A STUDY OF CIVIL TECHNICIAN NEEDS IN POPULATION CENTERS IN OKLAHOMA

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Submitted to the Faculty of the Graduate College
of the Oklahoma State University
in partial fulfillment of the requirements
for the Degree of
MASTER OF SCIENCE
July, 1971

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Thesis Approved:

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PREFACE

This thesis is concerned with the need for civil technicians in the state of Oklahoma. Having worked in private civil engineering consulting for a number of years, I have seen what a positive contribution can be made by a properly trained technician. Upon starting this study, I was disappointed to learn that only seven persons had been graduated from associate degree civil technology programs in Oklahoma during the past seven years. I became most concerned to know if there was a need to train civil technicians. It was gratifying to find what appeared to be a significant need among the group contacted.

The difficulty of this study was increased by the fact that the Oklahoma Professional Engineers Directory does not list the area of specialization of registered engineers. Furthermore, there is no available list of the sizes of private consultant engineering firms. This made it almost impossible to do any statistical extrapolation from the group sampled to the whole population of consultant firms.

In thinking of the people who have made this study possible, many names come to mind. I would like to express appreciation to Dr. Donald Phillips, who has taken much time from an extremely busy schedule to read and make constructive criticisms of this thesis; to Kenneth Govaerts, Head of the Civil Section of the Oklahoma State University Technical Institute, Oklahoma City Branch, and his office staff, for invaluable help in typing, signing, and mailing the questionnaires; to Dr. Robert Janes who supplied all the information concerning the

Oklahoma Section of the American Society of Civil Engineers membership; to Dr. James Key who at critical points in this study, helped with the mechanics of producing this thesis; to Dr. James Harris, of the Research Coordinating Unit of the State Department of Vocational and Technical Education, for helpful suggestions in the early stages of this study; to Dr. James Parcher and Dr. Don Kincannon, both of whom counseled with me concerning the civil engineer-civil technician relationship.

In addition, I would like to thank Miss Judy Lacy for typing this thesis, one of the important basic labors of any study.

Finally, I would like to express deep appreciation and love to my wife, Mary Anne, for her patience, advice, and encouragement in the production of this work. I would also like to express appreciation to my daughters Johannah, Laura, Emily, and Rachel for interludes of comparative quiet at the proper times.

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CHAPTER I

THE PROBLEM

Introduction

The need for the physical science and engineering technician has increased considerably over the past few years in Oklahoma. The same has been true outside Oklahoma. The Oklahoma Employment Security Commission anticipates that Oklahoma's demand for certain types of technicians will increase from 14,600 employed in 1967 to 16,900 in 1972, an annual increase of three percent.[9]

The state of Oklahoma, in order to meet the increased demand for technicians within the state, could follow one or a combination of three methods. First, train an adequate number in public or private educational institutions; second, encourage industry to train the required number; and third, attract sufficient technicians from other states.

This report deals with the question of what is the adequate number of a specific type of technician, the civil and highway technician, to be trained to fill the gap between supply and demand, if a gap exists.

Statement of the Problem

Educational administrators, counselors, and those in charge of manpower training programs are always in need of information as to the potential demand for a specific type of technician. There are several

sources of information to answer the question of what is the demand. One of the more reliable and accurate sources of information is the professional in industry or government who is the employer of a group of technicians similar to the ones under examination. The information obtained would be useful to the following groups:

1. Manpower training planners in the state of Oklahoma.
2. Educators who are responsible for the creation of technical programs in the public and private schools.
3. Recruiters of post-high school students for technical school programs.
4. Employers in planning sources of manpower to supply technician demand.
5. The student in choosing a technology in which a significant demand exists.

When the demand for civil technicians is considered, contradictory information seems to be evident. All needs studies in the state of Oklahoma seem to indicate a need for civil technicians. In the public and private schools of higher education within the state, few such technicians are being graduated.

The problem is whether, in the opinion of a selected group of registered civil engineers, there is a demand for civil technicians within Oklahoma.

Purpose of the Study

This study was conducted to determine if a need exists for graduates of civil technology programs in Oklahoma. The study sought to assess the demand for civil technicians in both public and private sectors. A secondary purpose was to ascertain the present sources of civil technicians.

Need for the Study

It is difficult for technical educators to determine which technologies should be offered in an institution specializing in technical training. There is seldom an adequate amount of financing to produce the number of technicians that are needed in all phases of industry, government, and private practice. The administrators are always forced to weigh demand against funds against the number of graduates needed in a technical area. It is equally burdensome to an administrator to have a program with few enrollees or a number of graduates with no job market for the trainees.

Studies have been conducted in the recent past of general manpower needs which indicated a need for civil technicians. In spite of predicted needs and two programs for training civil technicians, few have been graduated in Oklahoma.

There now is a need to restudy the specific demand for the civil technicians and see if, in fact, the need has been overestimated, or the need has been met from within the employment organization, or the need has been met by attracting technicians from outside the state.

Limitations of the Study

This study for the demand of civil technicians has been limited to questioning a selected group of engineers in the following categories:

1. Registered civil engineering consultants' offices in larger cities who have a listing as "Civil Engineer" in the telephone book.
2. City and county engineers in the more populated cities and counties who have that title in the local telephone book.

3. The central offices of state and national government agencies who by their work would be a likely source of employment for civil technicians.

4. Those registered engineers who belong to the Oklahoma section of the American Society of Civil Engineers.

The construction industry in Oklahoma was not sampled as such. Certain members of the construction industry are members of the American Society of Civil Engineers and are registered engineers, so they may be represented in the opinion sampling of individual engineers, but only as individuals and not as corporations. There was no attempt in this study to identify any other sources of civil technicians than those identified in the questionnaire sent to the selected members of the civil engineering profession. The entire study was limited to within state sources of occupational opportunity with no sampling done of neighboring states.

Questions to be Answered

The following questions were investigated in this study:

1. What is the number of civil engineering graduates employed by the selected organizations, both registered and unregistered?
2. What is the number of civil technicians presently employed, what is the salary range, and what is the civil technician to engineer ratio?
3. How were presently employed civil technicians trained? What was the experience requirement or educational requirement of the existing employees?
4. What are work functions performed by presently employed civil technicians?

5. Have trained civil technicians been attracted into Oklahoma from the surrounding states?
6. What courses would benefit the organizations starting civil technicians most and which would benefit them least?
7. How many new civil technician employees are needed in the next twelve months and what is anticipated starting salary ranges?
8. What work function will the new civil technician perform within the organization?
9. How many graduate engineers could be upgraded in engineering pursuits if graduate civil technicians were employed?

CHAPTER II

REVIEW OF LITERATURE

Much has been written in recent years about who the technician is, his impact on industry, education, and our economy. The technician has been surveyed, counted, queried, and anticipated. The category of civil and highway technician has not been studied as much as some others. That is the purpose to which the next few pages are devoted.

What does the civil and highway technician do? One of a series of Health, Education, and Welfare publications deals with the civil and highway technician and his training.[14]

> Civil and highway technicians perform many of the planning and design tasks necessary in the construction of highways, railroads, bridges, hangers, missile sites, airfields, viaducts, dams, factories, and other structures necessary for national defense. In the planning stage of construction they may be engaged in estimating costs, purchasing materials, preparing specifications, computing fills and cuts, and storm drain requirements, surveying, drafting, or designing. Once the actual construction has begun, many of them perform supervisory functions. Some may be responsible for seeing that construction activities are performed in proper sequence and for inspection of the work as it progresses for conformance with blueprints and specifications.

The publication goes on to explain that of all the engineering vacancies in the country, eleven percent are in civil engineering. It further states that the ratio of civil technicians to engineers at that time (1962) was 1 1/2:1 and was expected to rise to three or four to one. At that time indications were strong that a large gap between

available civil technicians and those required to satisfy the demand for them would develop.

The report stressed that in training the civil technician, the curriculum should include the technology of the occupational field, technical report writing, highway design, communication skills and applied mathematics and science. The strong emphasis of the program should be on integrating the total curriculum so the mathematics and science courses are introduced in the technology curriculum when needed.[14]

In 1967, at the height of the interstate highway program in the United States, a report was given at the World Meeting of the International Road Federation by Theodore Van Zelst.[15] In this report he described a survey conducted of all highway departments in the United States and sixty foreign countries. On the basis of these interviews he made the following comments:

> Most of the firms employing technicians or inspectors stated they found it necessary to train these people on their own and that it was difficult to find trained technical people. In fact, many of those interviewed appeared to be resigned to the fact that personnel of this type are not available, and that they had to carry on their own training programs.
>
> Many educational authorities are not fully aware of the need for specialized technicians in the highway industry.

He further stated that properly trained post-high school graduates in this area could be some of the most valuable people in the nation and draw better salaries than many college graduates.

The civil technician throughout the country in the late 1960's almost always found employment upon graduation. Two surveys conducted by the Engineering Manpower Commission showed that of the 1,258 civil

technicians graduated in 1968 throughout the country, fifty percent had employment, thirty-three percent were planning to enter full time study, and ten percent were going into military service.[2,4] Of all these graduates, only seven percent had no job offer or were not committed in some way. It was further shown in these surveys that the average starting salary for these graduates was $750 per month.

With an increasing need in the interstate highway program, many of the state highway departments of the United States looked for technicians to aid in supervising the increased planning, design, and construction that resulted. Many technicians in highway departments were hired by the construction industry to aid in the increased construction that resulted during this time. Other state highway employees were lost to consulting firms, materials suppliers, and neighboring states whose personnel budgets were larger. In all sectors of the civil highway community, a shortage of civil technicians developed.

Oklahoma, like the rest of the nation, experienced a technician shortage in the years from 1963 to 1968. In order to determine the manpower needs of Oklahoma, the Oklahoma Employment Security Commission made a survey in October, 1963, and in June, 1967.[8,9] In the 1963 survey, all firms with 100 or more employees were contacted, as were one out of five firms with 20 to 99 employees, and one out of 25 firms with four to 19 employees. A total of 1,903 firms were contacted in this survey, and a 54.2 percent return was obtained.

In the 1967 Manpower Survey, the upper 50 percent of employers, by size, were contacted.[9] Twenty percent of the third and fourth quartiles were contacted. Of the 2,544 employers in the survey, 70.1 percent responded with a usable answer.

The results of these two manpower surveys, although not entirely comparable, were interesting to compare. The 1963 survey showed 700 civil and construction technicians employed at that time with a projected additional manpower requirement of 818 and 899 by 1970 and 1975 respectively. This is interesting when compared with the 1967 survey. This later survey showed 1,824 civil technicians employed as of that date, with a projected additional manpower requirement of 1,921 and 2,063 by 1969 and 1972 respectively. As can be seen, the projected manpower need for 1975 fell short almost 1,000 of the actual employment of 1967. The projected need of 1975 in the earlier study was increased almost two and a half times in the later study, and the needs date was moved up to 1972.

These two studies cannot be directly compared and were made more to show trends than to be compared to each other. No doubt the slightly different base and the more complete returns on the second study made it much more accurate. Some interesting information to come from the two surveys is that the technician need per year in the earlier survey for years 1970 to 1975 was only 15 per year, whereas in the later survey the technician need per year from 1969 to 1972 was increased to 50 per year.

In order to further document the manpower needs in all Oklahoma, a yearly survey was instituted in August of 1968. It was called the Occupational Training Information System (OTIS).[13] Its purpose was:

> ...to develop and initiate a systematic continuous and detailed occupational training information system (OTIS) to provide a better data base for encouraging necessary changes (if any) in Oklahoma's State Plan for Vocational Education and, in consequence, patterns of occupational offering and enrollments.

> This system is designed to interface (match) supply and demand information for sub-professional occupations.

This survey used some information from the Oklahoma State Employment Service to predict and extrapolate the need for certain professional and technical occupations.

The report divided the state into eleven areas. From the results of extensive data gathered by questionnaire and by personal contact by vocational-technical teachers, it arrived at a yearly manpower need figure for almost the entire spectrum of occupational titles. The supply of manpower under training in any one specialty was subtracted from the manpower need for that specialty in each area. This gave a number of positions to be filled called demand minus adjusted supply.

The OTIS report in Appendix I-1, Interfacing Supply and Demand Data, concludes that a large demand exists for civil technicians. It states that in the entire state of Oklahoma a demand for 109 technicians exists, with only two being supplied. This leaves a demand minus supply total of 107 positions to be filled with no trainees enrolled to satisfy this demand.

If the various Oklahoma manpower studies were accurate, there should have been a good market for civil technicians graduated during the 1960's and a proportionate number of graduates produced. In 1968 Howard Paul Hardt[6] conducted a study on the number of engineering technicians produced in Oklahoma from 1960 to 1967. One of his conclusions was that based on his findings the demand for technicians will never be adequately filled in the future and would be filled less and less well as time went on. From Table III of his report, in the period covered, there were only seven civil technician graduates listed.

In a study conducted in 1967, Maurice W. Roney and Paul V. Braden[12] discovered that over 82 percent of the effort in technical programs was in the fields of drafting and design, data processing, electronics, and mechanical technology.

They further found that young people in Oklahoma were not interested in occupational education beyond high school. It was further revealed that many of Oklahoma's technical programs are operating at half capacity in spite of the excellent employment opportunities that exist for the graduates. Parents, counselors, and teachers have not been convinced of the practicality of non-baccalaureate education. They suggested an intensive program of public relations be instituted. This program would present the positive aspects of, and education for, para-professional occupations.

Summary of Literature

All through the 1960's there has been a demand for civil and highway technician graduates throughout the United States. These were considered to be essential to at least a portion of the country's continued economic well-being. In Oklahoma, each manpower study indicated a need for fifteen to one hundred civil technicians to be produced each year. Each source of information predicted a continuing and widening job market for the graduates. Yet in the state of Oklahoma, the public and private educational institutions have produced only ten percent of the lowest projected needs and less than one percent of the highest projected yearly need.

The need for civil and highway technicians in Oklahoma should be examined further. This need and its source will be discussed further in detail later in this report.

CHAPTER III

METHOD AND PROCEDURE

This study was conducted to determine if a need existed for graduates of a civil technology program in Oklahoma. Mailed questionnaires were used to gather data.

Two questionnaires with twenty-two items each were designed for use in this study. Seventeen of the items could be answered with check marks or simple one-word or one-number answers. The two questionnaires differed only in the first identifying questions. One of the questionnaires was sent to potential employers of civil technicians and the other to individual members of the engineering profession. These questionnaires are found in Appendix A.

Selection of Population

Information for this study was obtained from registered engineers in all but a few instances. This was done on the premise that registered engineers have thought through the role of the engineer and his relationship to the engineering technician, and would be better able to understand his need for engineering technicians.

The principal information required in this study was the need for civil technicians, so a list was assembled of the civil engineering offices who were prospective employers and who were located in larger population centers of the state. This list was composed of private

consulting engineers' offices and city and county engineers that were listed in the yellow page telephone directory in cities of over 15,000 population and county seats of counties over 30,000 population.

The private consulting engineers' offices were listed under the heading "Engineer-Consulting" in the yellow pages. In Oklahoma City, Tulsa, and Norman, the larger metropolitan centers, the list was further restricted to "Engineer-Consulting, Civil". If the corporation bore the name of a private individual, the name was cross-checked with the Oklahoma State Board of Registration for Professional Engineers[10] to insure the individual was registered as an engineer in the State.

The city and county engineering offices were obtained by using the yellow page listing of "Government-City" and "Government-County". Since there was no individual name connected with these offices, and Oklahoma has no Municipal Directory, there was no way of cross-checking to determine if the office holder was a registered engineer. Since there were so few of these listed, the assumption was made that registration was a requirement of holding that office.

The central offices of federal and state agencies most likely to employ civil technicians were included in the list of offices contacted. These names were obtained from the yellow page listing of "Government-State" and "Government-United States".

A list of individual registered professional engineers was also included. This was done in order to compare the replies of individual engineers with those of the larger offices. This group was composed of one third of all engineers within the state who were both registered engineers and were members of the Oklahoma Section of the American Society of Civil Engineers (A.S.C.E.). In order not to send two

questionnaires to the same person, the names of all principles of consulting engineering firms and the names of all known city or county engineers contacted in the other categories were removed from the list of registered engineers before the selection of names was made. The names of all educators were eliminated from the list.

Data Collection

The questionnaire was sent out on November 9, 1970 by the Oklahoma State University Technical Institute, Oklahoma City Branch, with a cover letter signed by Kenneth Govaerts, Head of the Civil Technology Section. The engineering organizations receiving the questionnaire were more likely to respond to an inquiry from a state agency than from a private individual pursuing an advanced degree. The Technical Institute was also interested in finding answers to the question under study.

The letter and employer questionnaire were sent to each of 82 consulting firms and to 33 government offices. A letter and the individual engineer questionnaires were sent to 39 individual engineers. A stamped return envelope was included in each letter to encourage response. For cover letter see Appendix B.

All responses were received by the first week in December 1970. Each of the offices or individuals who received the questionnaire were told that their organization's name would be listed as having participated in the survey but the data would be tabulated on basis of organizational size and type and no information would be attributed to a specific company or organization. The names of the participants are contained in Appendix E and the raw data in Appendix C.

CHAPTER IV

RESULTS

Responses to the civil technicians need questionnaire is shown in Table I. The groups who received the questionnaire, the number sent, the number of replies, and the percentage of replies are shown in this table.

TABLE I

RESPONSE TO CIVIL TECHNICIAN QUESTIONNAIRE

Type of Organization	Number Sent	Number of Replies	Percent of Replies
Private consultants	82	18	23
Cities over 15,000	13	5	38
Counties over 30,000	12	0	0
State offices	4	2	50
Federal Offices	4	2	50
Individual Civil Engineers	39	7	18
TOTAL	154	34	

There was a twenty-two percent response to the questionnaire. Since no county engineers responded, the county engineer category was eliminated from the study. The response from the individual members of the American Society of Civil Engineers was so small that their response was included in the private consultant and city category, and the

individual civil engineers as a category were eliminated. This was justified because three of the individual engineers who replied were employees of private engineering firms that did not respond. Another two of the individual replies were from employees of cities that did not respond. Of the remaining two individuals, one reply was that of a retired engineer and the other was from a city employee who duplicated the response from the city engineer of that city. These last two replies were eliminated from the study.

Thus the private consultants had a total of 21 responses out of 82 sent and the cities had seven responses from twelve cities questioned. With the county engineers and individual engineers eliminated as a category, there were 32 replies out of 103 questionnaires, or a 31 percent response.

Table II shows the breakdown of the number of replies from three different categories of private consultant firms based on number of civil engineering graduates employed.

TABLE II

PRIVATE CONSULTANT FIRMS SIZE
VS NUMBER OF REPLIES

Number of Civil Engineering Graduates	Number of Replies
0 - 5	16
6 - 10	3
10 - 31	2
TOTAL	21

A tabulation of all raw data is reported in Appendix C.

One question to be answered in a survey to determine the number of civil technicians needed is the number of civil engineering graduates and civil technicians now employed by the organization questioned. Table III lists this information along with the ratio of civil engineers and civil technicians.

TABLE III

PRESENTLY EMPLOYED CIVIL ENGINEERS
VS CIVIL TECHNICIANS

Organizations Size and Number of Engineers	Number of Organizations	Number of Civil Engineers	Number of Civil Technicians	Ratio of Technicians to Engineers
Consultants				
0 - 5	16	33	46	1.39 : 1
6 - 10	3	20	20	1 : 1
11 - 31	2	50	40	0.80 : 1
Consultant Total	21	103	106	1.03 : 1
Cities	8	21	57	2.7 : 1
State & National	3	30	13	0.43 : 1
Total Government	11	51	70	1.37 : 1
TOTAL	32	154	176	1.14 : 1

The activities of the presently employed technicians are summarized in Table IV. These percentage results are weighed on the basis of number of civil technicians in each organization.

An example of this would be the case where an employer "A" had 5 employees and the employer "B" had 1 employee. If employer "A" stated his employees spent 20 percent of their time in production and employer

TABLE IV*

PRESENTLY EMPLOYED CIVIL TECHNICIAN
ACTIVITIES WITHIN ORGANIZATIONS

Category	Design Percent	Production Percent	Research Percent	Installation Percent	Inspection Percent	Sales Percent	Other Percent	Number of Employees
Consultants								
0 - 5	30.2	46.3	1.0	0	13.1	3.2	6.1	46
6 - 10	8.5	28.5	1.5	12	49.5			20
11 - 31	26	74						40
Consultant Total	24.4	53.5	0.8	2.3	15.1	1.4	2.6	106
Cities	26.1	5.4	1.0	5.4	31.5		30.6	57
State and National	27.0	-	-	-	53.8	-	19.2	13
Total Government	27.2	4.5	0.8	4.4	35.6	-	28.5	70
Overall Total	25.1	33.8	0.8	3.3	23.3	0.9	12.9	176

*Note: This table is weighted on basis of number of civil technician employees in each organization.

"B" stated his employee spent 50 percent of time in production, the average was computed as follows:

$$\begin{array}{rrr} 5 \times 20 = & 100 & \\ \underline{1 \times 50} & \underline{50} & \\ 6 & 150 \div 6 = & 25\% \end{array}$$

25 percent of a total of 6 employees' time was spent in production.

One of the results of the tabulation in Table IV is to indicate that the private consultants' use of engineering technicians for the production of plans and specifications is more than ten times greater than the total government use of the civil technician for this purpose. The government use of the civil technicians for inspection is more than twice as great as that of the private consultant. The government response of use of technicians in the category of "other" represented over 28 percent of the response in that category. This use was detailed as "construction staking", "estimating", "surveys", "field work", and "drafting". As could be expected, the government response showed no personnel to be engaged in sales activity. The private consultants showed an average of one and four tenths percent involved in sales activity.

From this study the primary activities of civil technicians was production, design, inspection, other, installation, sales, and research, in that order. Of these, the activities of production, design, and inspection occupy over 80 percent of the civil technicians' time.

The tabulation of low and high salaries and the salary range of presently employed technicians is shown in Table V. This tabulation indicates that the range of salary for civil technicians is a low of $80 per week to a high of $228 per week. The upper salary limit for

TABLE V

SALARY RANGE AMONG
PRESENTLY EMPLOYED CIVIL TECHNICIANS

Category	Number of Respondents	Low Salary Range $ Per Week	High Salary Range $ Per Week	Actual Salary Range $ Per Week
Consultants				
0 - 5	16	80 - 176	125 - 225	80 - 225
6 - 10	3	100 - 150	125 - 200	100 - 200
11 - 31	2	110 - 110	160 - 200	110 - 200
Consultant Total	21	80 - 176	125 - 225	80 - 225
Cities	8	85 - 150	125 - 200	85 - 200
State and National	3	92 - 110	110 - 228	92 - 228
Total Government	11	85 - 150	110 - 228	
Overall Total	32	80 - 176	110 - 228	80 - 228

consultant employees is $3 per week less than for the government civil technician. On the other hand, the consultants category had the highest lower limit with $176 per week. To be more meaningful, these results should have been correlated with length of service and position held by the technician in the organization. In order to know the type of training the existing technician employees had, question No. 11 of questionnaire was asked. The respondents were to indicate the type of training of presently employed technicians. Table VI is a tabulation of responses.

The responses for all organizations indicate that the majority (75 percent) of all recorded civil technicians were trained within the responding organization or a previous engineering organization. Only a little over 10 percent were trained in a 2-year technical school, and less than eight percent were products of a junior college. The remainder had had some previous partial training in an engineering school.

In order to determine the source of supply of civil technicians, question No. 13 was included in the questionnaire. It was desired to know if civil technicians were being trained in other states and attracted to Oklahoma by job opportunities. A tabulation of the results of the response is shown in Table VII.

The overall response to the question indicated that in the responding organizations nearly 91 percent of the presently employed civil technicians were trained within this state.

To determine what the educational requirement was for employment among existing civil technicians, question No. 14 was placed in the questionnaire. The response is tabulated in Table VIII.

TABLE VI*

WHERE PRESENTLY EMPLOYED CIVIL TECHNICIANS WERE TRAINED

Category	Within Organization	By Previous Organization	Junior College	Two-Year Technical School	Partial Completion Of Engineering School	Other
Consultants						
0 - 5	53.8	14.3	15.8	5.4	9.2	1.5
6 - 10	85	6	9	-	-	-
11 - 31	64	12	24	24	-	-
Consultant Total	64.1	11.7	8.2	11.8	3.7	0.6
Cities	64.3	14.6	9.0	3.7	8.4	-
State and National	36.5	23.1	-	32.7	7.7	
Total Government	59.2	16.1	7.3	9.1	8.3	
Overall Total	62.0	13.5	7.8	10.7	5.6	0.4

*Note: This table is weighted on basis of number of civil technician employees in each organization.

TABLE VII

PERCENTAGE OF EMPLOYEES TRAINED IN OKLAHOMA

	Consultants 0-5	5-10	11-31	Cities	State And National	Consultant Total	Overall Total
Trained in Oklahoma	92.3	76	97	92.1	84.6	91	90.8
Trained Elsewhere	7.7	24	3	7.9	15.4	9	9.2

TABLE VIII*

EDUCATIONAL REQUIREMENT OF STARTING EMPLOYEES

Category	None Percent	High School Percent	Two-Year Technical School Percent	College Graduate Percent	Pass A Test Percent	Other Percent
Consultants						
0 - 5	19	59.4	13.5	2.7	5.4	-
6 - 10	30	15	55	-	-	-
11 - 31	-	100	-	-	-	-
Consultant Total	13.4	67	16.5	1	2.1	
Cities	-	98	-	-	2	-
State and National	15.4	81.8	-	-	-	3.8
Total Government	3.3	94.3	-	-	1.6	0.8
Overall Total	9.5	77.5	10.2	0.6	1.9	3

*Note: This table is weighted on basis of number of civil technician employees in each organization.

In the response to this question nearly one out of ten employees had no educational requirement, not even high school. Nearly 78 percent of employees were required to be high school graduates. Only one employee in ten civil technicians was required to have been through a

two year technical school and only two percent were required to pass an in-company test. The "other" category consisted of a requirement to have a knowledge of trigonometry and a combination of high school graduation and former job experience.

The results of question No. 15 were to show which curriculum, in the opinion of the employer, would most benefit the employee. He was to choose one of the following curricula: curriculum "A", an in-state technical institute curriculum[11]; curriculum "B", an in-state junior college curriculum[1]; curriculum "C", an out-of-state technical institute curriculum[7]; curriculum "D", an out-of-state Water and Waste Water Curriculum[5]. The results of the response are tabulated in Table IX.

TABLE IX*

CURRICULUM CHOSEN
BY EMPLOYER

Category	Percent Choosing Curriculum			
	Curriculum A	Curriculum B	Curriculum C	Curriculum D
Consultant				
0 - 5	36	16	44	4
6 - 10	37.5	62.5	-	-
11 - 31	-	33.3	66.7	-
Average Total	30.8	28.3	38.6	2.6
Cities	72.7	9.1	9.1	18.2
State and National	-	-	-	100
Average Government Total	50		6.2	43.8
Overall Average	36.4	20	29.1	14.5

*Note: Percentages are weighted on basis of each organizations expressed future civil technician requirement.

Many respondents picked the curriculum that most matched their operation or specialty. The Water and Waste Water Curriculum was chosen only three percent of the time by the consultants, while the government organizations choose it 44 percent of the time.

The respondents were asked to choose three or more courses from the curriculum chosen which would most benefit employees and three courses which would benefit them least. The respondents consistently picked surveying, mathematics, and drawing courses as being of most benefit. The results are tabulated in Table X.

TABLE X

COURSES OF MOST BENEFIT
TO EMPLOYEE

Category	Percent Choosing Course			
	Curriculum A	Curriculum B	Curriculum C	Curriculum D
Surveying	30	18	21	13
Mathematics	18	25	14	-
Drafting	10	40	13	10
Sanitation	-	-	-	13

This seemed to say that the organizations wanted technicians well grounded in fundamental mathematics, drawing, and surveying. This would tend to support the activities that presently employed technicians are now performing, as shown in Table IV.

Curriculum D shows more emphasis upon sanitation courses. This is the principal difference between this curriculum and the other three, so these courses could have been expected to rank high in benefit to employers choosing them.

The courses chosen which would least benefit employees were consistently courses in the humanities, in the first three curricula. The courses chosen in descending order of frequency were as follows:

Curriculum A: Humanities, Personal and Occupation Guidance, Calculus, Construction Planning

Curriculum B: Humanities, Physical Education

Curriculum C: Industrial Relations and Economics, Chemistry, Computer Programming

Curriculum D: Applied Electricity

The responding organizations indicate they see little benefit to employees from courses in humanities.

The need for civil technicians in the next 12 months is tabulated in the fifth column of Table XI. The comparison of existing civil technicians and proposed civil technician to engineer ratio is also tabulated.

This tabulation is based on assumption that civil engineering employee numbers would remain about the same for the next twelve months. There is no information in this study to predict an increase in the number of civil engineers. The only response concerning civil engineers is contained in answers to question No. 18, which asks how many civil engineers could be upgraded.

From this tabulation, there was a greater proportionate need expressed for civil technicians among private consultants than among the government units.

From this tabulation, the projected civil technician to engineer ratio tends to approach the U. S. average of 1.5:1 to 3.0:1.

The starting salary range of the proposed additional number of civil technicians was queried. This tabulation is shown in Table XII.

TABLE XI*

NUMBER OF CIVIL TECHNICIANS PRESENTLY EMPLOYED AND FUTURE NEED

Category	Current Employment Of			Projected Employment Of		
	Civil Engineers	Civil Technicians	Ratio	Civil Technicians	Total Civil Technicians	Projected Civil Technician To Engineer Ratio
Consultants						
0 - 5	33	46	1.39:1	25	71	2.15:1
6 - 10	20	20	1:1	8	28	1.40:1
10 - 31	50	40	0.80:1	6	46	0.92:1
Total	103	106	1.03:1	39	145	1.4 :1
Cities	21	57	2.7 :1	11	68	3.24:1
State and National	30	13	0.43:1	5	18	0.6 :1
Government Total	51	70	1.37:1	16	86	1.7 :1
Overall Total	154	176	1.14:1	55	231	1.54:1

*Note: Projected civil technician to engineer ratio assumes no increase in civil engineer employees in next twelve months.

TABLE XII

SALARY RANGES EMPLOYED VS
NEW CIVIL TECHNICIANS

Category	Presently Employed Technicians			Proposed New Technicians		
	Low Range $ Per Week	High Range $ Per Week	Actual Range $ Per Week	Low Range $ Per Week	High Range $ Per Week	Actual Range $ Per Week
Consultants						
0 - 5	80-176	125-225	80-225	80-150	100-200	80-200
6 - 10	100-150	125-200	100-200	120-140	130-150	120-150
11 - 31	110	160-200	110-200	140-150	150-160	140-160
Total	80-176	125-225		80-150	100-200	80-200
Cities	85-150	120-200	85-200	100-150	110-200	100-200
State and National	92-110	110-228	92-228	100	150	100-150
Government Total	85-150	110-228	85-228	100-150	110-200	100-200
Overall Total	80-176	110-228	80-228	80-150	100-200	80-200

The comparison of high salary range for consultants was $10 to $40 per week less for new civil technicians than for those presently employed. The high salary range for government units was $10 to $28 a week less for starting than for presently employed civil technicians.

The type of function performed by the starting civil technician is shown in Table XIII. The various categories reflect that civil technicians have been useful in the same function that new technicians will perform. The only slight shift in order shows an increase in use of new civil technicians for research and design. Less emphasis is shown in inspection and production than presently employed technicians in the private consultant category. A greater emphasis is shown in inspection, design, and research among cities and less emphasis on tasks outside the specified categories.

The respondents were asked what number of engineers could be released for higher engineering pursuits if their organization were to employ graduates of a two-year technical school. The results are tabulated in Table XIV.

The expression of opinion as to attitude toward civil technicians trained in two-year technical schools is tabulated in Appendix D. On the whole the respondents seem in favor of this procedure.

TABLE XIII*

FUNCTIONS CIVIL TECHNICIAN GRADUATES
WOULD PERFORM WITHIN ORGANIZATION

Category	Design Percent	Production Percent	Research Percent	Installation Percent	Inspection Percent	Sales Percent	Other Percent
Consultants							
0 - 5	38.8	32.8	6.0	2.8	14.4	5.2	
6 - 10	25	50	12.5		12.5		
11 - 31	30	70					
Consultant Average	34.8	42.5	6.4	1.8	11.8	3.3	
Cities	43.9		9.1	3.0	43.9		
State and National	33.3				33.3		33.3
Government Average	40.6		6.3	2.1	40.6		10.4
Overall Average	36.6	29.4	6.4	1.9	20	2.4	3.0

*Note: Percentages are weighted on basis of each organization's expressed future civil technician requirement.

TABLE XIV

NUMBER OF ENGINEERS
WHO COULD BE UPGRADED

Category	Number Of Responses	Number Of Engineers	Number Who Could Be Upgraded
Consultants			
0 - 5	16	33	15
6 - 10	3	20	4
11 - 31	2	50	1
Total	21	103	20
Cities	8	21	1
State and National	3	30	3
Overall Total	32	123	24

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

The purpose of this study was to determine if a need exists for graduates of civil technology programs in Oklahoma. The study sought to assess the demand for technicians in both the public and private sectors. It also tried to determine present sources of civil technicians.

A questionnaire was sent to 154 sources of information and 34 replies were received for a percentage return of 22 percent. Two categories were discarded because of low returns and the replies in them combined with two other categories. The final response was 32 usable replies from 103 questionnaires for a return of 31 percent. Of these, 21 were from consultants, eight were from cities and three were from state and national offices.

Summary

The results of the questionnaire were tabulated in Chapter IV. A brief summary is presented in order to answer questions raised in Chapter I. The questions and summary follow:

1. What are the number of civil engineering graduates employed by Oklahoma engineering organizations? How many of these engineers are registered?

The 32 organizations employ 154 graduate civil engineers, of which 129 are registered in Oklahoma and 26 are not.

2. What is the number of civil technicians presently employed in these organizations; what is the salary range and what is the civil technician to engineer ratio?

Among these organizations, there are 176 employees whom the employer classified as civil technicians on the basis of the definition given on the second page of the questionnaire (Appendix A). There were 106 employed by private consultants, 57 employed by cities, and 13 employed by state and national offices.

The salary range of these presently employed technicians is $80 to $228 per week. The consultant employees ranged from $80 to $225 per week, city employees $85 to $200 per week, and the government employees ranged from $80 to $228 per week.

The average technician to engineer ratio of all employees within the responding organizations was 1.14:1. These employes constituted a ratio ranging from 0.43:1 in state and federal respondents to 2.7:1 among the respondents from cities.

3. How were presently employed civil technicians trained? Is there an experience requirement or educational requirement for presently employed civil technician employees?

Three-quarters of the presently employed civil technicians within the responding organizations were trained within the organization or by a previous organization. Ten percent of technicians were trained in two-year technical schools, approximately eight percent in junior colleges, and approximately six percent were products of partial completion of engineering schools.

Of the respondents, fifteen indicated no prior experience required for employment. Six respondents listed two years of experience required, four respondents required four years, and two required five years experience. The overall average would indicate a little more than one year experience required.

4. What are the work functions performed by presently employed civil technicians.

The response to the work functions performed by the present employees indicates that the majority are used in production, design, and inspection.

The principle use of technicians among private consultants is in production of plans and specifications with 53.5 percent used in this manner. Another 24 percent are used in design, with 15 percent used in inspection.

The government organizations used 36 percent of civil technicians for inspection, 26 percent in design, and 28.5 percent in various forms of surveying and construction staking.

The overall weighted average use indicates 33.8 percent of total employees used in production, 25.1 percent used in design, 23.3 percent used for inspection and 13 percent used in staking and field work.

5. Have trained civil technicians been attracted into Oklahoma from surrounding states?

The response to the question of where existing civil technicians were trained would indicate that the responding organizations are not attracting many civil technicians into the state. Nine out of ten of the presently employed technicians were trained within the state.

6. What courses in the submitted curricula would most benefit starting civil technicians and which would benefit them least.

In the opinion of the respondents, the courses which would benefit starting civil technicians most were mathematics, drawing, and surveying. The courses which would benefit starting employees least were courses in the humanities.

7. How many new civil technician employees are needed in Oklahoma during the next year and what starting salary range could they expect to receive?

From the respondents in this survey, the number of new civil technicians that will be needed in the next twelve months was 55. Of these, the private consultants expressed a need for 39 and the government organizations a need for 16.

The starting salary range for prospective civil technician graduates was reported as $80 to $200 per week. The low starting salary range for consultants was $80 to $150 per week while the high range for this group was $100 to $200 per week. The government offices had a low starting salary range of $100 to $150 per week with the high salary range at $110 to $200 per week.

8. What work function will the new civil technician perform within the organization?

The work activities starting civil technicians will perform shows new employees generally doing the same things as present employees; an increase in the number to be used for design with 36.6 percent reported; a slight decrease in their use for production and inspection with 29.4 and 20 percent respectively. The only other significant increase was the six percent to be used in research.

9. How many engineers in each organization could be released for higher engineering pursuits if civil technician graduates were hired?

Respondents reported a total of 24 engineers could be engaged in higher engineering pursuits if civil technician graduates were hired. The government offices said four of their 51 engineers could be upgraded. The consultants reported the 20 of their 103 engineers could be upgraded.

Conclusions

In arriving at conclusions in this study, the reader must keep in mind the population base of the respondents. The study summarizes responses from smaller engineering firms overall. Nearly three-quarters of the responses were from engineering offices of from one to five civil engineering graduates. There were 21 responses from private consultants, eight from cities, and three from state and national governmental offices. The entire study is based on 32 responses from a population of 103 or a 31 percent of the population. The following conclusions were reached on the basis of this study:

1. The technician engineer ratio reported in this study is below the national average. The 1962 national study[14] found a civil technician to engineer ratio of 1.5:1. In this study the ratio was 1.14:1. This compares with the 1967 Manpower in Oklahoma Study[2] which showed a projected 1972 technician to engineer ratio of 1.18:1.

2. The salary range of both present employees and potential new civil technicians appears to give an average below the average starting salary of the remainder of the country. The lower level of starting

salary range might not be a strong inducement for the graduate civil technician to remain in Oklahoma as a technician.

3. Nearly all of the present civil technicians in the responding organizations were trained within the state and within the reporting organization. Employers must rely on recruiting nearly all technicians from within the state.

4. Responding employers have accepted employees who were both untrained and inexperienced. The employer must either prefer to train technicians within their organizations, be unable to find adequately trained technicians, or for some reason unable to make the job attractive financially.

5. The reporting organizations indicate the future use of civil technicians less in production and inspection and more in design and research. This indicates a change in the functions of civil technicians.

6. The majority of responding employers express the opinion that the two in-state civil technician curricula are adequate for training civil technicians.

7. There seems to be an inverse correlation between the size of consulting firms and the number of presently employed technician to engineer ratio. This indicates a greater acceptance of civil technicians among the smaller sized consulting firms.

8. There seems to be an inverse correlation between the size of consulting firms and future need of civil technicians. This indicates a continued greater acceptance of civil technicians among small sized consulting firms.

9. There was a need expressed by the respondent organizations for a number of civil technicians in the next twelve months. This small

population responding still accounted for more than one-half of the projected twelve months' need of one recent study. The yearly need for civil technicians may exceed some of the previous manpower studies.

10. According to respondents, a number of engineering organizations are using their graduate civil engineers at a civil technician level. This indicates an additional need for civil technicians if the organizations were to use civil engineers more effectively.

Recommendations

On the basis of the information contained in this study the following recommendations are made:

1. In assessing any future civil technician needs, the smaller consulting engineering firm should be carefully surveyed. These firms express a greater proportional need for technicians than larger firms.

2. Curriculum designers will want to take note of the apparent changing role of the civil technician. More emphasis in courses may need to be placed in design and research courses and less on drafting and production related courses.

3. The need in Oklahoma for a curriculum to educate water and waste water technicians should be considered. Several of the respondents expressed an interest in such a curriculum. The potential employers should be contacted to determine the number of technicians needed and the projected starting salaries. This would indicate whether enough need existed to recruit students for such a program.

4. A recruiting campaign should be started among potential civil technician students. A need exists for civil technicians. The civil

technician curricula in the two state schools is adequate in the opinion of employers. The greatest need appears to be for additional entering students.

5. If employers continue to train their own civil technicians, the two civil technician schools will want to examine their curricula to see if some of the courses could be used for cooperative in-service training where enough students can be found to justify a class.

6. The two training schools for civil technicians should communicate better to the larger size civil technician employers the extent and depth of their curriculum in order to point up the advantages of employing the two year civil technician graduate.

SELECTED BIBLIOGRAPHY

1. Eastern Oklahoma State College Catalog, 1969-1971. Wilburton, Oklahoma, 1968.

2. Engineering Manpower Commission of Engineers Joint Council. Degrees in Engineering and Industrial Technology 1967-1968. New York, N. Y., 1968.

3. Engineering Manpower Commission of Engineers Joint Council. Demand for Engineers and Technicians 1968. New York, N. Y., 1969.

4. Engineering Manpower Commission of Engineers Joint Council. Prospects of Engineering and Technology Graduates 1968. New York, N. Y., 1968.

5. Fayetteville Technical Institute Catalog, 1967. Fayetteville, North Carolina, 1967.

6. Hardt, Howard P. "Output of Engineering and Physical Science-Related Technicians from Oklahoma Schools 1960-1967." Unpublished Master's Thesis. Stillwater, Oklahoma: Oklahoma State University, 1968.

7. Kansas Technical Institute General Bulletin. Salina, Kansas, 1969.

8. Oklahoma Employment Security Commission of Oklahoma State Employment Service. Manpower In Oklahoma-A Current Inventory and Future Requirement Study. Oklahoma City: Oklahoma Employment Service, December, 1964.

9. Oklahoma Employment Security Commission of Oklahoma State Employment Service. Manpower In Oklahoma-Industrial and Occupational Analysis. Oklahoma City: Oklahoma Employment Service, April, 1969.

10. Oklahoma State Board of Registration for Professional Engineers and Land Surveyors. Oklahoma City, 1968.

11. Oklahoma State University Technical Institute, Oklahoma City, Catalog, 1968-70. Stillwater, 1968.

12. Roney, Maurice W. and Braden, Paul. Occupational Education Beyond the High School in Oklahoma. Stillwater: Oklahoma State University Research Foundation, 1967.

13. State Department of Vocational and Technical Education. Occupational Training Information System. Stillwater, Oklahoma, 1970.

14. U. S. Department of Health, Education, and Welfare. Suggested Techniques for Determining Courses of Study in Vocational-Technical Education Programs - Civil and Highway Technology. Washington: Government Printing Office, 1962.

15. Van Zelst, Theodore W. "A Technical Gap in the Highway Industry." Technical Education News, March, 1967, p. 16.

APPENDIX A

DATA COLLECTION INSTRUMENTS

SURVEY OF CIVIL TECHNICIAN EMPLOYERS

1. Organization _____

2. Address _____

3. Name of person answering questionnaire _____

4. Would you characterize your organization as (check applicable blank):
   Governmental: national _____ state _____ local _____ county _____
   Consulting: _____ Construction _____

5. Major work of your organization _____

   _____

6. Number of Oklahoma licensed civil engineers employed in your organization. _____

7. Number of unlicensed civil engineering graduates employed in your organization. _____

8. Number of employees who are working as civil engineering aides or para-professional level (civil technician) who spend time in other than skilled craftsman support activity. (Example: Draftsman who is a tracer, inker, lineman, or letterer only.)
   _____

9. Functions performed by those in Question 8, by per cent: design _____ production _____ research _____ installation _____ inspection _____ sales _____
   other (specify) _____

10. What is the approximate salary range of employees in Question No. 8?
    From _____ $/week to _____ $/week.

11. How were the employees in Question 8 trained? (by per cent) Within this organization _____ by previous organization _____ Junior College _____ Two year Technical school _____ partial completion of engineering school _____ other (specify) _____
    _____

12. What experience requirements do you have for starting civil technicians? None _____
    No. of years _____ other (specify) _____
    _____

13. What per cent of employees in Question 8 are originally trained in Oklahoma _____, out of state _____?

14. Minimum educational requirement of starting employees in Question 8; none _____, high school graduate _____, Two year technical school _____, college graduate _____, pass a test within organization _____, other (specify) _____
    _____

15. Which curriculum, of those enclosed, would you prefer your starting civil technicians to have taken: Curriculum A _____, B _____, C _____, D _____.

16. What courses in this curriculum (one chosen) would most benefit your employees? (Choose three or more. Example: American History in second semester of Curriculum A would be recorded as A-7) _____
    _____

17. Which courses in the choosen curriculum would least benefit them? _____
    _____

18. Number of engineers in your organization who could be released for higher level engineering pursuits if graduates of one of these curricula were hired? _____

19. Number of additional trained civil technicians needed by your organization in the next year? _____

20. Check approximate starting salary ranges civil technician graduates could expect per week within your organization.

    under $80 ____, $80 to $90 ____, $90 to $100 ____, $100 to $110 ____, $110 to $120 ____, $120 to $130 ____, $130 to $140 ____, $140 to $150 ____, $150 to $160 ____, $160 to $170 ____, $170 to $200 ____, over $200 ____.

21. What function would a civil technician graduate perform within your organization?

    Design ____, Production ____, Research ____, Installation ____, Inspection ____, Sales ____, other ____ (specify) _____

    _____

22. What is your reaction to civil technicians being trained in two year technical schools?

Civil and highway technicians perform many of the planning and design tasks necessary in the construction of highways, railroads, bridges, hangers, missile sites, airfields, viaducts, etc. and other structures necessary for national defense. In the planning stage of construction they may be engaged in estimating costs, purchasing materials, preparing specifications, computing fills and cuts and storm drain requirements, surveying, drafting or designing. Once the actual construction activities are begun, many of them perform supervisory functions. Some may be responsible for seeing that construction activities are performed in proper sequence and for inspection of the work as it progresses for conformance with blueprints and specifications.

SURVEY OF CIVIL ENGINEERS

1. Name _____
   Address _____
2. Employer _____ City _____
3. Degree of Education: High School _____; B.S. _____; M.S. _____; PhD _____.
4. Number of years with present organization? _____
5. In a sentence or two tell your primary duties: _____
   _____
   _____
   _____
6. Number of Oklahoma licensed civil engineers employed in your organization: _____
7. Number of unlicensed civil engineer graduates employed in your organization:
   _____
8. Number of employees who are working as civil engineering aides or para-professional level (civil technician) who spend time in other than skilled craftsman support activity. (Example: Draftsman who is a tracer, inker, lineman, or letterer only.)
   _____
9. Functions performed by those in Question 8, by percent: design _____ production _____ research _____ installation _____ inspection _____ sales _____ other (specify) _____
   _____
10. What is the approximate salary range of employees in Question No. 8? From _____$/week to _____$/week.
11. How were the employees in Question 8 trained? (by percent) Within this organization _____ by previous organizations _____ Junior College _____ Two year Technical Schools _____ partial completion of engineering school _____ other (specify) _____
12. What experience requirements do you have for starting civil technicians? None _____ No. of Years _____ other (specify) _____
    _____
13. What percent of employees in Question 8 are originally trained in Oklahoma _____, out of state _____?
14. Minimum educational requirement of starting employees in Question 8; none _____, high school graduate _____, two year technical school _____, college graduate _____, pass a test within organization _____, other (specify) _____
    _____
15. Which curriculum, of those enclosed, would you prefer your starting civil technicians to have taken Curriculum A _____, B _____, C _____, D _____.
16. What courses in this curriculum (one chosen) would most benefit your employees? (choose three or more. Example: American History in second semester of Curriculum A would be recorded as A-7)
    _____
    _____
17. Which courses in the choosen curriculum would least benefit them? _____
    _____
18. Number of engineers in your organization who could be released for higher level engineering pursuits if graduates of one of these curricula were hired? _____
19. Number of additional trained civil technicians needed by your organization in the next year? _____

20. Check approximate starting salary ranges civil technician graduates could expect per week within your organization.

    under $80 ____, $80 to $90 ____, $90 to $100 ____, $100 to $110 ____, $110 to $120 ____, $120 to $130 ____, $130 to $140 ____, $140 to $150 ____, $150 to $160 ____, $160 to $170 ____, $170 to $200 ____, over $200 ____.

21. What function would a civil technician graduate perform within your organization?

    Design ____, Production ____, Research ____, Installation ____, Inspection ____, Sales ____, other ____ (specify) _____

    _____

22. What is your reaction to civil technicians being trained in two year technical schools?

Civil and highway technicians perform many of the planning and design tasks necessary in the construction of highways, railroads, bridges, hangers, missile sites, airfields, viaducts, etc. and other structures necessary for national defense. In the planning stage of construction they may be engaged in estimating costs, purchasing materials, preparing specifications, computing fills and cuts and storm drain requirements, surveying, drafting or designing. Once the actual construction activities are begun, many of them perform supervisory functions. Some may be responsible for seeing that construction activities are performed in proper sequence and for inspection of the work as it progresses for conformance with blueprints and specifications.

APPENDIX B

TRANSMITTAL LETTERS

OKLAHOMA STATE UNIVERSITY

The Technical Institute—Oklahoma City Branch
(405) 232-5539—1900 Northwest Tenth Street
Oklahoma City, Oklahoma 73106

November, 9, 1970

Dear Potential Employer of Civil Technicians:

Oklahoma State University Technical Institute of Oklahoma City, in cooperation with the Technical Education Department of Oklahoma State University, Stillwater, is conducting a survey concerned with the need for Civil Engineering Technicians. This study is to be conducted among selected potential employers of Civil Technicians in governmental agencies and private practice. As one whose organization falls in the above category, we thought you would want to participate.

We would like to examine in depth the need, source, educational attainment, and desired training of Civil Technicians in the State of Oklahoma. Oklahoma has been a leader in technician training in the past. Much of the success of these programs has been due to the ready supply of information and participation from the public and private sectors of the Oklahoma economy.

For your convenience, we have enclosed a self-addressed envelope in which to return the completed questionnaire. Your organization's name will be listed as having participated in the survey. The remaining data on the questionnaire will be tabulated but only on basis of organizational size and type and no information will be attributed to a specific company or organization.

We wish to thank you in advance for participating in this survey.

Sincerely,

Kenneth C. Govaerts, P.E.
Head, Civil Technology

KCG/ct

Enclosures

P.S. See definition of Civil Technician on bottom of Questionnaire.

OKLAHOMA STATE UNIVERSITY

The Technical Institute—Oklahoma City Branch
(405) 232-5539—1900 Northwest Tenth Street
Oklahoma City, Oklahoma 73106

November 9, 1970

Dear Registered Engineer:

Oklahoma State University Technical Institute of Oklahoma City, in cooperation with the Technical Education Department of Oklahoma State University, Stillwater, is conducting a survey concerned with the need for Civil Engineering Technicians. This study is to be conducted among both employers and employees of governmental agencies and private consulting firms. As a professional engineer and member of ASCE we thought you would be willing to participate.

We would like to examine in depth the need, source, educational attainment, and desired level of training in the past. Much of this leadership has come about through effective programs of training. Much of the success of these programs has come from the ready supply of information of need and the participation from the public and private sectors of economy in Oklahoma.

For your convenience, we have enclosed a self addressed envelope in which to return the completed questionnaire. Your organization's name will be listed as having participated in the survey. The remaining data on the questionnaire will be tabulated but only on basis of participation on organizational size and no information will be attributed to a specific company or individual.

We wish to thank you in advance for participating in this survey.

Sincerely,

Kenneth C. Govaerts
Head, Civil Technology

KCG/ct

Enclosures

P.S. See definition of Civil Technician on bottom of Questionnaire.

APPENDIX C

SUMMARY OF RAW DATA

RAW DATA

CONSULTANT DATA

0-5

Respondent Number	Engineers: Licensed	Engineers: Unlicensed	Engineers: Total	Technicians	Tech:Eng. Ratio	Technician Activities: Design	Production	Research	Installation	Inspection	Sales	Other	Salary Range $: Low	High	How Technicians Were Trained: Organization	Previous Organization	Jr. College	2 Yr. Tech School	Engineering	Other	Where Education Trained Required: Experience Years	Oklahoma	Elsewhere	None	High School	2 Yr. Tech	College	Pass Test	other	Curricula chosen: A	B	C	D	Projected Salary Range $: Low	High	No Engin. Upgraded	New Tech Requir.	New Technician Activities: Design	Production	Research	Installation	Inspection	Sales
1	2	0	2	1	.5							25	130	130				100			1.5	100				×				x			110	120	2	2	x					
3	1	0	1	2	2.					100			100	125	70					30	2	100			x		x		x				90	100	0	2		x			x	
4	3	0	3	4	1.25	50	37.5				12.5		150	225	25	62.5		12.5			0	87.5	12.5								x			120	200	3	5	x	x	x		x	x
5	3	0	3	2	0.66	80				20			176	184					100		0	100	0		x					x			140	150	0	1	x					
6	2	0	2	2	1.0	50				50			100	150	33	33			34		2	0	100		x							x	120	130	1	1	x	x			x	
7	1	0	1	2	2.0		100								50	50					0	100	0		x							x	130	140	0	1	x	x				
8	1	1	2	1	0.5	50					50		125	125	100						0	100	0										120	130	2	-	x					
9	1	0	2	2	2.0	25		25		25	25		160	200		50			50		4	100	0		x					x			150	160	0	2	x	x	x		x	
10	1	0	1	5	5.0	10	90						100	130	25	12	63				0	100	0		x							x	120	130	1	2	x	x		x		
11	1	0	1	3	3.0		100						96	175							0	100	0		x							x	160	170	1	1	x					
13	1	0	1	2	2.0		100						140	140	33		33	33			0	100	0	x						x			170	200	0	2	x	x		x		
14	2	1	3	2	0.67		100						100	100	100						0	100	0	x							x		110	120	2	2		x				
16	3	0	3	3	1.0	75						25	100	150	30				40		0	100	0		x						x		90	100	0	0		x				
17	2	1	3	3	1.0								140	200							0	66	34	x						x			120	130	0	-						
18	3	0	3	4	1.33	30	70						80	200	66		33				2	100	0			x		x	x	x			80	90	1	3	x	x				
21	3	0	3	8	2.66	50				25		25									2-5	100	0																				

6-10

2	4	2	6	6	1.0		5	5	5	40	45			100	125	100						0	20	80	x								x	140	150	2	0		x				
15	4	2	6	6	1.0		10	90	.					100	175	50	20		30			2	100	0		x	x				x			120	130	2	3		x			x	
20	8	0	8	8	1.0		10				90			150	200	100						0	100	0			x					x		140	150		5						

10-31

12	16	3	19	24	1.3		30	70						110	160	80	20					0	95	5		x				x				150	160	0	2	x	x				
19	26	5	31	16	0.5		20	80						-	200	40			60			0	100	0		x					x			140	150	1	4	20	80				

RAW DATA

CITIES

Respondent Number	Engineers: Licensed	Engineers: Unlicensed	Engineers: Total	Technicians	Tech - Eng Ratio	Technician Activities: Design	Production	Research	Installation	Inspection	Sales	Other	Salary Range: Low	High	How Technicians Were Trained: Organization	Previous Organization	Jr college	2 Yr Tech School	Engineer.	Other	Experience Years	Where Trained: Oklahoma	Elsewhere	Education Required: None	High School	2 Yr Tech	College Grad	Pass Test	Other	Curricula Project Choosen: A	B	C	D	Salary Range: Low	High	No Engineers Upgraded	New Tech Required	New Technician Activities: Design	Production	Research	Installation	Inspection	Other
1	0	0	0	2	—	30			20	10		40	125	165	40	5	50	10			2	50	50		X							X	120	130	0	1	X			X	X	
2	1	0	1	2	2.0	90				10			100	125	50				50		0	50	50		X						X		100	110	0	1	X				X	
3	1	0	1	8	8.0	125	37.5			50			125	150	37.5	50		12.5			1	100	0		X					X			120	130	0	0		X			X	
4	1	0	1	1	1.0	80						20	85	100	100						0	100	0		X							X	100	110	0	1	X				X	
5	0	0	0	1	—	10	15	10	15	50			125	125		100					5	100	0					X		X			110	120	0	2			X		X	
6	3	0	3	2	0.67	25				25		50	150	175	75	75			10		4	100	0		X					X			150	160	0	0	X			X	X	
7	5	0	5	9	1.8	40		5	20	5		30	150	200	20	20	10	10	40		5	1	1		X					X			140	150	1	1	X				X	
8	8	2	10	32	3.2	20				40		40	110	185	90		10				—	95	5		X					X			110	200		5	X				X	

STATE & NATIONAL

1	4	2	6	10	1.67	10				70		20	92	140	40	10		40	10		1	100	0		X							X	100	150	3	5	X				X	X
2	3	3	6	1	.17	50						50	110	110	75			25			2-3	100	0		X			X			X		110	120	0	0	X				X	
3	15	3	18	2	.11	100							221	228		100					2			X									110	120	—	—		X				

APPENDIX D

TABULATION OF REPLIES TO QUESTION NUMBER 22

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QUESTION NUMBER 22

1. Excellent - Courses should be oriented so that student could credit work toward a B.S. in Engineering at completion if he should so choose, (and was capable).

2. Might create another salary range - in the consultant field we have non-graduates who make a maximum of $700.00 to $800.00 per month regardless of experience.

Graduate engineers start at $800.00 to $900.00 per month regardless of capabilities and their salaries increase rapidly.

3. The function of civil technicians in the consulting industry is a very useful and necessary one because 90% of the daily work can be performed by them and we think that a technician highly trained in specialist fields is more assistance to us than graduate engineers with general education backgrounds.

4. If you don't, we will. The gap between the typical drafting school graduate and the engineering graduate is too vast to be economically breached by an employer. Where would the Army be without its sergeants? The civil engineering "sergeants" are virtually unobtainable. However, the graduate of a two-year technical school will be hireable only if the school leaves out the high level, ivory tower, courses and sticks to the nitty gritty. Give us men who can think out practical solutions to practical problems and then communicate them!

5. Good idea!

6. Favorable.

7. Generally, I feel that after receiving training in technical schools the person needs several years of practice under an experienced person to be able to perform the tasks you have listed below. (Definition of civil technician).

8. Great, its got to happen. If they're good and know their business they can do as well as B.S. degree.

9. I think that it is an excellent program. Not everyone is inclined; nor has the time to become a college graduate. This two year technician program being proposed is far better than even three years of civil school under current curriculum.

10. Good.

11. Stay with the 2-year school. The engineering profession has a need for the tech school graduate. I strongly believe that he may have a brighter future within some organizations than the engineering graduate.

12. I think that there is a definite need for civil technicians in the consulting field.

13. Initial salary requirement mostly unrealistic.

14. Too many hours spent in humanities-arts-history, etc.

15. Don't know any.

16. I think it is a very good idea.

17. Very good idea. Most technicians we have hired in the past from drafting schools have not proved to be of value to us for at least 3 or 4 months of on the job training.

We have never had an applicant from a 2 year technical school.

All of your curriculum appears to be excellent, however, if you could provide public speaking courses it would be to an advantage to any of your students. We find that the ability to communicate verbaly is the worse fault of most engineers and technicians.

18. We need civil engineers trained in these courses, particularly surveying and drafting - The first two years we have a civil graduate, we have to spend training him in courses he should have had in college - Civil technicians could provide additional help but our need is for better civil graduates.

19. This will help to upgrade the industry.

20. Though only having been in municipal work for one year, previous to that I was in industry for eleven years. In both areas civil technicians are desperately needed. Technicians in many fields are needed.

Furthermore, training and re-training is needed for those technicians now working.

I personally believe that the "technician-gap" is extensive and is serious and will become worse before it improves.

21. A good idea if they don't attempt to be engineers and do work for which they are not qualified.

22. It is an excellent approach to the needs of individuals desiring only to be technicians.

23. There is a definite need for workers in this category and I think OSU is performing a great service to the state of Oklahoma by offering this training.

24. I think there is a need for people trained in basic skills for engineering work.

25. I think this is a very good program.

26. It appears to me that this is a good approach and that the type of individuals that would be pursuing these courses could be given more attention than if were trained in schools other than specified technical schools - This type of school should also be more flexible.

27. Definite need.

28. Great!

29. We think it an excellent idea.

30. I believe two year technical schools provide a good background for civil technicians who for various reasons cannot complete Civil Engineering college work.

31. Usually very good.

32. Hopeful - We need to develop this curriculum to provide better utilization of our professional engineers.

33. We rely on these people for design of water and sewer lines, storm sewer design, hydraulic analysis of water systems, setting paving grades, closing survey traverses, preparing reports and estimates, design of small structures and buildings and other basic civil engineering skills under the general supervision of a professional engineering. They also need to be able to supervise draftsmans, surveyors and others doing the detail drawings, etc.

APPENDIX E

QUESTIONNAIRE RESPONDENTS

QUESTIONNAIRE RESPONDENTS

CONSULTANTS

Fox and Drechsler
113 Falcon Road
Altus, Oklahoma 73521

J. B. Howle and Associates
9 N. 11th
Duncan, Oklahoma 73533

Hudgins, Thompson and Ball
of Enid
705 E. Cherokee
Enid, Oklahoma 73701

Affiliated Engineers
818 E. S
Muskogee, Oklahoma 74401

Clark Engineering
550 Highland Parkway
Norman, Oklahoma 73069

Larkin Engineers
1407 S. Midwest Blvd.
Oklahoma City, Oklahoma 73110

Phillips and Strong
2832 W. Wilshire Blvd.
Oklahoma City, Oklahoma 73116

Russell, Gravlin and Douglas
5724 S. Shields
Oklahoma City, Oklahoma 73129

Rea Engineering & Associates
1133 S. W. 74th
Oklahoma City, Oklahoma 73139

Gauger Engineering Inc.
525 Beacon Bldg.
Tulsa, Oklahoma 74103

Lloyd W. Abbott
1135 E. 38th
Tulsa, Oklahoma

Phelps, Spitz, Ammorman and
Thomas
308 N. E. 27th
Oklahoma City, Oklahoma 73105

Fell, Brusso, Bruton
3202 E. 21 St.
Tulsa, Oklahoma 74114

Netherton, Solnok, & Associates
8110 E. 46th
Tulsa, Oklahoma 74145

Frankfort, Short, Emery, McKinley
323 E. Madison
Oklahoma City, Oklahoma 73105

E. D. Hill, Jr.
320 Robert S. Kerr Avenue
Oklahoma City, Oklahoma 73105

Hudgins, Thompson and Ball
1411 Classen Blvd.
Oklahoma City, Oklahoma 73106

The Engineering Consultants
P.O. Box 1055
Stillwater, Oklahoma 74074

CITIES

Eldon T. Head, City Manager
City Hall
Duncan, Oklahoma 73533

Tom Sailor, City Manager
Convention Hall
Enid, Oklahoma 73721

Leonard D. Briley, City Manager
City Hall
Muskogee, Oklahoma 74401

Donald L. Grimes, City Manager
Municipal Building
McAlester, Oklahoma 74501

City Engineer
226 E. Gray
Norman, Oklahoma 73061

Director of Public Works
200 N. Walker
Oklahoma City, Oklahoma 73102

City Engineer
200 Civic Center
Tulsa, Oklahoma

STATE OF OKLAHOMA

Oklahoma Water Resources Board
2241 N. W. 40th
Oklahoma City, Oklahoma 73112

Oklahoma Turnpike Authority
3500 N. Eastern
Oklahoma City, Oklahoma 73111

UNITED STATES GOVERNMENT

Federal Highway Administration
2409 N. Broadway
Oklahoma City, Oklahoma

Tinker Air Force Base
Engineering Office
3000 S. Douglas Blvd.
Oklahoma City, Oklahoma 73150

AMERICAN SOCIETY OF CIVIL ENGINEERS MEMBERS

Allen G. Poppino
(Benham, Blair and Associates)
Box 53445
Oklahoma City, Oklahoma 73105

James M. Thompson
(Poe and Associates)
15 E. Washington
McAlester, Oklahoma 74501

Jewell T. Wood
(Holway Engineers, Inc.)
1850 S. Boulder
Tulsa, Oklahoma 74119

James R. Willis
1820 S. Third
Blackwell, Oklahoma 74631

Albert J. Hamlett, Jr.
City of Tulsa
5131 E. 29th St.
Tulsa, Oklahoma 74114

F. W. Denner
116 S. Jackson
Enid, Oklahoma 73701

APPENDIX F

CURRICULA

CURRICULUM A

CIVIL TECHNOLOGY

First Semester		Credit
A-1	Algebra & Trigonometry	5
A-2	Personal & Occupational Guidance	1
A-3	Freshman Composition	3
A-4	Engineering Drawing	2
A-5	Introduction to Public Works	2
A-6	Materials of Construction	3
		16

Second Semester		
A-7	American History	3
A-8	Surveying I	2
A-9	Technical Report Writing	3
A-10	Applied Calculus	5
A-11	Applied Physics	4
		17

Third Semester		Credit
A-12	Graphic Statics	3
A-13	Basic Computer Programming	2
A-14	Advanced Surveying & Photogrammetry	3
A-15	Construction Planning & Scheduling	3
A-16	American Government	3
A-17	Codes, Contracts and Specifications	3
		17

Fourth Semester		
A-18	Strength of Materials	3
A-19	Estimating	3
A-20	Highway Design & Const.	3
A-21	Principles of Hydraulics	2
A-22	Route Surveys	2
A-23	Inspection Principles	3
A-24	Elective (Approved)	2
		18

CURRICULUM B

CIVIL TECHNOLOGY

First Semester		Credit
B-1	English Communication Skills	3
B-2	Technical Math I	3
B-3	Engineering Drawing	2
B-4	Surveying	2
B-5	Technical Math II	3
B-6	Orientation & Library Science	1
B-7	Physical Education	2
		16

Second Semester		Credit
B-8	English Communication Skills	3
B-9	Technical Math III	3
B-10	Architectural Drawing	4
B-11	Physical Education	2
B-12	American Nat'l Government	3
B-13	American History	3
		18

Third Semester		
B-14	General Physics	4
B-15	Analytical Geometry	3
B-16	Engineering Statics	3
B-17	Structural Design	4
B-18	Map Drafting	4
		18

Fourth Semester		
B-19	General Physics	4
B-20	Strength of Materials	4
B-21	Advanced Surveying	4
B-22	Building Construction	4
B-23	Humanities Elective	2
		18

CURRICULUM C

CIVIL TECHNOLOGY

First Semester		Credit
C-1	Technical Math I	5
C-2	Technical Communications	3
C-3	Graphic Communications	3
C-4	Applied Chemistry	3
C-5	Introduction to Civil Technology	1
C-6	Materials Sampling Lab.	1
		16

Second Semester		Credit
C-8	Technical Math II	4
C-9	Plane Surveying	3
C-10	Technical Physics	4
C-11	Technical Communication II	3
C-12	Civil Drawing	3
		17

Summer Semester		
C-15	Mechanics I	3
C-16	Industrial Economics	3
		6

Fourth Semester		Credit
C-17	Construction Surveying	4
C-18	Structural Materials	3
C-19	Soils & Foundations	3
C-20	Construction Methods & Estimating	3
C-21	Industrial Relations	3
C-22	Construction Materials Lab.	1
		17

Fifth Semester		Credit
C-23	Photogrammetry	3
C-24	Fortran	3
C-25	Specification Interpretation & Writing	2
C-26	Reinforced Concrete	3
C-27	Civil Design & Const.	4
C-28	Technical Communication III	2
		17

CURRICULUM D

CIVIL TECHNOLOGY

FIRST YEAR

First Quarter		Credit
D-1	English (Grammer)	3
D-2	Technical Math	5
D-3	Physics (Properties of Matter)	4
D-4	Technical Drafting	2
D-5	Introduction to Sanitation	4
		18

Second Quarter		Credit
D-6	English (Composition)	3
D-7	Technical Math	5
D-8	Physics (Work,Energy,Power)	4
D-9	Surveying	4
D-10	Applied Biology	4
		20

Third Quarter		Credit
D-11	English (Report Writing)	3
D-12	Technical Math	5
D-13	Basic Hydraulics	4
D-14	Technical Drawing	2
		18

SECOND YEAR

Fourth Quarter		Credit
D-15	English (Oral Com.)	3
D-16	Sanitary Chemistry & Biology	4
D-17	Water Supply & Liquid Waste	4
D-18	Water Purification	5
D-19	Applied Electricity	4
		20

Fifth Quarter		Credit
D-20	Applied Economics	3
D-21	Sanitary Chemistry & Biology II	4
D-22	Liquid Waste Treatment	5
D-23	Control Systems	4
D-24	Drafting	2
		18

Sixth Quarter		Credit
D-25	Applied Psychology	3
D-26	Sanitary Chemistry & Biology III	4
D-27	Codes, Contracts & Spec.	2
D-28	Field Surveying	2
		17

VITA

William Benjamin Powell

Candidate for the Degree of

Master of Science

THESIS: A STUDY OF CIVIL TECHNICIAN NEEDS IN POPULATION CENTERS IN OKLAHOMA

Major Field: Technical Education

Biographical:

Personal Data: Born in Concordia, Kansas, September 28, 1926, the son of Mr. and Mrs. Ernest W. Powell.

Education: Graduated from Concordia High School, May, 1944; received Bachelor of Science in Civil Engineering from Kansas State University, 1950; took course work in computer programming at Kansas Technical Institute, 1968-1969; completed requirements for Master of Science Degree, Oklahoma State University in July, 1971.

Professional Experience: Licensed Professional Engineer employed by Wilson and Company Engineers, Salina, Kansas, 1950-1970; Resident Engineer, 1950-1954; Section Engineer, 1954-1960; Design Engineer, 1960-1964; Project Engineer, 1964-1968; Computer Section Engineer, 1969.

Professional Organizations: Kansas Engineering Society; National Society of Professional Engineers; Water Pollution Control Federation