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ABSTRACT

A feasibility study and task analysis was performed to determine the future job potential within the Southern California area for environmental technicians trained under a proposed vocational training program in community colleges. Questionnaires were mailed to possible employers in government and industry to obtain information about their monitoring systems for discharge products and their requirements for technicians, especially as to detailed educational level and vocational training. Responses, a disappointing less than 40 percent of those queried, indicated that varying majorities of the respondents considered physics, chemistry, and mathematics courses to be necessary for environmental technicians, with basic engineering, electronics, and other probable courses mentioned by less than half. The data appeared to reflect an uncertainty about pending government regulations for pollution control; these regulations would help to determine the educational level required for environmental technicians and the job market for them. As the costs of developing and implementing a technician-training program in a community college would be considerable, it was concluded that it would be premature to institute such a program at this time. (MF)

Final Report of

Feasibility Study of Training

Environmental Technicians

A Project Funded Under
Title I, Part C, Section 131 (h)
Public Law 90- 76 and the
CRCU Small Grant Program

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May 24, 1972

FINAL REPORT

of Feasibility Study of Training Environmental Technicians

Submitted to the California Research Coordinating Unit

I Introduction

This feasibility study and task analysis was undertaken by Donald M. Garrett, Assistant Professor of Geology and Oceanography and James Y. Vernon, Professor of Meteorology, both of Los Angeles City College, to determine the possibility of initiating a vocational education program to train environmental technicians. The basic problem was identified as the determination of future job potential within the Southern California area for trainees under such a program. The second aspect of the problem concerned the minimal educational requirements required of the trainees by prospective employers.

Application was made in the Spring of 1971 under Title I Part C, Sec. 131(b) of Public Law 90-576 to pursue this objective. The application for this grant is reproduced as Appendix A of this report.

After the authors received notification of approval, of the project, they compiled a definitive and comprehensive listing of governmental agencies and private industries in Southern California that would most likely be involved in the possible employment of these environmental technician trainees. The total listing was analyzed and selections were made from this group to yield a mailing list 118 governmental agencies and private industries which is attached as Appendix B.

A breakdown of 118 who were asked to participate identified the following categories:

	No. of Participants
Federal agencies	7
State agencies	3
County agencies	9
Municipal agencies	4
Miscellaneous governmental agencies	2
Private industries	93
a. Oil related industries	14
b. Pollution and atmospheric research	10
c. Surface transportation	7
d. Non-governmental public utilities	2
e. Airlines	7
f. Paint and paint related chemicals	19
g. Steel and other metals processing	12
h. Other chemicals and manufacturing products	22

While the final mailing list was being completed, the researchers prepared the questionnaire and cover letter to be sent to the 118 participants. A copy of these items will be found in Appendix C of this report.

The authors selected the criterion for a valid response as the completion of five or more questions on the returned questionnaire.

In January of 1972, the cover letter and questionnaire was sent by mail to the participants with a stamped, self-addressed envelope enclosed. A general statistical abstract of the response is as follows:

(1) Fifty-five questionnaires or 46.6 per cent were returned to the researchers out of the 118 sent.

(2) Forty-five or 38.1 per cent of the participants can be considered as valid returns.

These forty-five questionnaires represent the basis for the statistical data presented in the later sections of this report. The comments derived from personal interviews with selected individuals within this group of 118 will also be presented in their appropriate sections but will not be counted within the statistical data presented as these individuals had already responded on the questionnaire and were supplying additional information or clarification in the interviews.

Ten of the returned questionnaires were considered invalid for the following reasons:

(a) Several were returned blank and with no accompanying explanation for the lack of response.

(b) Three were returned with the notation that the addressee was a sales organization branch for the corporate name involved and there were no manufacturing processes present for that corporation within the Southern California area that might provide pollution problems.

(c) One large corporation (one that the researchers considered to have a considerable pollution problem in the Southern California area) responded with a commercial brochure illustrating their manufacturing operations and environmental control activities but with no responses on the questionnaire.

(d) One questionnaire returned with each item on the form marked "No Opinion". A statement written in by the respondent at the end of the questionnaire illustrated that the individual responding for his organization had completely missed the point concerning the information requested on the questionnaire.

The researchers were somewhat dismayed, needless to say, by the less than 40 per cent response to the mailed questionnaires Subsequent follow-up on a random sampling basis by telephone calls and personal interviews yielded information that partially accounts for the low percentage of returns. Some of these reasons were:

(1) Many small organizations are not doing anything about pollution problems or do not consider themselves to be pollution producers. Some also apparently felt that no one individual in their organization could respond on future policies of their organization with respect to environmental controls.

(2) In several large corporations, the mailroom personnel did not know the proper party to forward a letter to within their organization. Some of the questionnaires were addressed to "Chief Operating Engineer", "Chief of Operations", or "Director of Personnel" as no specifically named individuals were available to the researchers at the time the mailing list was compiled. In at least several cases of this nature, the mailroom personnel simply "pigeon-holed" the questionnaire letter and thus no response was made.

(3) Several companies informed J. Vernon that they were apprehensive about making responses on the basis that their organization might be singled out for in-sufficient response to the pollution situation.

In conclusion, personal contact with more of the organizations used on the mailing list might have increased the percentage of response, in spite of the fact that the questionnaire was constructed to allow an organization to remain anonymous.

II. Discussion of Responses to Questionnaire

In discussing and summarizing the responses to the items of the questionnaire, the following procedure will be followed:

(1) Statement of the question
(2) Statistical analysis of the responses
(3) Conclusions drawn by the researchers from the responses

Question 1: Do you think that current policies of your organization or trends in legislation will require that you institute monitoring systems on discharge products?

Per Cent	Numbers	Response
68.9	31	Yes.
22.2	10	Not in forseeable future.
8.9	4	No.

Summary: Approximately two-thirds of the respondents indicated that they will require monitoring systems and/or additional monitoring systems. This illustrates that many organizations feel that future legislation requirements will impose the necessity of such monitoring systems upon their operations and that very few will be free of such requirements.

2: Will these monitoring systems require technician personnel trained specifically for the operation of these monitoring systems?

Per Cent	Numbers	Response
55.6	25	Yes.
15.6	7	Not in the forseeable future.
17.9	8	No.
6.8	3	No Opinion.
4.4	2	Did not answer the question.

Summary: Slightly over half of the participants indicated that personnel will need to be specifically trained for jobs related to monitoring systems. It is interesting to note that while over two-thirds of these organizations indicate that they will be or are installing monitoring equipment, only slightly over half of these will need individuals trained specifically for handling this equipment.

3: What would you visualize as the duties of these individuals if they were employed by your organization? (Please check all applicable boxes.)

Per Cent	Numbers	Response
64.4	29	Instrument observation.
57.8	29	Recording instrument data.
62.2	28	Calculations involving raw data using simple formulas.
46.7	21	Calculations involving tabularized or graphic relationships of raw data.
51.1	23	Interpretation of instrument sequences showing potentially hazardous emissions.
40.0	18	Ability to communicate data and/or operations to the public or other sections of the same organization.
26.7	12	Other (Please explain)

Responses in the "Other" category were as follows:

(1) Perform maintenance only

(2) Perform field sampling only

(3) Mainly familiarity with regulations of enforcement agencies (Federal, State, and local)

(4) Would use outside firm to perform monitoring - contact with other firm

(5) "We do not discharge into sewer"

(6) Some respondents listed items in this section covered Question #10.

Summary: The responses to the choices of instrument observation, recording instrument data, calculations involving raw data using simple formulas, and interpretation of instrument sequences showing potentially hazardous emissions all showed that over half the respondents considered these functions to be important facets of an environmental technician's duties. In addition, two additional choices selected for usage by the researchers (calculations involving tabularized or graphic relationships of raw data and ability to communicate data and/or operations to the public or other sections of the same organization) were apparently also considered to be of some importance to the participants as both received greater than 40 per cent response on the questionnaires.

It would appear from these that most organizations would envision an environmental technician as an individual working with emission monitoring equipment, both in the reading of instrumentation and in the development of further data based upon the instrument readings. This would indicate the need for a basic familiarization with the equipment of monitoring systems and the methods of data reduction dependent upon these monitoring systems. Maintenance or repair (although not listed as a specific choice) was not written in by many individuals as another choice and therefore, it would appear that this phase of the instrumentation would be left to service firms.

4: How many persons would you forsee employed in this monitoring program within the next five years?

Per Cent	Numbers	Response
22.2	10	None.
37.8	17	1 - 5.
13.3	6	6 -10.
00.0	0	More than 10.
24.4	11	Impossible to determine at this time.

Summary: Less than one-fourth of the participants indicated that they did not expect to be hiring personnel in the capacity of an environmental technician within the next five years. The greatest portion of the respondents felt that a staff of one to five individuals would be the projected quota within this time interval which indicates that the general concensus of governmental agencies and private industries would be towards relatively small environmental

technician sections within these organizations. However, a significant portion (nearly 20 per cent) indicated that they could make no determination of this type of employee utilized within the immediate future. This would tend to indicate that some of these industries may not initiate environmental control and emission sections until legislation requires it. The uncertainty as to future legislation requirements has caused these organizations to adopt a "wait and see" attitude in many cases. This makes any prediction of utilization of environmental technician trainees impossible for any significant span into the future but indicates that minimal usage of trainees will be the future trend unless future legislation changes this.

5: What salary range would you expect for these individuals? This question was left completely open to answers from the individual respondents and the researchers established the following categories on the basis of the returns:

Per Cent	Numbers	Response
2.2	1	$ 500 - $ 600 per month
13.3	6	$ 600 - $ 700 per month
15.6	7	$ 700 - $ 800 per month
22.2	10	$ 800 - $ 900 per month
4.4	2	$ 900 - $1000 per month
2.2	1	$1000 - $1100 per month
8.9	4	$1200 - $1300 per month
31.1	14	Did not answer.

Summary: A wide range in starting salaries in indicated by the previous set of ranges. This is highly correlated with the responses to a later question which asked for the minimum degree that would be considered acceptable for environmental technician trainees. In this question, a significant percentage of the respondeants indicated that an Associate in Arts degree would be satisfactory and these were the questionnaires on which the lower group of salary ranges were located. However, some of the respondents indicated that the minimum acceptable level of training would be a Bachelor's degree and these were generally tied to the higher group of salary ranges. Nearly all of those indicating that the Associate degree was satisfactory gave salary ranges from $600 to $900 per month.

6: If such monitoring systems are installed by your organization, do you expect to (please check all applicable boxes):

Per Cent	Numbers	Response
64.4	29	Convert currently employed personnel
22.2	10	Hire persons trained in educational institutions
20.0	9	Other (please explain)
13.3	6	Did not answer

In the "Other" category, two of the participants indicated that Civil Service employment procedures would have to be devised and followed for hiring such technicians. Two additional organizations indicated that they would contract outside of their own organization

for monitoring services. Four indicated that they already have the personnel to carry out whatever monitoring systems they have.

Summary: The greatest portion of the participants indicated that they will convert currently employed personnel from within their own organizations rather than look to outside sources for these technicians. This could correlate with the significant portion of Bachelor's level personnel indicated in the question on desired level of training. The current employment situation in the engineering field could also be related with the plan of some organizations to convert possible excess engineers into this new field rather than to consider this individual as a possible surplus.

7: If you expect to convert currently employed personnel, will this be completed by (please check all applicable boxes):

Per Cent	Numbers	Response
51.1	23	Education by persons currently employed by your organization or education by persons that will be hired by your organization.
31.1	14	Encouraging employees to enroll in programs sponsored by local colleges, if they exist.
17.9	8	Siminars or in-service training under contract with consulting firms specializing in this type of program.
2.2	1	Other (please explain).
46.7	21	No applicable.
11.1	5	Did not answer.

In the "Other" category, the participants indicated that Civil Service procedures and examinations establsihed by Civil Service Personnel Boards would determine the hiring or conversion criteria.

Summary: Most of the organizations that expect to convert their own employees into this new field will complete this operation by training conducted from within their own ran.s. Only slightly less than one-third of the organizations might use a training program available at a local college, and for many of these, the college training would be coupled with training activities within the organization. It is interesting to note that nearly half of the organizations marked that this question was not applicable to their own situation which would indicate that they might be looking toward educational institutions completely in the future for trained personnel. However, some of these are also organizations that indicated that they did not know how many, if any, environmental technicians they might be hiring in the next five years. One could conclude that the indecision with respect to the future employment of these trainees has left these organizations with no thoughts toward the source or creation of such employees if they would be needed in the future.

8: If courses necessary to convert some of your employees to technicians capable of performing the necessary tasks associated with these monitoring programs were available at a community college, would you (please check all applicable):

Per Cent	Numbers	Response
46.7	21	Encourage some employees to attend such courses.
11.1	5	Give paid time off from work to attend such courses.
6.7	3	Give non-paid time off from work to attend such courses.
48.9	22	Give an employee a refund of tuition and/or book costs for attendance.
13.3	6	Offer a program of possible salary advancement dependent upon completion of such courses.
20.0	9	No applicable.
2.2	1	Other (please explain).
11.1	5	Did not answer.

The "Other" category checked by one organization was accompanied with a statement "Courses relevant to the duties described would be welcomed".

Summary: A comparison of the results of this question with the previous question appears contradictory in the sense that less than one-third of the organizations indicated that they might encourage attendance at such courses in a local college while nearly half of these organizations would give a refund of tuition and/or book costs for attendance at such college courses. It would appear from the comparison of these statistics that some organizations that might have responded only to the choice of Question #7 that training would be conducted from within the organization might have slightly revised their thoughts in responding to Question #8. Another possible alternative is that although many organizations would not look directly to local colleges for training as a primary method of developing skilled personnel in this career field, they would offer varying degrees of incentives if they found it necessary to resort to this approach to training.

9: If you expect to hire persons trained in educational institutions, what would be the minimum educational level required for technicians to operate these monitoring systems?

Per Cent	Numbers	Response
44.4	20	A. A. Degree.
24.4	11	Bachelors Degree.
11.1	5	Other (please explain).
26.7	12	Did not answer

The organizations utilizing the "Other" choice in this case indicated several different possibilities. Most of these indicated that a high school diploma would be satisfactory and the individual would probably be trained "on the job". One of these indicated that the Civil Service Personnel Boards had not yet established the minimum education requirements.

Summary: Although the greatest single response within this question indicated the A. A. degree would be an acceptable minimum level the specific course requirements as indicated in the next question will establsih some apparent contradictions. Also, a significant percentage of organizations (nearly 25 per cent) are considering Bachelors degree levels as necessary for performance in this career field. These firms are apparently looking for engineer trained personnel for the environmental technician positions. Other emplications can be drawn from the combined information of this question and Question #10 which will then be discussed in the summary section on Question #10.

10: If you expect that the A. A. degree (2 year curriculum) will be sufficient for technician training for your monitoring systems, what subject background would you consider as the MINIMUM mandatory for this position?

Per Cent	Numbers	Response
6.7	3	High School Physics.
31.1	14	Basic College Physics.
13.3	6	Engineering Physics.
15.6	7	No opinion on physics requirements.
6.7	3	No opinion on any course requirements.
26.7	12	Did not answer question.
8.9	4	High School Chemistry.
44.4	20	Basic College Chemistry.
11.1	5	Advanced Chemistry.
00.0	0	No opinion on Chemistry requirements.
6.7	3	No opinion on any course requirements.
26.7	12	Did not answer question.
13.3	6	High School Biology.
8.9	4	General College Biology.
2.2	1	Advanced Biology.
42.2	19	No opinion on biology requirements.
6.7	3	No opinion on any course requirements.
26.7	12	Did not answer question.
6.7	3	Basic Algebra.
8.9	4	Geometry & Trigonometry.

Per Cent	Numbers	Response
20.0	9	College Algebra.
13.3	6	Calculus.
17.8	8	No opinion on mathematics requirements.
6.7	3	No opinion on any course requirements.
26.7	12	Did not answer question.
2.2	1	Geology.
13.3	6	Meteorology.
2.2	1	Surveying.
4.4	2	Oceanography.
35.6	16	Basic engineering courses.
17.8	[illegible]	Other course (please enumerate)

Specific courses listed in the "Other" category included 5 participants listing electronics courses, one listing a course on small boat handling, one listing applied chemistry and metorology courses, one listing hydraulics and open channel flow, and one indicating courses for developing written and oral proficiencies.

While the previous statistical data presents the views of course requirements of all 45 participants, a separation of these same course requirements with participants that checked the A. A. degree level will illustrate some interesting relationships. Since a total of 21 participants indicated that the A. A. degree would be an acceptable level, the following statistics are based upon those 21:

Per Cent	Numbers	Response
00.0	0	High School Physics.
57.1	12	Basic College Physics.
14.3	3	Engineering Physics.
23.8	5	No opinion on physics requirements.
4.8	1	No opinion on any course requirements.
00.0	0	Did not answer question.
4.8	1	High School Chemistry
66.7	14	College Chemistry.
14.3	3	Advanced Chemistry.
9.5	2	No opinion on chemistry requirements.
4.8	1	No opion on any course requirements.
00.0	0	Did not answer question.
9.5	2	High School Algebra.
14.3	3	Geometry & Trigonometry.
38.1	8	College Algebra.
9.5	2	Calculus.
23.8	5	No opinion on mathematics requirements.
4.8	1	No opinion on any requirements.
00.0	0	Did not answer question.
9.5	2	High School Biology.
14.3	3	College Biology.

Per Cent	Numbers	Response
4.8	1	Advanced Biology
66.8	14	No opinion on biology requirements.
4.8	1	No opinion on any course requirements.
00.0	0	Did not answer question.
9.5	2	Oceanography.
19.0	4	Meteorology.
4.8	1	Surveying.
52.4	11	Basic Engineering courses.
4.8	1	Geology.
23.8	5	Electronics.
4.8	1	Other (please explain)

The "Other" course listed in this case was a course in small boat handling. The course requirements listed by the participants indicating that an A. A. degree is an acceptable level of education is also visually illustrated in Figure 1 on the following page.

Summary: Although slightly more than half (51.11 per cent) of the participants indicated that physics courses would be necessary in the education of environmental technicians, the desired minimum level of preparation varied through the full range from high school physics through engineering physics. However, the most frequently checked box on the questionnaire in the physics section was that of basic college physics. The indication of basic college physics as the desirable level of preparation on the 21 that indicated that the A. A. degree level was adequate was an even higher proportion than with the total participants. It is interesting to note, however, that nearly 50 per cent of total respondents indicated no physics requirements on this career field.

Nearly two-thirds of the total respondents (64.44 per cent) indicated that some chemistry background would be necessary for environmental technicians. In both analytical groupings (total participants and those indicating the A. A. degree as satisfactory), more organizations indicated that basic college chemistry was the desired level of preparation than any other level. However, 18 out of the 21 (85.21 per cent) A. A. degree respondents indicated that some chemistry would be required as against the 64.44 per cent from the total group.

In the case of biological course preparations, by far the majority in both groupings had no opinion as to what level of biological training would be the minimum accepted. However, for the few participants that did indicate a definite preference, they were spread through the full range of biology courses, including one participants addition of microbiology under the specialized biology courses. Thus it would appear that most industries and organizations are not particularly concerned with the biological aspects of preparation of environmental technicians.

MINIMUM EDUCATIONAL REQUIREMENTS INDICATED BY THE 21
RESPONDANTS FOR A.A. DEGREE LEVEL TRAINEES

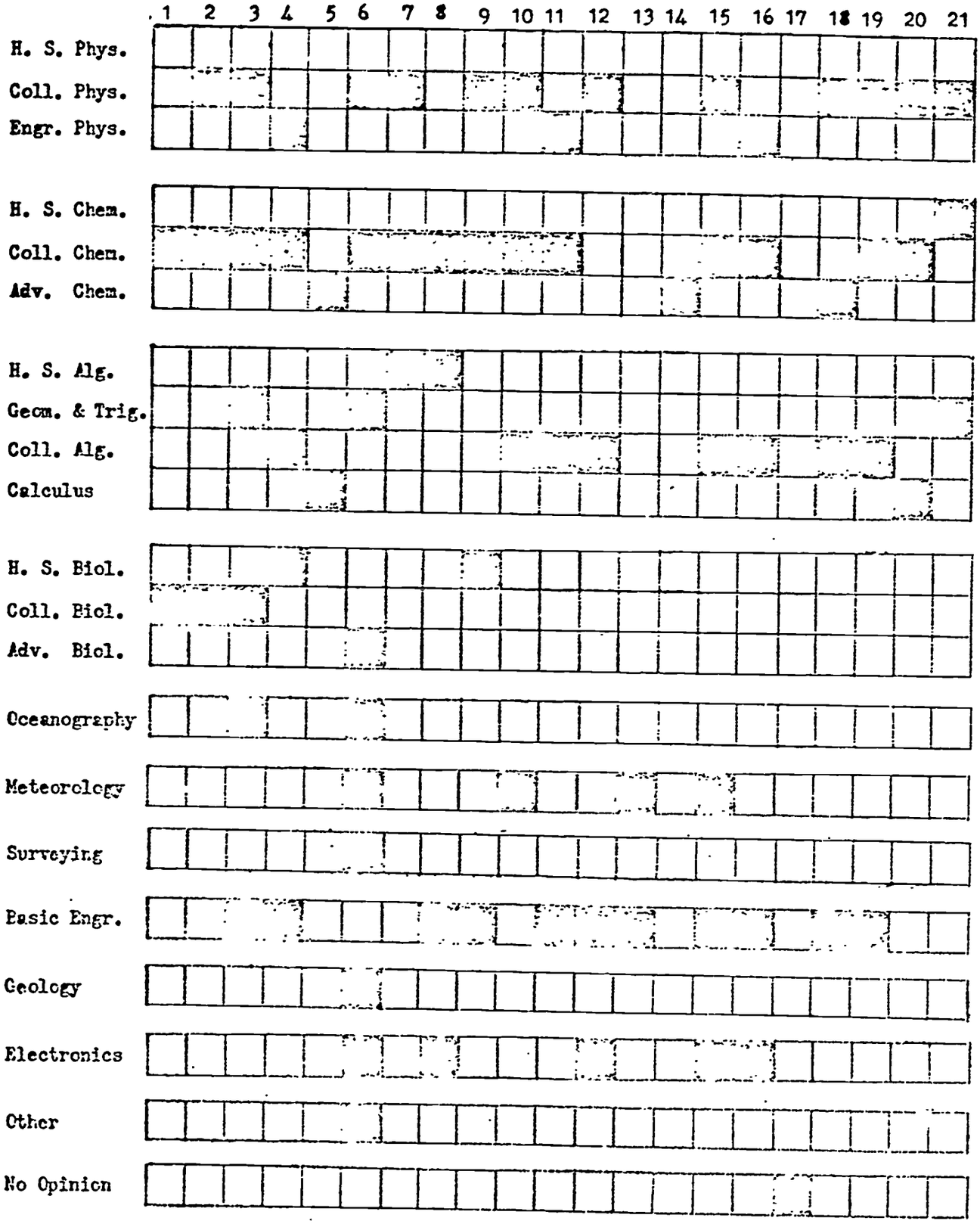

Figure 1 II-A

Most of the participants in both categories also indicated that some mathematics background would be needed for environmental technician positions. However, the desired level of training within the field of mathematics varied from high school algebra through calculus in both the full group and the portion that favored the A. A. degree. The most common choice in both groups was college algebra, and this choice was used somewhat more consistantly with the A. A. degree group. It is interesting to note that the three organizations in the A. A. degree group that indicated that engineering physics would be a desirable level of physics preparation also indicated that college algebra would be sufficient mathematical preparation. In actual practice, however, calculus must be taken before or concurrently with engineering physics. Of the two organizations that indicated calculus as a desired level of mathematics preparation, one had no opinion with respect to physics course requirements, and the other indicated that basic college physics would be sufficient. These relationships appear somewhat incongruous to the researchers.

In the non-sequential courses that were listed (such as geology, meteorology, oceanography, and others), relatively few organizations in either category indicated that these preparations would be required. Only four out of the A. A. degree group indicated a necessity for meteorology which indicates that a knowledge of basic atmospheric relationships would not be considered a necessity for successful performance of technicians duties. This would tend to indicate that the technician will not be expected to have knowledge of what will cause various instrumentation responses, but instead to follow through fixed or mechanical steps until the final data is obtained. The final interpretation and corrective action would be taken by supervisory personnel or engineers receiving this data.

Knowledge gained from basic engineering courses was also indicated as necessary by better than 50 per cent of the A. A. degree group and nearly 36 per cent of the total group of respondents. However, this did not correlate with the requirements for engineering physics or higher levels of mathematics preparation.

Although electronics courses were not written in as a specific choice, five organizations added this choice in the listing of "Other" courses. Probably other organizations might have checked a specific entry of this nature if it had been present. This would appear reasonable in the light of the technicians duties being centered around instrumentation systems. Some of these technicians might be asked to perform minor repairs and maintenance on these instrumentation systems.

11: Would you prefer that an individual trained at the A. A. degree level have a background in environmental courses relating to the needs of your organization?

Per Cent	Numbers	Response
26.7	12	Highly recommended.
42.2	19	Preferable, but not necessary.
6.7	3	Would not be considered as a factor in employment.

Per Cent	Numbers	Response
8.9	4	No opinion
4.4	2	Other (please explain)
11.1	5	Did not answer.

The two entries in the "Other" category stated that the question was "Not Applicable" to their organization.

Summary: A total response of nearly 69 per cent indicated in varying degrees that some environmental courses directed towards industrial problems would be at least preferable, if not strongly recommended. This is probably a good location within the environmental technician curriculum where various types of problems could be discussed both with respect to the general causes and the Federal State, and local regulations controlling the problems and their causes. These courses would be conceived by the researchers to cover the more generalized aspects of environments, their controls, and pollution problems arising from these factors.

12: What basic knowledge would you expect a community college program to give such a technician directly pertinent to his position with monitoring systems (check all applicable)?

Per Cent	Numbers	Response
71.1	32	Basic familiarity with monitoring equipment.
60.0	27	Use of graphs and tabularized reductions
66.7	30	Ability to interpret instrument data.
55.6	25	Basic familiarity with respect to Federal, State, and local regulations governing emission of liquid and atmospheric pollutants.
13.3	6	Other (please explain)
20.0	9	Did not answer.

In the "Other" category, the following statements were received on the six questionnaires:

(1) "With respect to the statement on basic familiarity with respect to Federal, State, and local regulations governing emission of liquid and atmospheric pollutants, the technician should know how to find these regulations."

(2) "Some survey courses in industrial operations producing emissions to be monitored and chemistry of basic air contaminants."

(3) "All of the previous are necessary in our program."

(4) "Basic course in instrumentation including basic electronic circuitry." (This individual did not list basic electronics courses in Question #10.)

(5) "Basic elementary applied meteorology and basic chemistry."

(6) "Perhaps a capsulized course in economics - including a recognition that business cannot provide jobs and pay taxes unless it operates at a profit. A study of manufacturing processes - heating, smelting, refining, plating, pickling, painting, power production, etc."

Summary: The majority of the participants indicated that the four specific knowledge areas indicated by the researchers were also considered to be of importance to them. Most of the comments in the "Other" section appeared to be a reemphasis of comments made on previous questions by the participants, with a few exceptions. It would appear that these participants would prefer some emphasis placed on the mechanical aspects of the operation of these monitoring systems by technicians in addition to the theoretical aspects covered by the academic types of courses such as chemistry, physics, and mathematics.

13: Would there by any physical requirements placed on individuals that would be hired by your organization in this technician capacity?

Per Cent	Numbers	Response
40.0	18	No.
44.4	20	Yes. (please explain)
15.6	7	Did not answer.

In the "Yes" category, 12 out of the 20 participants indicated that a physical examination would be required for employment. Some of the other responses in this category were:

(1) "Would have to work in other areas as well, to be able to support his cost."

(2) "To drive a car and get around to acquire field tests."

(3) "That necessary for potential field work."

(4) "Should be active."

(5) "Good health and ability to swim; physical endurance to work several hours in a small boat."

(6) "Usually need agility to handle emplacement of sensor probes in ducts and stacks."

The majority of participants either indicated that no special requirements would be levied on prospective employes or did not answer the question. This would indicate that with the execption

of a few specialized organizations, most prospective employers would require nothing more than good health. A few organizations would be involved with field sampling procedures and the individuals would have to acquire special "talents" for participation in these activities.

14: Any other comments that might be of benefit for the individuals conducting this research?

Per Cent	Numbers	Response
91.1	41	No comment entered by participants.

The four participants that entered comments on this question gave the following statements:

(1) "Public speaking - ability to explain air reports."

(2) "Technical knowledge of marine equipment, engines, and simple electric circuitry for minor repair or radio and instruments.

(3) "We have already converted to APCD requirements - can think of no further need for additional change - technicians or equipment."

(4) "Liquid waste discharges are monitored by private and local agencies and the State Regional Water Quality Control Boards, not State Department of Water Resources who monitors "water resources'."

Summary: The few comments entered in response to this question appear to add little additional insight into the problems of constructing a curriculum for environmental technicians. One of the participants has added additional background areas desired for his particular needs but these would not appear to be desired by many other organizations.

15: Are there any other organizations or individuals to whom you could suggest sending this questionnaire? If so, please indicate them below.

Per Cent	Numbers	Response
84.4	38	Did not answer question.
15.6	7	Gave one or more references.

Summary: All of the referrals cited by the seven participants indicated above were organizations already on the final mailing list and thus, no additional valid information could be gained from using these referrals as a second group of participants.

III. Conclusions

Generalizations and conclusions drawn from the body of data presented in the previous section of this paper are considered to reflect the current conditions pertinent to establishing an environmental technician training program. Many industries appear unsure as to what federal, state, and local regulations will be instituted in the near future with respect to emission products. On this basis, these organizations realize that they will probably have to institute environmental control sections and hire the personnel to staff them. But this also leaves uncertainty as to how soon will have to be done.

Responses from the participants would also indicate that these environmental control sections may be staffed by one or two individuals trained in engineering or consist of an engineering type supervisor aided by one or more technician-trained personnel. Most of these sections will probably be small. The majority of organizations indicated that they will be staffed by five or less individuals. Staffing of these environmental control sections will also depend upon the nature of federal, state, and local regulations developed within the next few years. The strength of these regulations will help to determine the education level required of the technician portions of these environmental control sections. The job market in the next few years may also have an impact as unemployed engineers may be favored to step into these sections. These factors all tend to lend uncertainty to the direction in which industry will move in the next few years in satisfying new environmental laws.

Although many organizations indicate that there will probably be a definite need for environmental technicians trained at the A. A. degree level in a vocational program, there is considerably diversity in the opinion with respect to training levels in various subject areas. Most organizations indicate that the potential environmental technician will need some courses in physics, chemistry, and mathematics. However, the level of preparation considered the minimum necessary varied through a wide range in each of thse major subject areas. Only basic college chemistry received a majority indication from all participants in the major subject fields. However, some participants thought that high school chemistry would be sufficient while a few indicated that advanced chemistry courses would be required. In the fields of mathematics and physics, the participants were well divided in their opinions as to the proper level of training.

Many organizations also indicated that basic engineering courses would be necessary for the environmenal technician field. However, some of these participants did not indicate the appropriate background courses in physics and mathematics that would have to accompany these engineering courses. Also, a significant number of organizations indicated that basic electronic knowledge would be required or desired for these technicians. The electronics background would also require some

additional background in mathematics and possibly physics.

In general, the educational requirements indicated by the participants pose a formidable educational load upon a vocationally trained individual. The consensus of requirements on some physics, chemistry, and mathematics generally within the college level would yield a well-trained individual at the end of two years of college experience. However, successful completion of course material in this degree of complexity would produce a trainee who is generally very capable of finishing a four-year program for a Bachelors degree. Unless the trainee had financial hardships, the researchers visualize that he would continue on in his educational pursuits and not quit at the technician training level.

If the need for technician-trained personnel becomes more definite than is indicated by the statistics of this report, industry and government agencies may agree to accept slightly more elementary levels of training in the areas of physics, chemistry, and mathematics. At this time a vocational program for training environmental technicians may be instituted with basic courses in physics, chemistry, and mathematics at a level commensurate with vocational programs. This would also involve the development of new courses directly related to this potential career field but at a vocational level of training.

New courses designed specifically for this curriculum should train an individual in a generalized manner toward these technician positions. Course material should include an introduction to basic types of monitoring systems, how to read the data furnished by these monitoring systems, how to perform basic calculations based upon the moniroing system readings, and how to perform simple maintenance on the equipment. The trainee should also be introduced to some basic meteorologic and/or ocanographic knowledge that would be applicable to atmospheric or liquid pollution emissions. These more specialized aspects of the curriculum could include the basic engineering relationships necessary to the trainee.

Additional complications appear, however, as a significant number of participants have indicated that they would prefer to convert currently employed personnel by "in-service" training sessions. This is probably at least partially caused by the current instability in employment of engineers and technicians. Many firms would probably prefer to convert some of thir present employees rather than to lay them off and then hire new personnel into the environmental technician sections if such retraining could be reasonably completed. If some courses were available at local colleges to satisfy this operation, some participants have indicated that they would utilize them. However, these courses would not be a complete curriculum in themselves, but only something to "fill the gap." In this situation there would be considerable diversity of needs from one industry to another and it would be extremely difficult to design a single course or even

a few courses to satisfy a large number of local organizations and thus insure a reasonable enrollment. Therefore, the role of the community college as an aid in retraining individuals currently employed to fit into new environmental technician sections appears to have minimal chances of success.

The cost of implementing a technician-training program in a community college should not be overlooked. Although there are many indefinite aspects of the immediate future for training these technicians, a curriculum could be developed which would appear to be the "best compromise" according to the views of the participants. Probably some changes would have to occur in this curriculum as federal, state, and local regulations make the requirements on industries more definite. These changes would be an additional cost above the expenses of developing the original courses. The institution of courses for the environmental technician program would also require the purchase of specialized types of monitoring equipment for training purposes. This segment of the cost would be considerable. The total cost of development should be assessed against a program where the quantity of trained personnel needed by government agencies and industries is fairly uncertain for the next five-year period.

The complete picture to the researchers as of now is one of a lack of direction and future planning on the part of government agencies due to a lack of development of regulations and laws comprehensively controlling the aspects of pollution emission. These regulations must be initiated by the various levels of government before organizations can completely assess their needs for technians trained in environmental control. When this has occurred, industry will determine the quantity of individuals and the quality of education required for environmental technicians. The employment market at that time will help to determine if conversion of personnel from other allied filds or college training of new personnel will be a more desirable path. Therefore, the researchers conclude that it is premature to institute a community college program to train environmental technicans now but such a career field should develop in the near future. Educational institutions should monitor the changes in government regulations and their impact on industries in the next few years and be prepared to develop a curriculum for training environmental technicians when these conditions become more favorable.

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