pollution control and

agrees that these regulations should be set by the government (Table 4). Of all the manufacturers sampled, heavy manufacturers disagree most strongly that industry should set pollution control regulations. Food manufacturers are likely to agree or disagree in equal proportions with this statement.

On the other hand, 78 percent of the respondents agree or strongly agree that the government should set these regulations (Table 4), with thermal polluters favoring government regulations the most and noise polluters favoring them the least. Heavy manufacturers also support government regulations for pollution control more strongly than do other types of manufacturers.

More than other manufacturers do, food manufacturers seem to favor the allocation of the cost of enforcement by the harmfulness of the effluent discharged (Table 4). Thermal polluters also strongly favor the allocation of enforcement cost by the harmfulness of effluent, whereas, a substantial number of air polluters do not favor this basis for allocation. However, few respondents (20 percent) are ready to accept covering the cost of enforcement by a tax on the product.

In general, respondents do not express very strong feelings about the alternatives of closing a plant because of excessive pollution. Most have moderate views on this subject, but they disagree with the general idea that the government should close any plant that degrades the environment. Thermal polluters, who strongly favor the idea, are an exception, and food manufacturers are stronger opponents of the idea than are other types of manufacturers.

Lower-level executives do not agree as much as high-level executives do with the idea that no one should pollute the environment even if he pays for it (Table 4). Of all the types of polluters, air polluters most strongly support this idea, and among the types of manufacturers, food manufacturers and heavy manufacturers agree most strongly. Although most of the chemical manufacturers agree with the statement, a substantial proportion of them do not.

Information resources on pollution

This section analyzes how easy or difficult it is for the respondents to obtain different types of information about water pollution and whether they need the information. It also reviews potential sources of pollution control information to determine how much information is obtained from each source and how useful that information is.

Table 5
 PROBABILITY OF OBSERVED DIFFERENCES IN TYPES OF INFORMATION NEEDED
 BY TITLE, INDUSTRY, AND ENVIRONMENTAL PROBLEM

Types of Information	Title of		Main Environmental Problem
	Respondent	Type of Industry	
Legal requirements	n. s.	n. s.	n. s.
Community activities	n. s.	n. s.	n. s.
Legislative activities	n. s.	.025	n. s.
Biochemical data	n. s.	n. s.	n. s.
Water flow and sedimentation data	n. s.	n. s.	n. s.
Water regeneration data	.05	n. s.	n. s.
Installation engineering data	.05	n. s.	n. s.
Production method information	n. s.	n. s.	n. s.
Suppliers of pollution control devices	.01	n. s.	.05
Cost and tax requirements	.10	n. s.	.05
Effectiveness of controls	n. s.	n. s.	.025

n. s. = no significant difference

n. a. = not available

Importance and availability of different types of information.

Information on legal requirements is considered to be important by most (over 90 percent) of the respondents; and a majority of the respondents reports that this type of information is, nevertheless, hard to find. Information on community activities is needed by an even greater proportion of executives (93 percent), and most of them report that this type of information is available and generally easy to find. Information on legislative activities is also ranked as important by 93.8 percent of the respondents, but the majority says it is somewhat difficult to find.

The proportion of respondents who feel that biochemical data are needed (80 percent) is not as high as the proportion who feel that the first three types of information are needed, and only 5 percent of the respondents say such data are easy to find. In the case of water-flow and sedimentation data, an even lower percentage (73.4 percent) of executives finds that they are needed, and fewer than 8 percent of them report that such data are easy to find. Water regeneration data are felt to be needed by 75 percent of the respondents, but only 5 percent say these data are easy to find.

Respondents attached more importance to installation engineering data: 86 percent of them say this information is needed, and only 9 percent report the information easy to find. Even more respondents (88.4 percent) feel that production-method information is needed. This type of information is reported to be a little easier to find; about 18 percent of the respondents say it is easy or very easy to find. Information on suppliers of pollution control devices is also rated as needed by a large majority of respondents (89 percent), and a majority of them report that this type of information is easy to find. Although 90 percent of the respondents feel that cost and tax requirements information is needed, a small proportion of them (9.5 percent) say that it is easy or very easy to find. Finally, information on the effectiveness of controls is felt to be needed by a large number of respondents (91.2 percent) but is reported to be very difficult to find. Only 6 percent of the respondents say it is easy or very easy to find.

Water regeneration data, installation engineering data, cost and tax requirements, and the identification of suppliers of pollution control devices were the only types of information that all levels of respondents did not report to be uniformly easy or difficult to find (Table 5). Higher-level executives consider information on legal requirements, community activities, legislative activities, and effectiveness of controls generally easy to find or at least available. The lower the level of the reporting officer, the more difficulty he reports in finding

this information. On the other hand, the higher the level of the reporting officer, the more difficulty he reports in finding biochemical data, water-flow and sedimentation data, water regeneration data, installation engineering data, and information production methods, on suppliers of pollution control devices, and on cost and tax requirements.

Regardless of the type of industry in which they were engaged, respondents reported all types of information uniformly easy or difficult to find, except information on legislative activities (Table 5). In general, of all manufacturers, software manufacturers have the hardest time finding information. Except for water regeneration and installation engineering data, they report all categories of information hard to find. Although food manufacturers also report more difficulty than others in finding data on water flow and sedimentation, water regeneration, and installation engineering, and information on cost and tax requirements and effectiveness of controls, they consider that information on suppliers of pollution control devices is fairly easy to find. Other manufacturers, except for chemical manufacturers, consider this type of information hard to find. Chemical manufacturers report that information on legislative activities is hard to find and installation engineering data are easier for them to get than they are for other industries. Heavy manufacturers consider information on legal requirements and biochemical data easy to find.

The identification of suppliers of pollution control devices, cost and tax requirements, and information on the effectiveness of controls were the only three types of information which tended to be easier or harder to find depending upon the environmental problems facing the respondents (Table 5). A significant number of these manufacturers, although not the majority, say that they do not need water regeneration data. Remarkably, only food manufacturers are unanimous in saying that they need all the types of information listed, with the exception of one respondent, who says he does not need water regeneration data, but does need all the other information.

Thermal polluters generally consider it easy to get information on water pollution (Table 5). Forty percent of them say they do not need water-flow and sedimentation data or water regeneration data. Noise polluters report having difficulty finding information on legal requirements, while air polluters consider it hard to find the following data: biochemical, water flow and sedimentation, and water regeneration; and very hard to find information on the effectiveness of controls. On the other hand, they say that finding information on community activities is relatively easy. The companies which report that their main problem is chemical pollution of the water feel that it is difficult to find biochemical data and information on cost and tax requirements and effectiveness of controls, but these

companies consider it easy to find information on suppliers of pollution control devices.

Importance and usefulness of different sources of information.
The respondents rated a number of different information sources according to how much information on water pollution they have received from these sources and how useful this information is. Few respondents say they get information from Chambers of Commerce or other business groups or from their professional associations. As many as 30 percent do not get any information at all from professional associations. Very few respondents say they get information on water pollution from business colleagues or from conservation groups. Significantly few get information from the Water Resources Commission or other state agencies, from professionals in the field of environment, or from their own staffs.

In addition, significantly few respondents get information from the Environmental Protection Agency or from other federal agencies, and almost half say they never get any information from this source. A large majority of the respondents (82.3 percent) say they do not get any information from the governor's office, and almost none of the respondents use legal experts or labor unions as a source of information on water pollution. Over 97 percent of them do not get any information at all from labor unions. Almost 60 percent of the respondents say they never tap scientific researchers as a source of information.

Significantly few executives find information obtained from their business colleagues to be useful. Most of the respondents also indicate that information from professional associations, legal experts, the Environmental Protection Agency, and other federal agencies is not very useful. Very few of the respondents who say they receive information from scientific researchers, conservation groups, and Chambers of Commerce or other business groups have found that information useful. Of all the respondents, 48.3 percent say that information from labor unions about pollution is not useful; another 48.3 percent do not express any opinion at all on the usefulness of this information. Half of the respondents do not express any opinion on the usefulness of information from the Governor's office, but most of those who do express an opinion (77 percent) say it is not all useful. Responses indicate that information obtained from the Water Resources Commission or other state agencies and from the company staff is not significantly useful.

On the other hand, a significant number of respondents use their trade associations and trade publications as sources of information on water pollution, only 14 percent saying that they do not get any information at all from this source. Only 10.5 percent of the sample report that this information is not useful at all, and a majority finds it very useful. Most executives

also get at least some information on water pollution from the mass media; however, their responses indicate that they do not find this source significantly useful. Few executives feel that the mass media are a very useful source of information on water pollution, and as many as 26 percent say the media are not useful.

When asked to name the most useful sources of information on water pollution with which they have contact, 35 percent of the respondents say they have contact with no useful sources. Those who did not contact the particular information sources mentioned and receive information in return were not included in this analysis. The source of information that is mentioned most often is the mass media (26 percent of those who answered.) Trade associations and trade publications and the Water Resources Commission or other state agencies are also mentioned more often than other sources (16.5 percent and 15.3 percent). Legal experts, labor unions, and the Environmental Protection Agency are not mentioned at all as most useful sources of information on water pollution.

Higher-level and lower-level executives rated somewhat different sources of information on water pollution as most useful (Table 6). Lower-level executives mention the Water Resources Commission and other state agencies more often than higher-level respondents do. They also mention trade associations and publications more often. Although professionals in the field of environment are not often mentioned as a useful source of information on water pollution, the respondents who do mention them are from the lower levels of administration, principally plant managers.

Higher-level respondents, especially company owners, mention the mass media more often than lower-level respondents do (Table 6). Only higher-level respondents mention their staffs as the most useful source of information on water pollution. Although not frequently considered as a useful source of information on water pollution, business colleagues are mentioned more often by a higher-level of executives than by lower-level executives. Although very few respondents use information from both the Governor's office and from Chambers of Commerce and find it useful, all who do are higher-level executives. The five respondents who indicate that no source of information on water pollution is worth mentioning as most useful are all higher-level executives.

Respondents also differed by industry group when asked to name one or two of the most useful sources of information on water pollution that they have employed (Tables 6 and 7). Software manufacturers are more likely than other manufacturers to draw on and find useful information from conservation groups, trade associations, and the mass media, but they are less likely

Table 6
 PROBABILITY OF OBSERVED DIFFERENCES IN SOURCES OF INFORMATION USED
 BY TITLE, INDUSTRY, AND ENVIRONMENTAL PROBLEM

Information Sources Used	Type of		Main Environmental Problem
	Respondent	Industry	
EPA	n. s.	n. s.	n. s.
Governor's Office	.975	n. s.	n. s.
WRC	.01	n. s.	.025
Chambers of Commerce	.90	n. s.	n. s.
Trade Associations	n. s.	n. s.	.05
Professional Associations	n. s.	n. s.	n. s.
Labor Unions	n. s.	.95	n. s.
Conservation Groups	n. s.	n. s.	n. s.
Scientific Researchers	n. s.	n. s.	n. s.
Professionals in Environment	n. s.	n. s.	n. s.
Legal Experts	n. s.	.90	.05
Mass Media	n. s.	n. s.	n. s.
Company Staff	.05	n. s.	.10
Business Colleagues	n. s.	n. s.	n. s.

n. s. = no significant difference

n. a. = not available

Table 7
 PROBABILITY OF OBSERVED DIFFERENCES IN SOURCES MENTIONED AS MOST USEFUL
 BY TITLE, INDUSTRY, AND ENVIRONMENTAL PROBLEM

Most Useful Source	Title of Respondent		Type of Industry		Main Environmental Problem	
EPA	n. s.		n. s.		n. s.	
WRC	.025		n. s.		n. s.	
Local Government	.99		n. s.		n. s.	
Chamber of Commerce	n. s.		n. s.		n. s.	
Trade Associations	.025		n. s.		n. s.	
Professional Associations	.99		.005		n. s.	
Conservation Groups	n. s.		.025		n. s.	
Scientific Researchers	.995		.005		n. s.	
Professionals in Environment	.10		n. s.		.05	
Mass Media	n. s.		n. s.		n. s.	
Company Staff	n. s.		.90		n. s.	
Business Colleagues	n. s.		n. s.		.10	
None	n. s.		.10		.01	

n. s. = no significant difference
 n. a. = not available

to use information from Chambers of Commerce, scientific researchers, and their staffs. Software manufacturers also mention trade associations and the mass media more than the other industries do, and they are the only respondents to mention professional associations as most useful sources of information. Food manufacturers are more likely than many other manufacturers to get information from the Water Resources Commission and from trade associations and to find it useful, and they are less likely than others to get information from conservation groups or to find information from Chambers of Commerce useful. Most of those who mention scientific researchers as useful sources of information are food manufacturers. Chemical manufacturers and heavy manufacturers are a little more likely than are the other industry groups to get such information from the Environmental Protection Agency and to find it useful. Heavy manufacturers are the only ones to use information from labor unions, while chemical manufacturers are the only ones to find legal experts useful as a source of information on water pollution. They were also more likely than others to use their own staffs and to find them useful sources of information. Finally, the mass media are not used very much by chemical manufacturers and are generally not considered a useful source of water pollution information by either food or chemical manufacturers.

In rating the different sources of information on pollution control, the respondents give different ratings according to the major environmental problem of their particular company (Tables 6 and 7). Thermal polluters say that they do not get any information from the Environmental Protection Agency, the Governor's office, scientific researchers, or professionals in the field of environment. They also consider information from these sources to be of little use. They use very little information from trade associations and publications, but are more likely than other polluters to get information from Chambers of Commerce, legal experts, the mass media, and business colleagues. Chemical polluters are more likely to get information from the Water Resources Commission and from their staffs and to find it useful. Air polluters use trade associations as a source of information and noise polluters are a little more likely than other polluters to get information from conservation groups.

Cross-tabulation of the choice of information sources and their usefulness. In general, the more information respondents get from each of the different information sources listed, the more useful they report this information to be. However, there tends to be a saturation point for information from the mass media, in particular. After quite a bit of information is received from the mass media, the information is generally rated not very useful.

Differentiation of Responses by the Level of
the Respondent's Optimism

Creating the index of optimism

Responses to three questions were combined to create an index of the respondents' optimism about the successful implementation of pollution controls. These questions are:

- How much lead time will be required for your company to install controls or to change its process to reduce pollution? (Question 5)
- How effective will these changes be in removing the harmful effects of the effluent? (Question 6)
- What will it cost to reach the level of effectiveness indicated above? (Question 7)

The answers to question 5 were coded from 1 to 4, with a low code meaning that a short time would be required to install controls or change the production process to reduce pollution. The answers to question 7 were coded from 1 to 6, with the low code representing a low expected cost of reaching the stated level of effectiveness. Question 6 was initially coded in terms of the percentage of effectiveness of effluent control. It was then recoded into 10 equal percentage categories, and the direction of the scale was reversed to allow the responses to correspond both in direction and relative size to the responses for questions 5 and 7. Thus, for all three component variables, the low codes represent an optimistic view of successful implementation of pollution controls, while the higher codes represent progressively pessimistic views of the success of implementing pollution controls.

The sum of the coded answers to questions 5, 6, and 7 formed an index indicating optimism or pessimism on the part of the respondent. The higher the code (the highest total was 11), the more pessimistic the respondent. For analysis, the index was reduced to four groups as nearly equal in size as possible, using the following key:

2	=	1	Optimism
3-4	=	2	
5-6	=	3	
7-11	=	4	Pessimism

The number of respondents in the second group is largest (34.2 percent) and that in the fourth group is lowest (18.4 percent), indicating some degree of optimism in the sample. It should be noted that more than half the respondents did not answer these

questions and were deleted from the analysis, a fact which alone may account for the apparent bias toward optimism among the respondents.

Results of cross-tabulations

Attitudes toward pollution. Among the most optimistic respondents, only 44 percent strongly disagree with the statement that industry should set regulations for water pollution control, whereas 86 percent of the most pessimistic respondents strongly disagree with it (Table 8). Along the same line, pessimistic respondents are more likely than optimistic ones to agree that government should set regulations for water pollution, and they are more likely than optimistic respondents to disagree strongly with the proposal that the cost of enforcement be covered by a tax on the product. The more optimistic the respondents' scores on the index are, the more likely they are to agree strongly that the cost of enforcement should be allocated by the harmfulness of the effluent discharged. The more pessimistic their scores, the more likely they are to disagree with the proposition that government should close any plant which degrades the environment. The attitudes of the company officials on these questions, then, tend to reflect their general opinions of their company's ability to respond quickly, effectively, and cheaply to the problem of pollution control.

Optimistic respondents are also a little more likely than pessimistic respondents to disagree strongly that talk about pollution is a waste of time, while pessimistic respondents are a little more likely than optimistic respondents to disagree strongly with the assertion that big business is the real cause of pollution in this country (Table 8). However, the relationships of these factors are not statistically significant.

Availability of different types of information. Optimistic respondents are generally more likely than pessimistic respondents to consider such information as legal requirements and water-flow and sedimentation data easy to find (Table 9), while they are more likely than pessimistic respondents to consider information such as installation-engineering data, production-method information, information on suppliers of pollution control devices and on cost and tax requirements hard to find. Optimistic respondents generally agree more than pessimistic respondents do that information on water pollution, except for information on community and legislative activities, is needed.

Usefulness of different sources of information. Respondents who are pessimistic about their company's ability to install pollution controls quickly, efficiently, and cheaply are much

Table 8

PROBABILITY OF OBSERVED DIFFERENCES IN MANAGERS' ATTITUDES
 BY LEVEL OF OPTIMISM AND COMPANY COMMITMENT
 TO POLLUTION CONTROL

Statements of Opinion	Optimism/ Pessimism	Company Commitment
Talk about pollution is a waste of time	n. s.	n. s.
Water quality is becoming more of a problem	n. s.	n. s.
We are all responsible for pollution	n. s.	n. s.
Big business is the major cause of pollution	n. s.	n. s.
Business should alter harmful products	n. s.	.025
Industry should set regulations	n. s.	n. s.
Government should set regulations	n. s.	n. s.
Cost of pollution should be covered by product tax	n. s.	.975
Costs should be allocated by harmfulness of effluents	n. s.	n. s.
Government should close plants which pollute	n. s.	n. s.
No one should be allowed to pollute, even if he pays for it	n. s.	n. s.

n. s. = no significant difference

n. a. = not available

Table 9
 PROBABILITY OF OBSERVED DIFFERENCES IN TYPES OF INFORMATION NEEDED
 BY LEVEL OF OPTIMISM AND COMPANY COMMITMENT
 TO POLLUTION CONTROL

Types of Information	Optimism/ Pessimism	Company Commitment
Legal requirements	n. s.	n. s.
Community activities	n. s.	n. s.
Legislative activities	n. s.	n. s.
Biochemical data	n. s.	. 90
Water flow and sedimentation data	n. s.	n. s.
Water regeneration data	. 10	n. s.
Installation engineering data	n. s.	n. s.
Production method information	n. s.	n. s.
Suppliers of pollution control devices	n. s.	n. s.
Cost and tax requirements	n. s.	n. s.
Effectiveness of controls	. 975	n. s.

n. s. = no significant difference

n. a. = not available

more likely than are optimistic respondents to get a lot of information from the Water Resources Commission and other state agencies and to find it very useful (Tables 10 and 11). Also the more pessimistic the respondents are, the more they tend to get information from professional associations, from business colleagues, and from their staffs. On the other hand, pessimistic respondents are less likely than optimistic respondents to consider information from the Environmental Protection Agency useful. Pessimistic respondents are also less likely to get information from the mass media than optimistic respondents, but find it more useful than optimistic respondents do.

Optimistic respondents tend to get more information from the governor's office and are a little more likely to find it useful (Tables 10 and 11). They also tend to find information from trade associations and scientific researchers more useful than do pessimistic respondents. Although optimistic respondents generally get a little more information from conservation groups than do pessimistic respondents, they also tend to find it less useful.

Differentiation of Responses by Level of the Companies'
Organizational Commitment to Pollution Control

Creating the index of commitment

Responses to the following two questions were combined to create a new variable indicating the level of organizational commitment on the part of a responding company:

- How long ago was a section with specific responsibility for pollution control established? (Question 14)
- What is the size of this section? (Question 15)

Answers to these questions (coded 0 to 6 and 0 to 5) were added together, and nonrespondents were deleted from the analysis. The lower codes indicated little commitment of personnel and organizational resources to pollution control.

Before further analysis the respondents were divided into three groups, as nearly equal as possible, using the following key:

<u>Sum of coded responses</u>		<u>Recoded level of commitment</u>
0	=	1
1-3	=	2
4-9	=	3
		(low)
		(high)

Table 10

PROBABILITY OF OBSERVED DIFFERENCES IN SOURCES OF INFORMATION USED
 BY LEVEL OF OPTIMISM AND COMPANY COMMITMENT
 TO POLLUTION CONTROL

Information Sources Used	Optimism/ Pessimism	Company Commitment
EPA	n. s.	n. s.
Governor's office	n. s.	n. s.
WRC	n. s.	.005
Chambers of commerce	n. s.	.975
Trade associations	n. s.	n. s.
Professional associations	.975	.90
Labor unions	n. s.	n. s.
Conservation groups	.05	n. s.
Scientific researchers	n. s.	n. s.
Professionals in environment	.025	n. s.
Legal experts	n. s.	.005
Mass media	n. s.	n. s.
Company staff	n. s.	.0005
Business colleagues	.975	.025

n. s. = no significant difference

n. a. = not available

Table 11
 PROBABILITY OF OBSERVED DIFFERENCES IN THE USEFULNESS OF SOURCES
 OF INFORMATION BY LEVEL OF OPTIMISM AND COMPANY COMMITMENT
 TO POLLUTION CONTROL

Sources	Optimism/ Pessimism	Company Commitment
EPA	n. s.	n. s.
Governor's office	n. s.	. 10
WRC	n. s.	. 0005
Chambers of Commerce	n. s.	n. s.
Trade associations	n. s.	. 10
Professional associations	n. s.	n. s.
Labor unions	n. s.	. 10
Conservation groups	n. s.	n. s.
Scientific researchers	. 10	n. s.
Professionals in environment	n. s.	n. s.
Legal experts	n. s.	. 05
Mass media	n. s.	n. s.
Company staff	n. s.	. 005
Business colleagues	n. s.	n. s.

n. s. = no significant difference
 n. a. = not available

The largest number of firms fall in the first third (65.7 percent), indicating little commitment of the part of most companies. Again, it is interesting to note that more than half the respondents did not answer these questions and were deleted from the analysis. This fact may suggest that commitment of company resources is even less than the low level of commitment noted.

Results of cross-tabulations

Attitudes toward pollution. Respondents who indicate no commitment of company personnel to pollution control are less likely than other respondents to disagree strongly that talk about pollution is a waste of time (Table 8). They are also a little less likely to agree that water quality will continue to become more of a problem. Respondents who indicate a high commitment on the part of their companies are more likely to disagree strongly with the statement that big business is the real cause of pollution in this country. They are also more likely to agree that business should alter products if the end use of such products is harmful to the environment, and that government should set regulations for water pollution control. On the other hand, they disagree more strongly with the idea that government should close any plant which degrades the environment. It is interesting to note that respondents who indicate no commitment on the part of their companies agree more strongly than the others that no one should be allowed to pollute the air or water, even if he pays for it.

Availability of different types of information. Respondents who indicate no commitment on the part of their companies are more likely than others to have a hard time finding information on legal requirements, community activities, water sedimentation data, water regeneration data, installation engineering data, and cost and tax requirements (Table 9). As might be expected, they are also more likely to feel that they do not need these types of information.

Usefulness of different sources of information. Respondents who indicate that their companies have committed no personnel to pollution control are less likely than others to get information from the Environmental Protection Agency and to find that information useful (Tables 10 and 11). The more committed a company is to pollution control, the more information its management gets from the Water Resources Commission and other state agencies, business colleagues, and the company staff, and the more useful it considers this information to be. Information from trade associations is generally considered more useful by respondents who indicate high commitment in their firm, and these respondents also report that they get more information from professional associations and legal experts and find it

useful. On the other hand, the more committed a company is to pollution control, the less information it gets from conservation groups and mass media, and the less useful it considers this information to be.

Highlights of the Survey Results

The survey of Michigan company executives reveals surprising confidence in the ability of industry to control and eventually stop pollution in a minimum of time, with a maximum of effectiveness, and for a minimum cost. Most respondents say that the lead time required to install controls to reduce pollution is less than two years. In contrast, the Wall Street Journal survey respondents considered five years necessary to reach a desirable level of pollution control. Sixty-two percent of our respondents believe that the effectiveness of such controls will be over 90 percent, and as many as 60 percent feel that the cost of reaching this level of effectiveness will be less than \$50,000. This last finding is particularly interesting, despite the fact that 40 percent of the respondents do not give any estimate at all, because it is commonly believed that, to be on the conservative side, company executives tend to overestimate or exaggerate the financial impact that pollution control regulations will have on business. Most respondents in our survey express much concern for water pollution problems; in fact, this concern is much greater than their companies' involvement and commitment of personnel indicate it would be.

Organizational structure

More than a third of the executives surveyed say that no one person in their company has a specific responsibility for pollution control. When such a post does exist, the person who holds it has the title of operations manager (only 5 percent of the companies call him environmental manager).

The background of the person responsible for pollution control is most likely to be engineering, and in Michigan firms his major pollution control activities appear to be more limited than was found to be the case in either the Conference Board or the Wall Street Journal national studies. Most of our respondents mention they have responsibility for the implementation of policies regarding pollution, but few mention planning and control responsibilities or even handling response to litigation. This response seems to indicate that, in most Michigan companies, decisions and planning about pollution control, along with relations with outsiders (government and public), are still considered a top-management function and are therefore most likely to be assumed by the president of the company or chairman of the board. Moreover, very few Michigan companies report that

the pollution control officer spends more than 15 percent of his time on pollution control activities. Separate pollution control units are not common; only 12 percent of the companies report having one. Furthermore, only 5 percent of the respondents anticipate changes in their company's present organizational structure, which indicates that the number of companies with separate units is not likely to increase much in the near future.

The higher the title of the respondent, the less his report shows the company to be organized for pollution control. Higher-level executives report fewer separate pollution control sections and anticipate fewer changes in the organizational structure of their companies than do lower-level respondents.

Michigan chemical manufacturers and heavy manufacturers delegate responsibility for pollution control to lower ranks and have more people involved at the operational level. Chemical firms also report more separate units identifying personnel with specific responsibility for pollution control activities.

Companies which report that chemical pollution of water is their main environmental problem spend more time on pollution control than companies with other environmental problems. Those companies which report thermal pollution of water as their main environmental problem anticipate more changes in organizational structure to accommodate pollution control activities than companies facing other pollution problems.

Company attitudes, priorities, and commitments

Only a minority of respondents from Michigan firms (8.4 percent) agree that talk about pollution is a waste of time and most believe that water quality will become more of a problem in the future. This response confirms the findings by the Conference Board and the Wall Street Journal that most company executives are clearly aware of and concerned about ecological problems. A large majority agrees that we are all responsible for pollution and disagrees that big business is the real cause of pollution in this country. Sixty-one percent of the respondents disagree with the idea that industry should set regulations for pollution control, and 78 percent agree that government should be responsible for setting these regulations.

Within Michigan companies, lower-level executives are generally more concerned about water quality than are higher-level executives. Higher-level executives tend to be more optimistic about the future success of pollution control efforts; the higher the level of the respondent, the shorter the estimate of the time required to install controls. Lower-level respondents anticipate a larger expenditure for pollution control de-

vices and do not expect a very high level of effectiveness.

Very few lower-level executives agree with the statement that government should close any plant which degrades the environment, perhaps because of their concern for job security and their close ties with labor unions. This is consistent with the fact that lower-level executives are less likely than higher-level executives to feel that no one should be allowed to pollute the air or water even if he pays for it.

Software manufacturers are the most likely to disagree strongly that big business is the real cause of pollution in the United States. Heavy manufacturers are strong supporters of government regulations on water quality; and food manufacturers seem to favor, more than do other manufacturers, the allocation of the cost of enforcement by the harmfulness of effluent discharged. Food and heavy manufacturers most strongly agree that no one should be allowed to pollute the air or water, even if he pays for it.

Michigan companies which report that thermal pollution of water is their main environmental problem tend to express greater concern over pollution. They are also more in favor of government regulation of pollution than companies with other pollution problems. The category least in favor of such regulations is that of noise polluters. Air polluters strongly support the idea that no one should be allowed to pollute the air or water, even if he pays for it. It is interesting to note that respondents who indicate that their company has not committed personnel resources to pollution control agree more strongly than others with the proposition that no one should be allowed to pollute the air or water, even if he pays for it.

Types and sources of information on pollution control

Although the respondents indicate that all the types of information listed in the questionnaire are needed, those types which are said to be needed most are information on legal requirements, community activities, legislative activities, cost and tax requirements, and the effectiveness of controls. The different types of information are not said to be equally available, however, and very few types are reported to be easy to find. Only information on community activities, on production methods, and on suppliers of pollution control devices is considered easy to obtain.

The most useful sources of information appear to be trade associations and publications, the mass media, and the Water Resources Commission or other state agencies. Three sources not mentioned at all as being useful are: legal experts, labor

unions and the Environmental Protection Agency. Forty percent of the respondents did not mention any source as most useful, however, leaving only 60 percent who found particular sources of information useful at all.

No respondents are very enthusiastic about any specific source of information. Most executives get at least some information from the mass media, for example, but few of them say that this source is very useful. The only source that respondents find generally useful is trade associations and publications, suggesting that most external sources of information on pollution control available to companies are either ignored or considered not useful by most executives. Internal information from their own staffs is not sought either, and very few respondents report using it.

Higher-level respondents tend to have more difficulty than lower-level respondents in finding technical data--such as biochemical information or information on water flow, water regeneration, or production method--and cost and tax data. On the other hand, higher-level executives find it easier to get information on legal requirements, community and legislative activities, and the effectiveness of controls. Lower-level respondents favor the Water Resources Commission and trade associations as useful sources of information, whereas higher-level respondents tend to prefer the mass media, business colleagues, and Chambers of Commerce. These preferences might be explained by the fact that when respondents are lower-level executives, they are more likely to be specifically in charge of pollution control activities and, therefore, to have contact with specialized sources of information. This observation is reinforced by the fact that higher-level executives are the only respondents who mention their own staffs as useful sources of information on pollution problems.

Software manufacturers have the most difficult time finding information on pollution control. Chemical manufacturers and food manufacturers are the only ones who consider information on suppliers of pollution control devices easy to find. Only food manufacturers consider (almost unanimously) that they need all types of information listed. Food manufacturers seem to use the Water Resources Commission as a source of information more than the other manufacturers do. Chemical and heavy manufacturers are a little more likely to get information from the Environmental Protection Agency and to find this information useful. Heavy manufacturers, who also have more people at the operational level in charge of pollution control, are more likely than other firms to use information from labor unions.

Thermal polluters say that they do not get any information from the Environmental Protection Agency, the Governor's office, scientific researchers, and professionals in environment. They

tend to prefer Chambers of Commerce and legal experts, while chemical polluters tend to favor the Water Resources Commission. Air polluters get most of their information from trade associations, and noise polluters get the most information from conservation groups.

Thermal polluters generally consider information on water pollution easy to find. Chemical polluters feel that it is difficult to find biochemical data and information on costs, tax requirements, and the effectiveness of controls. It was generally found that the more a respondent used any specific source of information, the easier it was for him to get most types of information. Respondents who had general difficulty in finding needed information tended to rate sources of information as useless, although this is not true for the ratings of all sources of information. In particular, information from conservation groups and from the mass media is judged more useful when most of the listed types of information become harder to find, suggesting that the mass media and conservation groups are the ultimate sources of information to which executives refer when it is too hard to find specific information. However, complete production method information is not available through the mass media.

The more personnel a company commits to pollution control, the more information its management gets from the staff and the more useful the management considers this source to be. Not surprisingly, the more information respondents get from a particular source, the more useful they report both the information and the source to be.

Conclusions and Recommendations for Future Research

This study has helped to identify the attitudes, predispositions, and degree of commitment on the part of Michigan firms and their decision makers working on problems of pollution control. It has also revealed some important aspects of business opinion on what pollution control should be. Finally, it has helped to evaluate the different sources of information which have an impact on decision makers in the firms, in an effort to provide the Sea Grant Program with specific recommendations for improving both the quality and supply of the information on water quality which is needed by industrial firms.

The data gained from the basic research has yielded information useful in developing active strategy for dealing with pollution control problems. The information on the executives' attitudes and predispositions, their informational aids, and their willingness to establish a formal organizational structure have helped to describe factors which influence environmental decision making in the firm.

Further research on the availability and the content of the sources of information on pollution control would help to identify the real informational needs of the business community. In particular, it would be interesting to investigate why important sources of information on pollution control, such as the Environmental Protection Agency and professionals in the field of environment, are not widely used or found useful. Research should focus on the ways these sources can be improved--circulation, content, etc.--so that they are appealing to companies and helpful to them in the formulation of policies on pollution control. Such a study would help to improve the appropriate vehicles for the transfer of environmental technology and information from specialized sources, such as Sea Grant researchers, to industrial decision makers.

APPENDIX

UNIVERSITY OF MICHIGAN SURVEY

Environmental Information Use
in Industrial Decision Making

- 1:8,9 1. What is your title? _____
- 1:10,11 2. What product does your company manufacture? _____
- 1:12 3. Recognizing that every company has its environmental problems, what is the main concern of your company?
- _____ 1) air pollution
 - _____ 2) noise pollution
 - _____ 3) thermal pollution of water
 - _____ 4) chemical pollution of water
 - _____ 5) other: please specify _____
- 1:13,14 4. What type of effluent resulting from your production process do you feel will seriously affect water quality in the near future?
- _____
- 1:15 5. How much lead time will be required for your company to install controls or change its process to reduce pollution?
- _____ 1) less than 1 year
 - _____ 2) 1-2 years
 - _____ 3) 2-3 years
 - _____ 4) over 3 years
- 1:16,17 6. After such changes are made how effective will they be in removing the harmful effects of the effluent?
- Percent
- 0 10 20 30 40 50 60 70 80 90 100
- |-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
- 1:18 7. What will it cost to reach the level of effectiveness indicated above?
- _____ 1) less than \$50,000
 - _____ 2) \$50,001 to \$500,000
 - _____ 3) \$500,001 to \$1,000,000
 - _____ 4) \$1,000,001 to \$2,500,000
 - _____ 5) \$2,500,001 to \$5,000,000
 - _____ 6) over \$5,000,000
- 1:19,20 8. What is the title of the person who has been delegated the responsibility for pollution control?
- _____

APPENDIX

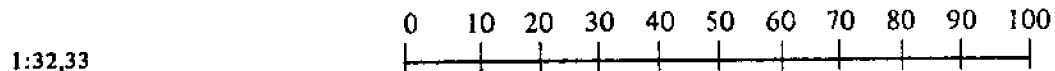
1:21,22 9. What is his professional background? _____

10. What are his major pollution control activities?

- 1:23 _____ a) Development of company policy on pollution control
- 1:24 _____ b) Implementation of policies regarding pollution
- 1:25 _____ c) Proposing action to meet current water quality standards
- 1:26 _____ d) Participating in product planning and research
- 1:27 _____ e) Handling the firm's response to litigation
- 1:28 _____ f) Responding to consumer pressures
- 1:29 _____ g) Community and regional public relations
- 1:30 _____ h) Governmental agency relations
- 1:31 _____ i) Other: please specify _____

11. What per cent of his time per month is spent on pollution control activities?

Percent



1:34,35 12. Who else participated in these activities? (Titles only) _____

1:36,37 _____

1:38,39 _____

1:40,41 _____

13. Does your company have a separate unit, section, or department with specific responsibility for pollution control?

1:42 _____ 1) Yes _____ 2) No

14. How long ago was this section established?

- 1:43 _____ 0) No such section
- _____ 1) Less than 1 year ago
- _____ 2) 1-2 years ago
- _____ 3) 2-3 years ago
- _____ 4) 3-4 years ago
- _____ 5) 4-5 years ago
- _____ 6) Over 5 years ago

15. What is the size of this section?

- 1:44 _____ 0 persons
- _____ 1 person
- _____ 2 people
- _____ 3 people
- _____ 4 people
- _____ 5 or more people

APPENDIX

1:45 16. Do you anticipate any changes in your present organizational structure for pollution control, e.g., the hiring or transfer of personnel into this section?

_____ 1) Yes _____ 2) No

17. Please circle the answer which best expresses your opinion on each item.

		Strongly Disagree	Disagree	No Opinion	Agree	Strongly Agree
1:46	a. All this talk about pollution is a big waste of time.	1	2	3	4	5
1:47	b. Water quality will continue to become more of a problem.	1	2	3	4	5
1:48	c. We are all responsible for pollution.	1	2	3	4	5
1:49	d. Big business is the real cause of pollution in this country.	1	2	3	4	5
1:50	e. Business should alter products within the production process if their end use is harmful to the environment.	1	2	3	4	5
1:51	f. Industry should set regulations for water pollution control.	1	2	3	4	5
1:52	g. Government should set regulations for water pollution control.	1	2	3	4	5
1:53	h. The cost of enforcement should be covered by a tax on the product.	1	2	3	4	5
1:54	i. The cost of enforcement should be allocated by harmfulness of effluent discharged.	1	2	3	4	5
1:55	j. The government should close any plant which degrades the environment.	1	2	3	4	5
1:56	k. No one should be allowed to pollute the air or water, even if they pay for it.	1	2	3	4	5

PLEASE BE SURE TO MARK PAGES 4 AND 5

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APPENDIX

18. Please circle the answer which indicates how easy or difficult it is for you to obtain each of the following types of information.

		Very Easy to Find	Easy to Find	Available	Hard to Find	Very Hard to Find	Not Needed
		1	2	3	4	5	x
1:57	a. Legal requirements						x
1:58	b. Community activities						x
1:59	c. Legislative activities						x
1:60	d. Biochemical data						x
1:61	e. Water flow and sedimentation data						x
1:62	f. Water regeneration data						x
1:63	g. Installation engineering data						x
1:64	h. Production method information						x
1:65	i. Information on suppliers of pollution control devices						x
1:66	j. Cost and tax requirements						x
1:67	k. Effectiveness of controls						x

19. Please name one or two of the most useful sources of information on water pollution that you have had contact with (magazines, agencies, research or consulting groups, etc.). Please be specific.

1:68,69

1:70,71

APPENDIX

20. From your experience, rate each of the sources below according to how much information on water pollution you have received and how much you have used it.

	Source	How much information do you get from this source?					How useful is the information you get from this source?						
		None at all	1	2	3	4	5	Not at all useful	1	2	3	4	5
2:8,9	a. Environmental Protection Agency or other federal agencies		1	2	3	4	5		1	2	3	4	5
2:10,11	b. Governor's office		1	2	3	4	5		1	2	3	4	5
2:12,13	c. Water Resources Commission or other state agencies		1	2	3	4	5		1	2	3	4	5
2:14,15	d. Chamber of Commerce and other business groups		1	2	3	4	5		1	2	3	4	5
2:16,17	e. Trade associations and publications		1	2	3	4	5		1	2	3	4	5
2:18,19	f. Your professional associations		1	2	3	4	5		1	2	3	4	5
2:20,21	g. Labor Unions		1	2	3	4	5		1	2	3	4	5
2:22,23	h. Conservation groups		1	2	3	4	5		1	2	3	4	5
2:24,25	i. Scientific researchers		1	2	3	4	5		1	2	3	4	5
2:26,27	j. Professionals in the field of environment		1	2	3	4	5		1	2	3	4	5
2:28,29	k. Legal experts		1	2	3	4	5		1	2	3	4	5
2:30,31	l. The mass media		1	2	3	4	5		1	2	3	4	5
2:32,33	m. Your staff		1	2	3	4	5		1	2	3	4	5
2:34,35	n. Business colleagues		1	2	3	4	5		1	2	3	4	5

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