A STUDY OF THE SUPPLY AND DEMAND OF ELECTRONICS, ELECTROMECHANICAL, AND INSTRUMENTATION TECHNICIANS OF SELECTED SCHOOLS AND INDUSTRIES

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1968

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
May, 1974

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Thesis Approved:

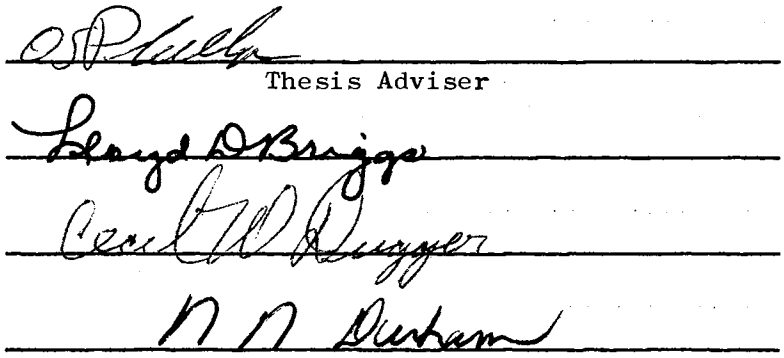

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

INTRODUCTION

The technological growth and industrial strength of any nation is directly related to its labor force, particularly its professional and semi-professional personnel. One member of the team responsible for the tremendous industrial growth in the United States during the past two decades has been the engineering technician. All manpower studies in recent years have indicated a continuing increase in the demand for engineering technicians; however, most of these studies have been on the state or national level.

Of great interest to any educational institution involved in technician education is the demand for engineering technicians at the community level.

Statement of the Problem

According to economists, the law of supply and demand, and the prevailing wage will insure that a sufficient number of persons are trained to meet the needs of industry for any particular job classification. Although this is basically true, the time lag between when the need by industry arises and when a sufficient number of persons are prepared to fill the need, is very often considerable.

If sufficiently accurate data is available to the local educational institution, determination of immediate and future needs by

industry can be determined and acted on.

Stated concisely, the problem with which this study was concerned was the need for accurate data on the demand and supply of electronics, electromechanical, and instrumentation technicians in Tulsa County.

Purpose of the Study

The purpose of the study was to determine the number of electronics, electromechanical, and instrumentation technicians presently employed in selected industries in Tulsa County, as well as present needs and future needs over the next five year period for these types of technicians. The study was designed to answer the following questions:

1. Does Tulsa industry presently employ engineering technicians? If so, how many are employed by the selected industries?
2. How many new engineering technicians are apt to be employed by the selected industries in Tulsa County each year for the next five years?
3. Will graduating engineering technicians have a choice available to them as to the type of industry in which they wish to seek employment within the selected industries?
4. Will graduating engineering technicians have a choice available to them as to the size industry with which they wish to seek employment within the selected industries?
5. Is there a sufficient number of engineering technicians being educated by schools within a 100 mile radius of Tulsa to meet the needs of local industry?

6. What percentage of the total number of engineering technicians available are apt to seek, or find, employment in Tulsa?

Need for the Study

The need for the study was generated by the continuing industrial growth of the city of Tulsa, as well as the projected growth, and the recent establishment in Tulsa of a junior college concerned with the education of engineering technicians.

Government studies indicate that the demand for associate degree engineering technicians will continue to increase for a decade and that 80 per cent of new jobs by 1980 will require more than a high school diploma but less than a baccalaureate degree.

As a new and expanding educational institution, Tulsa Junior College is and will continue to be vitally concerned with present and projected needs for electronics, electromechanical, and instrumentation technicians in Tulsa. A diverse industrial community exists in Tulsa which demands a widely diverse labor source. Technician education curricula are designed to prepare the graduate to enter a diverse labor market with a minimum amount of additional training after employment.

As technology continues to advance, new skills will be required of the engineering technician. Educational institutions must identify these new skills and design them into updated, modern curricula.

Scope of the Study

The study was limited to the supply and demand of engineering technicians as defined in the next section of this chapter. The study was concerned with the engineering technician because Tulsa Junior College is involved in the education of post secondary, associate degree technicians as are the seven other state financed educational institutions which comprise the supply aspect of the study. All state financed Oklahoma schools within a one hundred mile radius of Tulsa which offer post secondary technician education programs were included in the study. The demand aspect of the study was concerned with present needs and future needs for the next five years for engineering technicians for 150 selected firms within Tulsa County. No attempt was made to predict the total number of engineering technicians needed by all industry in Tulsa County.

Definition of Terms

An Engineering Technician is a person who works at a job which requires applied technical knowledge and skill. His work in this respect is akin to the engineer, but is usually narrower in scope. His job also requires some manipulative skills, those necessary to handle properly the tools and instruments to perform the technical tasks. In his special field he has considerable technical knowledge of technical-industrial processes, and in the field he knows how to apply the necessary principles of the physical sciences and mathematics. In general he uses instruments in contrast to tools. His contribution is mainly through mental effort rather than muscular exertion (1).

The engineering technician is usually employed in one of the following categories:

(1) research, design, or development

(2) production, operation, or control

(3) installation, maintenance, or sales

If working in category (1), the engineering technician usually works with an engineer or scientist. When working in category (3), he is frequently working at a job that would otherwise be performed by an engineer.

Technician Education is a planned sequence of classroom and laboratory experiences at the post secondary level designed to prepare persons for a cluster of job opportunities in a specialized field of technology. The program of instruction normally includes the study of the underlying sciences and supporting mathematics inherent in the technology, and the methods, skills, materials, and processes commonly used in the technology. A planned sequence of study and extensive knowledge in a field of specialization is required in technicial education, including competency in the basic communication skills and related general education. Technician education prepares one for the occupational area between the skilled craftsman and the professional person.

Technician education curricula are structured to prepare the graduate to enter a job and be productive with a minimum amount of additional training required after employment. Technician education provides a background of knowledge and skills which will enable one to advance as technology advances, and will enable one to advance to positions of increased responsibility with a reasonable amount of

experience and additional education (12).

The Junior College is an institution of higher learning which offers the first two years of college instruction. The junior college generally grants an associate degree, but does not grant a baccalaureate degree. It may be either a public or non-public independently organized institution, an institution which is part of the public school system, or part of an independently organized system of junior colleges. Offerings may include college transfer courses, technical and occupational programs, continuing education programs for adults, and community services (12).

A Skilled Craftsman is an individual who possesses a high degree of manipulative skill and can perform practically all the operations of his job, is in command of the necessary scientific facts, can complete the necessary calculations essential to the performance of his work, and make judgements and decisions regarding given situations.

Engineers represent all persons actually engaged in chemical, civil, electrical, mechanical, metallurgical, or any other type of engineering work at a level which requires knowledge of engineering, physical, life, or mathematical sciences equivalent at least to that acquired through completion of a four-year college course with a major in one of these fields, regardless of whether they hold a college degree in the field.

Scientists represents all persons actually engaged in scientific work at a level which requires knowledge of the physical, life, engineering, or mathematical sciences equivalent at least to that acquired through completion of a four-year college course with a major

in one of these fields, regardless of whether they hold a college degree in the field.

CHAPTER II

REVIEW OF LITERATURE

This chapter is concerned with a review of literature relative to engineering technicians. Much has been written about the engineering technician; however, as one begins a review of literature pertinent to engineering technicians and technician education it soon becomes apparent that considerable confusion exists in both education and industry as to just what an engineering technician is. Should he be defined in terms of his education? Should he be defined in terms of the work he performs? Are there more definitive means to describe the engineering technician? These and other questions concerning engineering technicians have been debated for years at the local, state, and national level. Because this confusion exists, the review of literature for this study will proceed on the assumption that the definition for the engineering technician stated in Chapter I is acceptable.

Technician Education

The engineering technician's struggle for occupational recognition has been long and sometimes difficult. Prior to World War II technicians were practically non-existent. What few there were had no widely accepted credentials, were not accepted as part of the engineering team, and were not extended recognition or encouragement by

any professional or educational body. A shortage of engineers during World War II forced industry to utilize technical personnel in many areas previously considered to be in the engineer's preserve. By the end of the war the Engineer's Council for Professional Development was speaking of "the engineering team", linking the engineering technician closely to the engineer.

Although he was beginning to receive some recognition by the war's end, a great deal of confusion still existed regarding the engineering technician. By whom and at what level should he be educated? Technical institutes have existed around the country since the early 1900's for the express purpose of technician education. These institutions have traditionally provided leadership in technical education in this country (3). Technical institute curricula have long been identified with engineering technology, however, federal legislation still insisted that technician education was less than college level. Legislation such as the Smith-Hughes Act and the George-Barden Act authorized expenditures in occupational education; however, most has gone for skill development rather than technical education.

The year 1957 brought a new era to the world--space travel. The national spotlight was turned on apparent weaknesses in the educational system and the danger these weaknesses posed to the nation's space and defense effort. As a result, the National Defense Education Act of 1958 was passed. With respect to occupational education, one problem which caught the attention of many legislators was the desperate shortage of technical personnel, particularly in the science and engineering fields. These technician manpower needs became linked with vocational facilities and evolved as Title VIII of the NDEA. While

there have been many problems associated with the Title VIII NDEA program, it never-the-less helped to graduate at least 25,000 technicians during the years 1958 through 1963 (13). The National Defense Education Act has prompted all but a few states to improve their vocational and technical programs. One very important outcome of this has been an increased understanding of technician education on a national scale.

The year 1963 was perhaps the most important in the legislative history of technical education. The Higher Education Facilities Act of 1963 specifically earmarked funds for junior colleges and technical institutes for technician education. This marked the first time that technician education had been specifically tied to higher education in federal legislation. The stated purpose of the act was "to assist the nation's institutions of higher education . . . to accommodate mounting student enrollments . . . to meet demands for skilled technicians, and for advanced graduate education"(13). The Higher Education Facilities Act was a most encouraging development for post-secondary technician education in that it was recognized as a legitimate and necessary part of higher education.

Engineering Technology Curricula

Instruction in engineering-oriented technician education covers a spectrum of levels. The objectives of curricula at the upper end of the spectrum approach closely engineering while curricula at the other end of the spectrum have objectives which are similar to those in secondary school programs in technical high schools. Between these extremes are a number of intermediate levels of technician education.

This multi-level concept of technician education is often misunderstood. Many people tend to view all technician education curricula, and therefore all technicians, as being at the same level. There are, however, many levels of technician education. However, in this vein, the level of the program is not an index of quality. Some observers tend to assume that high-level programs are good and low-level programs poor. Such an assumption is invalid as has been pointed out by McGraw in his study "Characteristics of Excellence in Engineering Technology Education:"

> The level of a program is determined by its objectives and the quality by how well it achieves these objectives. If, for example, the objectives of a program is to train retarded persons to perform simple household tasks, it may excel at accomplishing this objective. On the other hand, a graduate program in a highly abstract field may well be of poor quality (1).

There is little question that each level of technician education serves a valid purpose. The demand for technicians in industry reflects a need for capabilities which vary as widely as the levels of educational preparation. Many industries have classifications for their technical personnel. For each of these classifications there are defined duties and responsibilities, minimum qualifications, and typical job titles.

The critical content in defining the level of any technical curriculum is the mathematics. It underlies true comprehension of the physical sciences which are the foundations upon which the technical specialities are based (4). The technology of interest will determine the mathematics required; however, topics from college level algebra and trigonometry should be included in all technician education curricula. In addition, the mathematics may include selected topics

from plane, solid, descriptive, and analytic geometry, vector, linear, and Boolean algebra, differential and integral calculus, or probability and statistics.

At all levels of education, the content included in the treatment of a particular subject is selected from the knowledge amassed in the field. Subjects rarely can be treated exhaustively. In designing the content of the mathematics course for a technical curriculum, extreme care must be given as to what topics from the various areas of mathematics should be included.

The technician with his somewhat limited knowledge can go only so far. It is the mathematics which determines just how far he can go. This is why mathematics is the determining factor as to the level of an engineering technology curriculum. However, mathematics is not the sole determining factor of the level of a curriculum. The sciences also play a very important role. A technical curriculum may include chemistry, physics, biology, statics, dynamics, fluid mechanics, electrical circuitry, material properties, or thermodynamics. As is true with mathematics, only selected topics from the selected field of science can be included. These topics should be selected according to the requirements of the technology (4).

The objective of the program in question dictates the type and amount of science which should be included. In developing a curriculum, one works back from the final objective to include the necessary topics from the technical specialty, and then to the required science and mathematics. If the objectives are somewhat theoretical, the science and mathematics will be quite comprehensive and the level will be high. Similarly, less analytical objectives require a lesser foundation in

science and mathematics, and the level will be lower.

As important as mathematics and science are in defining the level of a technical curriculum, they are not the courses which in the end make the engineering technician. Since the objective of all technician education programs is to prepare graduates for roles as part of the engineering team, the crucial curriculum content must be centered around the ability to solve practical problems.

The precise content of a technical specialty cannot be permanently defined because it is always in transition. In today's ever advancing technology, yesterday's innovations are tomorrow's obsolete practices. Curriculum content must be continually updated and techniques kept abreast of the times. Technical specialties must be taught through both theory and practice. In most instances heavy emphasis should be placed upon laboratory work. The student must acquire intimate familiarity with apparatus, instrumentation, and techniques. He must be taught to collect, analyze, interpret, and present data. Regardless of the level of the program, the technical specialty is the crucial content of the total program and the determining factor as to the total effectiveness of a program involved in educating the engineering technician.

The Engineering Technician

During the past two decades there have been a number of manpower studies performed at the state and national level. Virtually all of the studies have indicated a tremendous need for engineering technicians. However, in spite of this consistent finding there seems to be an amazing lack of agreement as to what properly constitutes the work

of a technician. The work assigned to technicians in industry ranges from that normally assigned to mechanics to work which would normally be assigned to graduate engineers. Any in-depth study of the place of technicians in industry will reveal that an accurate analysis of work activities is difficult because of the lack of uniformity in job titles.

As technology advances manpower requirements shift accordingly. A large percentage of the new manpower requirements created by new technology is in the semi-professional and technical areas according to Norman C. Harris of the University of Michigan:

> The really significant changes in our labor force, and in society in general, have occurred at the level of the semi-professional and technical; the managerial, business and sales; and the highly skilled jobs. These jobs taken together, will account for over 50 per cent of the labor force by 1970 (5).

Considering the engineering technician to be one who is employed in support of engineers and scientists, there were approximately 800,000 employed in 1960. The Bureau of Labor Statistics conducted a national survey of engineering, scientific and technical personnel for the National Science Foundation, also in 1960. From the study, the number of technicians which would need to be educated during the 1960's was estimated to be 67,800 per year just to maintain the ratio of 0.7 to 1 of technical to scientific and engineering personnel which existed at that time (7).

Many studies indicate that a 2 to 1 ratio of technical to scientific and engineering personnel is desirable (8). To achieve this ratio it would have been necessary to graduate some 200,000 technicians annually during the 1960's. It has been estimated, however, that

approximately 50,000 people enter technical occupations each year (7). All indications point toward a great demand for technicians over the next decade with literally hundreds of typical occupational titles assigned to technicians in industry. One could conclude that every segment of industry is open to the technician (13).

The O.T.I.S. Project

The Occupational Training Information System (O.T.I.S.) is a project with the purpose of developing and initiating continuous and detailed manpower data in the entire state of Oklahoma. The project is designed to have six components; manpower, supply, manpower demand, cost, follow-up, underdeveloped human resources, and socio-political involvements. Only the supply and demand components of the O.T.I.S. project are pertinent to this study.

The primary supply population with which the O.T.I.S. project dealt was: (a) full-time public programs, (b) adult public programs, (c) Manpower Development and Training Act programs, (d) private schools, (e) industrial and government on-the-job training programs, (f) registrants at the Oklahoma Employment Security Commission, and (g) selected non-federally reimbursed vocational and technical programs. The manpower supply was divided into the following seven major skill clusters: (a) agriculture, (b) distributive, (c) health, (d) home economics, (e) office, (f) trade and industrial, and (g) technical. Only the technical cluster of the O.T.I.S. project is pertinent to this study.

The manpower demand aspect of the O.T.I.S. project was investigated by personal interview by technical educators with representatives of every manufacturing firm in Oklahoma which employs four or more

persons. The survey involved 2964 manufacturing firms. The O.T.I.S. Advisory Committee deemed necessary geographical as well as occupational demand data. To acquire the geographical data the state was divided into eleven school districts. Figure 1 is a map of Oklahoma showing these geographic regions. Only the data involving the Tulsa Standard Metropolitan Statistical Area is pertinent to this study. The O.T.I.S. project arrived at a new manpower requirement figure for a specific occupation, in a particular geographic region, by subtracting the total supply from the total demand.

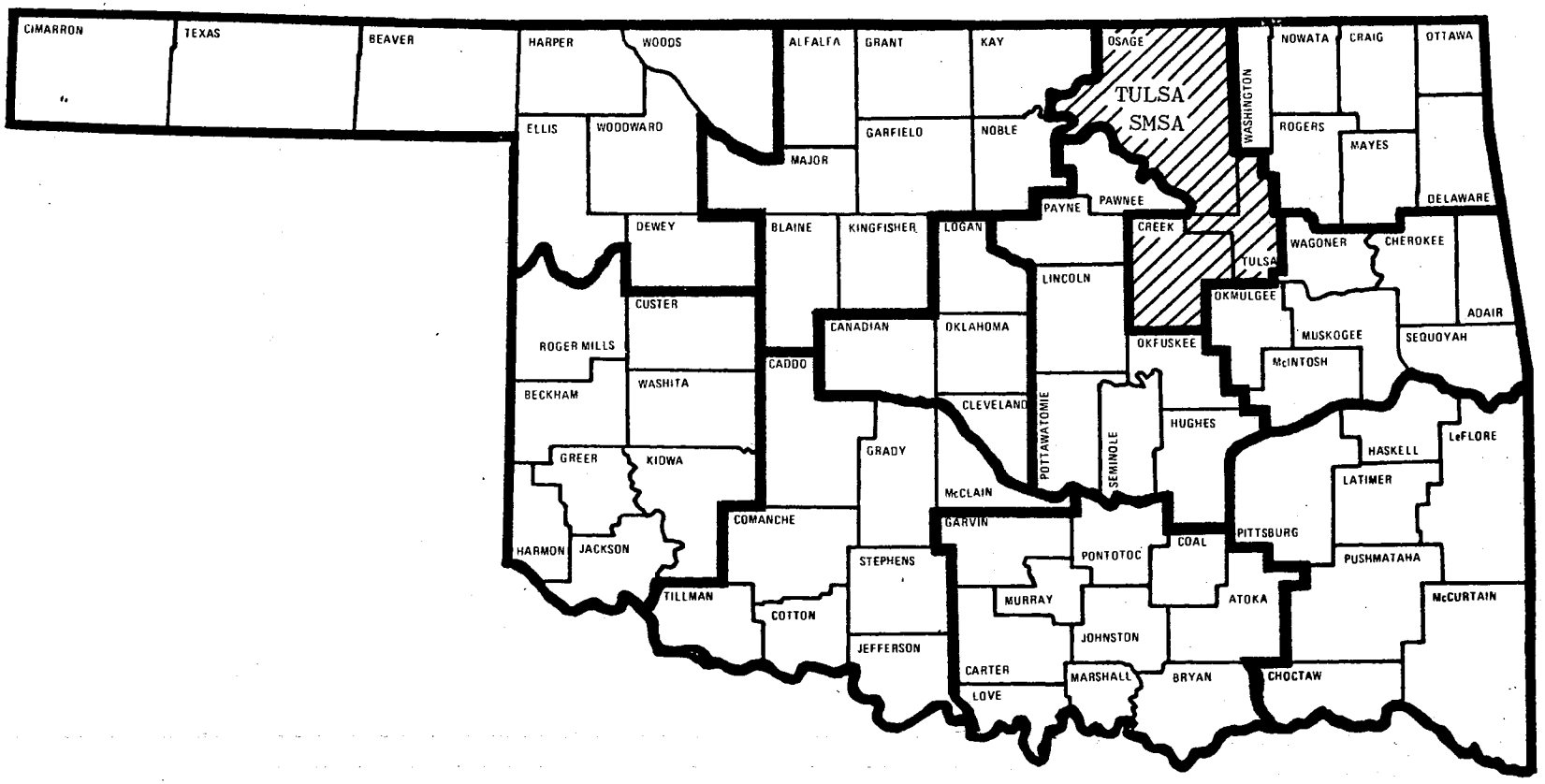

Figure 1. Geographic Regions Established in the O.T.I.S. Project for Data Collection

CHAPTER III

METHOD OF INVESTIGATION

The selection of a problem having significance to technical education and to Tulsa Junior College were prime considerations in reaching a decision. The purpose of this chapter is to describe the design of the study, the selection of the population to be studied, the instruments used for the collection of data, and the method of data analysis.

Design

An ex-post-factor design was selected for the study. This design involves descriptive research in one or more of several categories including survey studies, interrelationship studies, and developmental studies. This research problem was conducted in the form of a survey. Descriptive research conducted by the survey method is useful to describe current practices and conditions, point out competencies and behavioral traits, and show short term trends.

The study was of the ex-post-facto design and of a descriptive nature. The study was conducted by survey. An open-form questionnaire was used for educational institutions while a combination open-form--closed-form questionnaire was selected for use with industry.

The Procedure

After defining the problem with which the study was to be concerned, a review of published literature related to technician education was conducted to promote a better understanding of this facet of education. Particular emphasis was given to engineering technician curricula to insure that the curricula pertinent to the study then being offered at Tulsa Junior College were adequate.

The population for the study was two-fold. The population for the supply aspect of the study was composed of all Oklahoma educational institutions within a one-hundred mile radius of Tulsa which offered technician education programs at the time and which were state supported. The following eight institutions were identified: (1) Eastern Oklahoma State College, (2) Northern Oklahoma College, (3) Northeastern Oklahoma A & M College, (4) Oklahoma State Tech, (5) Oklahoma State University Technical Institute, Oklahoma City, (6) Oklahoma State University Technical Institute, Stillwater, (7) Oscar Rose Junior College, and (8) Tulsa Junior College.

The population for the demand aspect of the study was made up of 150 selected industrial firms located in Tulsa County. The list of companies was formulated with the aid of the Manufacturer's Directory published by the Tulsa Chamber of Commerce and the telephone directory for metropolitan Tulsa. Eighty companies were selected from the Manufacturer's Directory according to their number of employees and products manufactured. A total of seventy-five companies were selected from the metropolitan Tulsa telephone directory. Approximately three companies were selected from each letter of the alphabet. Companies

were selected only if there was reason to believe the firm might employ engineering technicians.

The Instrument

After reviewing several research instruments and considering the purpose of the study and the population, an open-form questionnaire was selected for the educational institutions while a combination open-form, closed-form questionnaire was selected for industry. While the closed-form questionnaire is easier for the respondent to fill out, and facilitiates tabulation and analysis, it was felt data received from open-form questionnaires would be more useful. Both questionnaires were pre-tested with the aid of faculty members of Tulsa Junior College. Revisions were made and the final form was constructed. A copy of the questionnaire for education institutions is found in Appendix B, while Appendix C shows a copy of the questionnaire mailed to industry.

Letters of transmittal were formulated which explained the purpose and significance of the study. Each person in the educational population was mailed an individually addressed letter, a copy of the questionnaire, and a stamped, self-addressed envelope in which to return the completed questionnaire. Each person in the industrial population was mailed a copy of the questionnaire, and a stamped, self-addressed envelope in which to return the completed questionnaire. No letterhead stationary was used to avoid biasing the data.

Method of Analysis

The primary methods of analysis of data were: the study of past trends showing changes in the number of engineering technicians employed in the selected companies, the ratio of engineers and scientists to engineering technicians, changes in total employment by the companies, and trends in pertinent educational institutions with regard to total technical enrollment, number of graduates, and geographical areas of employment. The data were described both qualitatively and quantitatively.

CHAPTER IV

PRESENTATION AND ANALYSIS OF DATA

The purpose of this chapter is to present and analyze the data received concerning supply and demand of engineering technicians. The data is presented in two parts--the data from the educational institutions which are potential suppliers of engineering technicians for Tulsa industries, and the data from the industries which represent the demand aspect of the study.

Background Information

Supply Aspect of the Study

Data was obtained on the potential supply of engineering technicians for Tulsa industry by mailing a questionnaire to Oklahoma state financed educational institutions with post secondary technician education programs within an 100-mile radius of Tulsa and which had technician graduates prior to August, 1973. Eight institutions were identified. The location of each is shown on the map in Figure 2. These institutions were viewed as being the primary sources of associate degree engineering technicians for Tulsa industry. The types of educational institutions included in the study were: five junior colleges, two technical institutes, and one trade-technical school.

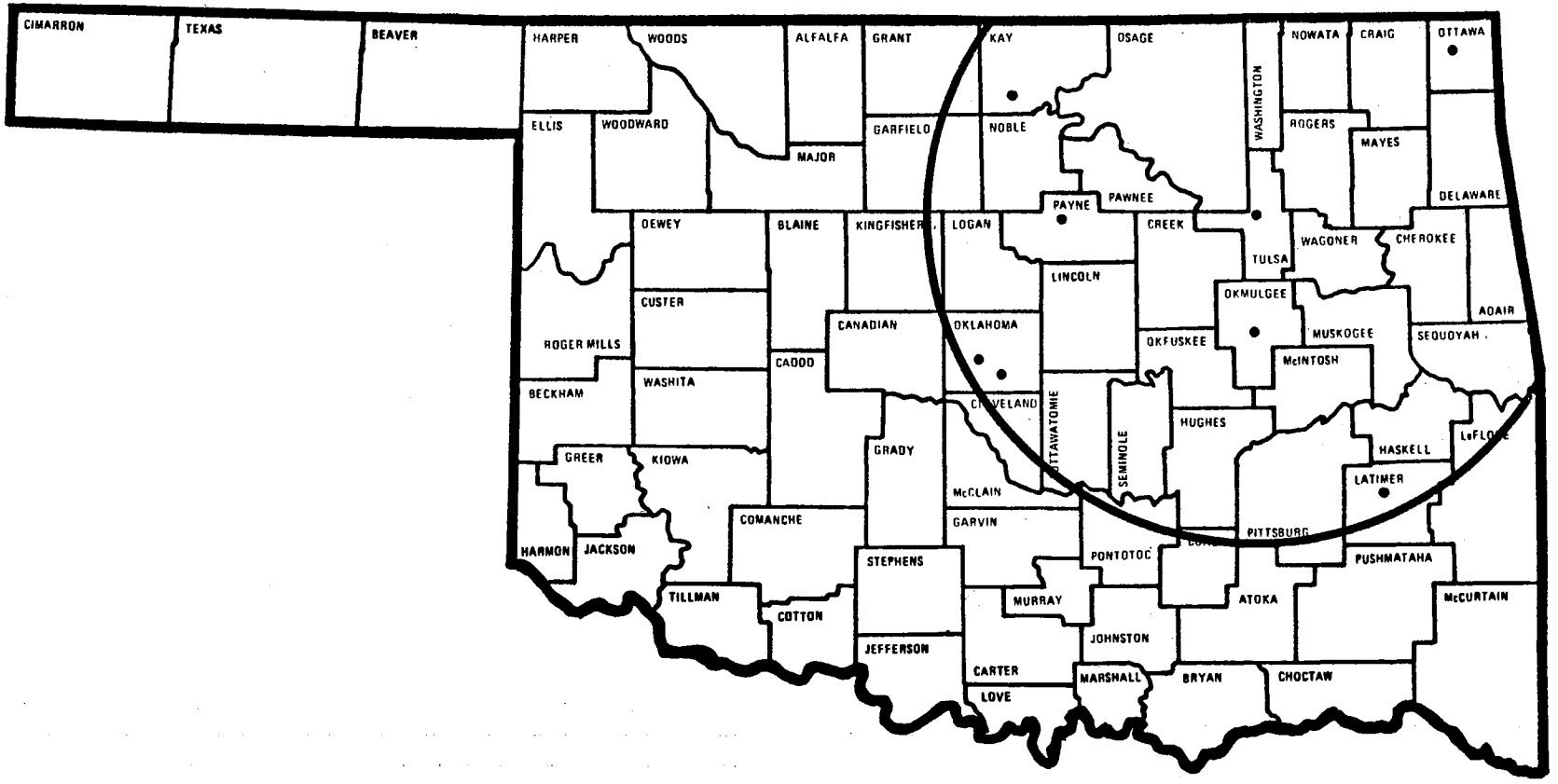

Figure 2. Location of Eight Schools Comprising the Supply Population of the Study

Demand Aspect of the Study

Data was obtained on the need for engineering technicians by Tulsa industry by formulating a list of 150 companies in Tulsa County with the aid of the Manufacturer's Directory published by the Tulsa Chamber of Commerce and the telephone directory for metropolitan Tulsa. Eighty companies were selected from the Manufacturer's Directory according to their number of employees. Table I lists the number of companies selected according to size. The selection was not intended to be a random selection. Companies were selected because it was believed the company might employ engineering technicians because of the type products manufactured, company production by automation, or automated equipment such as numerical control equipment used in production.

TABLE I

NUMBER OF MANUFACTURING COMPANIES SELECTED VERSUS NUMBER PERSONS EMPLOYED BY COMPANIES

No. of Employees	No. Companies Selected
0-25	10
26-50	10
51-100	10
101-200	15
201-350	10
351-500	10
501-1000	10
over 1000	5

A total of seventy-five companies were selected from the telephone directory for metropolitan Tulsa. Again, companies were selected because of the belief that the company might employ engineering technicians. Appendix A is an alphabetical list of the 150 companies selected. Eighty-eight companies or 58.6 per cent of the companies returned the questionnaire.

Analysis of Research Questions for Post Secondary Schools

Question 1

In which of the following programs is an associate degree offered at your institution?

(a) Electronics technology

(b) Electromechanical technology

(c) Instrumentation technology

The data in Table II was received from the seven respondants with regard to the programs offered at their institutions.

TABLE II

ENGINEERING TECHNICAIN PROGRAMS VERSUS THE NUMBER OF INSTITUTIONS OFFERING EACH PROGRAM

Program	No. Schools Offering Programs
Electronics technology	7
Electromechanical technology	4
Instrumentation technology	2

Question 2

At the beginning of the 1973-74 school year how many students at your institution indicated plans to major in one of the following programs?

(a) Electronics technology

(b) Electromechanical technology

(c) Instrumentation technology

The data in Table III tabulated the information received from the respondants. The data shows that 93.5 per cent of the total enrollment in the programs studied are in electronics technology.

TABLE III

ENGINEERING TECHNICIAN PROGRAMS VERSUS THE TOTAL NUMBER OF STUDENTS IN EACH PROGRAM

Program	No. of Enrollees
Electronics technology	475
Electromechanical technology	30
Instrumentation technology	3

Question 3

How many second year students do you have in each of the following programs?

(a) Electronics technology

(b) Electromechanical technology

(c) Instrumentation technology

The data in Table IV tabulates the information received from the respondants. The data shows that 97.3 per cent of the second year students in the programs of interest at the institutions studied are majoring in electronics technology.

TABLE IV

ENGINEERING TECHNICIAN PROGRAMS VERSUS THE TOTAL NUMBER OF SECOND YEAR STUDENTS IN EACH PROGRAM

Program	No. Second Year Students
Electronics technology	286
Electromechanical technology	8
Instrumentation technology	0

Question 4

How many graduates do you expect to have in May, 1974 in each of the following programs?

(a) Electronics technology

(b) Electromechanical technology

(c) Instrumentation technology

The data in Table V tabulates the information received from the respondants. The data shows that 94.5 per cent of the students expected to graduate from the programs of interest are electronics technology majors.

TABLE V

ENGINEERING TECHNICIAN PROGRAMS VERSUS THE TOTAL NUMBER OF STUDENTS EXPECTED TO GRADUATE FROM EACH PROGRAM IN MAY, 1974

Program	No. of Graduates
Electronics technology	137
Electromechanical technology	8
Instrumentation technology	0

Question 5

How many graduates have you had in each of the following programs each year for the past three years?

(a) Electronics technology

(b) Electromechanical technology

(c) Instrumentation technology

The data in Table VI tabulates the information received from the respondants. The data shows that 94.5 per cent of the total number of graduates from the programs of interest during the past

three years were electronics technology majors.

TABLE VI

ENGINEERING TECHNICIAN PROGRAMS VERSUS THE TOTAL NUMBER OF GRADUATES FROM EACH PROGRAM DURING EACH OF THE PAST THREE YEARS

Program	Number of Graduates		
	1970-71	1971-72	1972-73
Electronics technology	123	141	126
Electromechanical technology	1	12	8
Instrumentation technology	0	0	1

Question 6

How many of your graduates have accepted employment offers with companies in Tulsa county at the time of graduation in each of the following programs for the past three years?

(a) Electronics technology

(b) Electromechanical technology

(c) Instrumentation technology

The data in Table VII tabulates the information received from the respondants. The respondants stated the data supplied was approximate numbers. The data shows that 26.5 per cent of the total number graduating from the programs of interest during the past three years accepted employment offers with companies in Tulsa at the time of

graduation.

TABLE VII

ENGINEERING TECHNICIAN PROGRAMS VERSUS THE NUMBER OF GRADUATES OF EACH PROGRAM DURING THE PAST THREE YEARS WHICH HAVE ACCEPTED EMPLOYMENT IN TULSA AT THE TIME OF GRADUATION

Program	No. of Graduates		
	1970-71	1971-72	1972-73
Electronics technology	33	37	31
Electromechanical technology	0	3	4
Instrumentation technology	0	0	1

Question 7

How many of your graduates have accepted employment offers with companies in Oklahoma City in each of the following programs for each of the past three years?

(a) Electronics technology

(b) Electromechanical technology

(c) Instrumentation technoloty

The data in Table VIII tabulates the information received from the respondants. The respondants stated the data supplied was approximate numbers. The data shows that 47 per cent of the total number

graduating from the programs of interest during the past three years accepted employment offers with companies in Oklahoma City at the time of graduation.

TABLE VIII

ENGINEERING TECHNICIAN PROGRAMS VERSUS THE NUMBER OF GRADUATES OF EACH PROGRAM DURING EACH OF THE PAST THREE YEARS WHICH HAVE ACCEPTED EMPLOYMENT IN OKLAHOMA CITY AT THE TIME OF GRADUATION

Program	No. of Graduates		
	1970-71	1971-72	1972-73
Electronics technology	59	72	58
Electromechanical technology	0	3	2
Instrumentation technology	0	0	0

Question 8

How many of your graduates have accepted employment offers with companies in Oklahoma, but outside of Oklahoma City and Tulsa, in each of the following programs for the past three years?

(a) Electronics technology

(b) Electromechanical technology

(c) Instrumentation technology

The data in Table IX tabulates the information received from the respondants. The respondants stated the data supplied was approximate. The data shows that 10 per cent of the total number graduating from the programs of interest during the past three years accepted employment in Oklahoma, but outside Oklahoma City and Tulsa, at the time of graduation.

TABLE IX

ENGINEERING TECHNICIAN PROGRAMS VERSUS THE NUMBER OF GRADUATES OF EACH PROGRAM DURING EACH OF THE PAST THREE YEARS WHICH HAVE ACCEPTED EMPLOYMENT IN OKLAHOMA, BUT OUTSIDE OKLAHOMA CITY AND TULSA, AT THE TIME OF GRADUATION

Program	No. of Graduates		
	1970-71	1971-72	1972-73
Electronics technology	13	11	11
Electromechanical technology	1	5	0
Instrumentation technology	0	0	0

Question 9

How many of your graduates have accepted employment offers with companies in other states in each of the following programs for the past three years?

(a) Electronics technology

(b) Electromechanical technology

(c) Instrumentation technology

The data in Table X tabulates the information received from the respondants. The respondants state the data supplied was approximate. The data shows that 16.5 per cent of the total number graduating from the programs of interest during the past three years accepted employment outside Oklahoma at the time of graduation.

TABLE X

ENGINEERING TECHNICIAN PROGRAMS VERSUS THE NUMBER OF GRADUATES OF EACH PROGRAM DURING EACH OF THE PAST THREE YEARS WHICH HAVE ACCEPTED EMPLOYMENT OUTSIDE OKLAHOMA AT THE TIME OF GRADUATION

Program	No. of Graduates		
	1970-71	1971-72	1972-73
Electronics technology	19	21	26
Electromechanical technology	0	1	2
Instrumentation technology	0	0	0

Question 10

What percentage of the total combined 1972 graduates in Electronics, Electromechanical, and Instrumentation technology graduated from

a high school in the city in which your institution is located?

The data received indicated that approximately 50 per cent of the students at the institutions in Oklahoma City and Tulsa were graduates of local high schools while less than 10 per cent of the students at the remaining institutions were graduates of their local high schools.

Analysis of Research Questions for Industry

Question 1

Does your company have persons classified as engineering technicians on their payroll?

Data received from the respondants shows that companies ranging in size from less than 25 employees to over 1,000 employees employ engineering technicians. Table XI tabulates the data received with regard to company size, number of companies responding, and number of companies employing engineering technicians. The data shows that fewer of the selected companies ranging in size from 101 to 250 employees use engineering technicians.

TABLE XI

NUMBER OF COMPANIES WHICH EMPLOY ENGINEERING TECHNICIANS VERSUS COMPANY SIZE

No. of Employees	No. of Companies Responding	No. Companies Employing Technicians
0-25	25	13
26-50	8	4
51-100	7	4
101-250	23	6
251-500	8	3
501-1000	12	6
over 1000	5	3

Question 2

If your company does not hire graduates of two-year electronics, electromechanical, and instrumentation programs, please indicate why.

Data received from respondants as to why they do not employ engineering technicians is tabulated in Table XII. Of the selected companies responding in the negative with regard to employment of engineering technicians, 63 per cent stated it was because their company had no technical work in the areas of interest.

TABLE XII

RESPONSES OF SOME OF THE SELECTED COMPANIES AS TO WHY THEY DO NOT EMPLOY ENGINEERING TECHNICIANS

Reason	Number Responses
No work in these areas	27
No job classification between engineers and craftsmen	6
Not familiar with abilities of technicians	2
All technical jobs performed by engineers	4
Starting pay for technicians too high	0
Other	4

Question 3

If you indicated in question 2 that you were not familiar with the abilities of engineering technicians would you like to receive information concerning their abilities?

Although only two companies gave this as their reason for not employing engineering technicians, these two companies plus seven others requested information on engineering technicians.

Question 4

If your company does not presently hire engineering technicians, do you anticipate that they might in the future?

Data received from the respondants regarding possible future employment of engineering technicians is tabulated in Table XIII. The data shows that 41 per cent of the companies which do not presently employ engineering technicians stated that they may do so in the future.

TABLE XIII

RESPONSE OF COMPANIES WITH REGARD TO THE POSSIBILITY OF FUTURE EMPLOYMENT OF ENGINEERING TECHNICIANS

Statement	No. Responses
Yes	8
No	20
Perhaps	11
Don't know	7

Question 5

Does your company have job classifications other than engineering technicians for which graduates of a two-year technician education program would be considered?

Data from the respondants with regard to consideration of employment of graduates in jobs other than as engineering technicians shows that 48 companies have such job classifications while 24 do not. Sixteen companies did not respond to the question.

Question 6

How many persons are presently employed by your company in Tulsa or through your Tulsa offices?

The data in Table XI shows the number of companies which responded by size for all respondants. Of primary interest was the total combined employment of companies employing engineering technicians. There were 35 companies which employ engineering technicians that provided all the information requested. The total combined employment of these companies was 13,377.

Question 7

How many persons were employed five years ago? Two years ago?

The total employment for the 35 companies of interest five years ago was 10,651. Two years ago their total employment was 11,836. Figure 3 shows a graph of the number of employees versus time from 1969 to 1974. The graph is extropolated to 1979 by continuing the graph for five years with the slope noted in 1974. Assuming the ratio

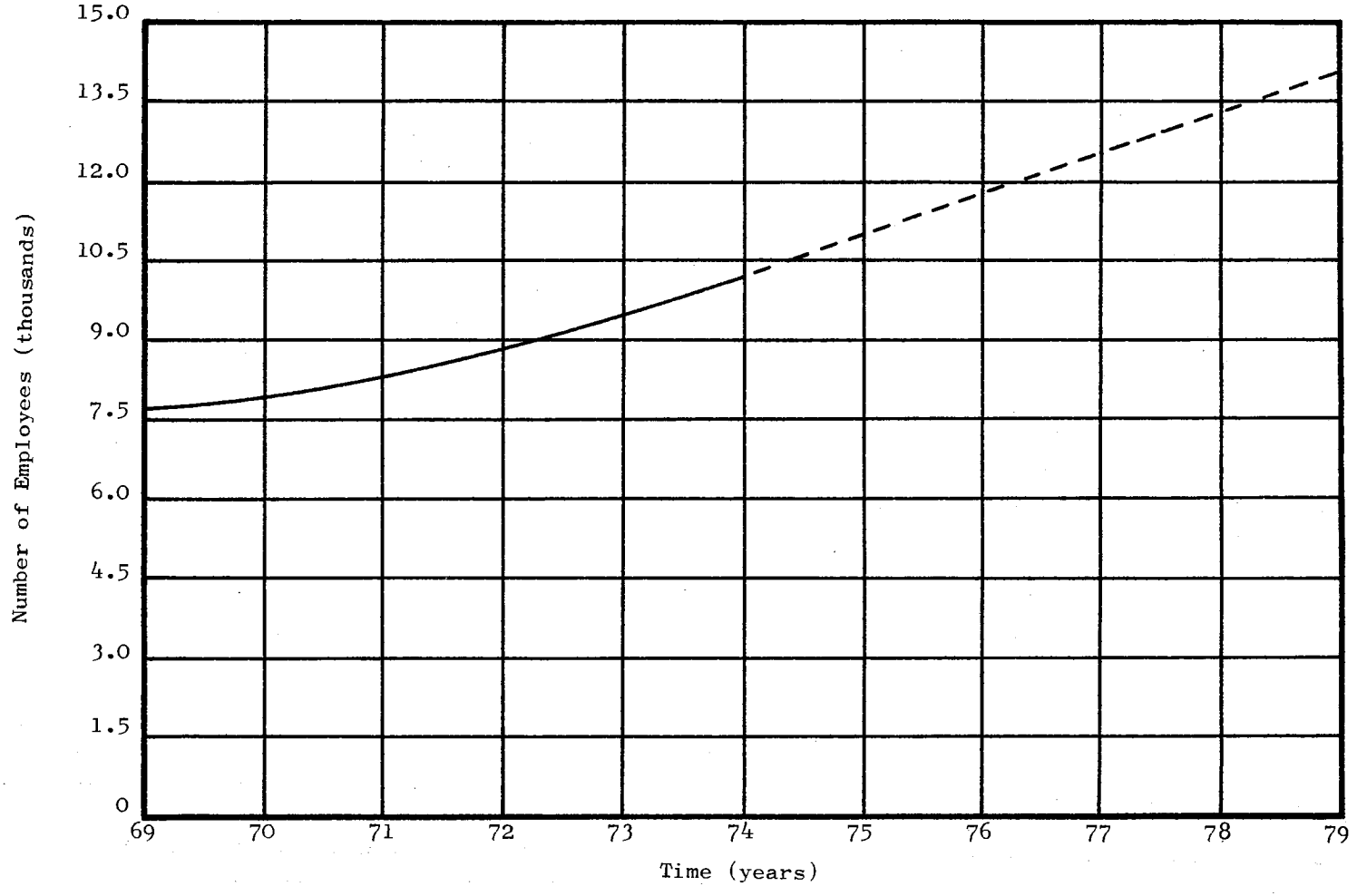

Figure 3. Total Employment of Respondants which Employ Engineering Technicians

of technical employment to total employment remains constant, the need for engineering technicians should increase over the next five years.

Question 8

How many of the following types of engineering technicians does your company presently employ? Electronics _____, Electromechanical _____, Instrumentation _____.

The companies which indicate they presently employ engineering technicians stated that there are 1320 engineering technicians presently on their payroll. Table XIV shows the number of technicians versus the types of industries responding. The data shows that 80 per cent of the engineering technicians presently employed by the selected companies are electronics technicians. The data also shows that 51 per cent of the engineering technicians presently employed are employed by manufacturing firms.

TABLE XIV

TYPES OF INDUSTRIES VERSUS THE NUMBER OF ENGINEERING TECHNICIANS EMPLOYED BY EACH TYPE INDUSTRY

Type Industry	Electronics	Electromechanical	Instru.	Total
Manufacturing	574	52	54	680
Sales and Service	118	95	6	219
Public Utilities	57	0	24	81
Federal Government	3	0	0	3
State & Local Government	6	0	0	6
Oil Related	283	20	10	313
Other	18	0	0	18
Total	1059	167	94	1320

Question 9

How many engineers or scientists are presently employed by your company in Tulsa or through your Tulsa division?

The respondants stated there are 1706 engineers or scientists presently employed in Tulsa or through their Tulsa division.

Question 10

How many engineers or scientists were employed five years ago? _____ Two years ago? _____

The respondants stated there were 1622 engineers or scientists employed by their company two years ago and 1529 employed five years ago. Table XV tabulates the data received on questions 9 and 10 along with the percentage of the total work force made up of engineers or scientists for the companies supplying the data.

TABLE XV

NUMBER OF ENGINEERS OR SCIENTISTS EMPLOYED BY RESPONDING COMPANIES AND THE PER CENT OF THE WORK FORCE THEY REPRESENT WITHIN THE COMPANIES

Time	No. Engineers or Scientists	Per Cent of Work Force
Present	1706	12.75
2 years ago	1622	13.70
5 years ago	1529	14.35

Question 11

How many skilled craftsmen are presently employed by your company in Tulsa or through your Tulsa division?

The respondants stated there were 1685 skilled craftsmen employed by their companies at the time of the survey.

Question 12

How many skilled craftsmen were employed by your company five years ago? _____ Two years ago? _____

The respondants stated that there were 1549 skilled craftsmen employed by their company two years ago while 1443 skilled craftsmen were employed five years ago. Table XVI tabulates the data received on questions 11 and 12 along with the percentage of the total employees of the companies responding which were skilled craftsmen.

TABLE XVI

NUMBER OF SKILLED CRAFTSMEN EMPLOYED BY RESPONDING COMPANIES AND THE PER CENT OF THE WORK FORCE THEY REPRESENT WITHIN THE COMPANIES

Time	No. Skilled Craftsmen	Per Cent of Work Force
Present	1685	12.6
2 years ago	1549	14.3
5 years ago	1446	13.6

Question 13

What is the major activity of your company?

Table XVII shows the number of companies in each of nine categories which responded to the questionnaire and the number of companies in each category which employ engineering technicians.

TABLE XVII

NUMBER OF COMPANIES IN NINE CATEGORIES WHICH EMPLOY ENGINEERING TECHNICIANS

Major Activity	No. Companies Responding	No. Companies Employing Technicians
Construction	0	0
Federal Government	1	1
Manufacturing	43	17
Mining	0	0
Public Utilities	3	2
Sales and Service	17	12
State and Local Government	2	1
Oil Related	6	2
Other	14	3

Question 14

What is the major source of engineering technicians for your company?

Table XVIII lists ten sources of engineering technicians and the number of companies which indicated each as a major source of engineering technicians which they employ. The data shows that technical institutes and newspaper advertisements accounted for 41 per cent of the respondants sources of engineering technicians while junior colleges provide only six per cent.

TABLE XVIII

MAJOR SOURCES OF ENGINEERING TECHNICIANS FOR SELECTED INDUSTRIES

Sources	No. Responses
Military	9
State Employment	9
Private Employment Agency	5
Junior Colleges	5
Technical Institutes	20
Four-Year Colleges and Universities	4
In-Plant Promotions	8
Newspaper Advertisements	14
Walk-Ins	6
Other Sources	3

Question 15

Of the total number of engineering technicians employed by your company, how many are graduates of a two-year technician education program?

The respondants stated that approximately 380 of the engineering technicians employed by them were graduates of a two-year technician education program. This represents 29.2 per cent of the persons who are employed as engineering technicians.

Question 16

What percentage of the engineering technicians employed by your company work directly with engineers or scientists?

The respondants stated that an average of 57 per cent of the engineering technicians worked directly with engineers or scientists. The percentages ranged from 0 per cent to 100 per cent according to the type company. The data is tabulated in Table XIX.

TABLE XIX

PERCENTAGE OF ENGINEERING TECHNICIANS THAT WORK DIRECTLY WITH ENGINEERS OR SCIENTISTS IN THE DIFFERENT TYPE INDUSTRIES WITHIN THE 150 SELECTED INDUSTRIAL FIRMS

Per Cent of Time	No. Companies Responding by Activity Classification					
	Oil Related	Mfg.	Sales&Serv.	Fed. Gov.	Pub. Util.	Other
0%	1	2	7	0	0	0
30%	1	1	1	0	0	0
50%	0	2	0	0	0	0
70%	0	0	0	0	0	2
80%	0	1	0	0	2	0
100%	0	9	2	1	1	1

Question 17

Would an engineering technician employed by your company be required to join a Union?

Out of the thirty-five companies of interest, one responded "yes," two responded "perhaps," and thirty-two responded "no" with regard to Union affiliation.

Question 18

How many graduates of the following two-year technician education programs do you anticipate hiring over the next five-year period?

The respondants stated that over the next five years they anticipated hiring a total of 733 electronics, electromechanical and instrumentation technicians. Table XX shows the number of engineering technicians needed per year by Tulsa industry for the period 1974 through 1978.

TABLE XX

ESTIMATED NUMBER OF ENGINEERING TECHNICIANS NEEDED BY SELECTED INDUSTRIES IN TULSA FROM 1974 THROUGH 1978

	1974	1975	1976	1977	1978	Total
Electronics	95	96	105	113	118	523
Electromechanical	21	23	25	27	29	125
Instrumentation	13	16	16	17	19	79
Total	128	135	146	157	166	727

Question 19

Indicate below what relationship your company has had with the following schools. If you have had no relationship with any of these schools, please indicate this.

The data received is tabulated in Table XXI which shows the number of companies which responded to each question. Twelve companies stated they had no relationship with any of the schools.

TABLE XXI

INTERACTION BETWEEN SCHOOLS AND SELECTED INDUSTRIES REGARDING ENGINEERING TECHNICIAN PROGRAMS AND GRADUATES

INSTITUTION	Received information about their technical programs	Received inquiries about employment possibilities from their graduating technicians	Employed their technical students part-time during school year or summer	Sent a representative to interview and recruit graduating technicians	Made job offers to graduating technicians	Hired graduating technicians
Tulsa Junior College Tulsa	10	8		2		1
OSU Technical Institute Oklahoma City	7	5	2	3	2	3
Oscar Rose Junior College Midwest City	2	1			1	
Oklahoma State Tech Okmulgee	14	13	7	9	12	19
Northeastern Oklahoma A&M, Miami	7	6	3	2	5	5
Eastern Oklahoma A&M Wilburton	7	4	3	3	4	3
OSU Technical Institute Stillwater	12	10	6	5	10	12
Northern Okla. College Tonkawa	5	3	1	2	3	3

Question 20

Has your company hired engineering technicians from schools other than those listed in question 19?

The data supplied by the respondants is shown in Table XXII.

TABLE XXII

RESPONSES FROM SELECTED INDUSTRIES REGARDING EMPLOYMENT OF ENGINEERING TECHNICIANS FROM SCHOOLS OUTSIDE THE SUPPLY POPULATION

Response	Number Responding
Yes, other schools in Oklahoma	12
Yes, schools outside Oklahoma	16
No	10
No response to question	7

Question 21

Approximately how much per month would an engineering technician initially earn with your company?

The data supplied by the respondants is shown in Table XXIII. All of the respondants stated that an engineering technician would start at a salary of $500 or more per month. Eighty-five per cent of the respondants indicated the starting salary would range between $500 and $700 per month.

TABLE XXIII

RANGE OF STARTING SALARIES FOR ENGINEERING TECHNICIANS WITHIN THE SELECTED INDUSTRIES

Starting Salary	Number of Companies Responding
Less than $500	0
$500 to $600	20
$600 to $700	14
Over $700	6

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

The problem with which this study was concerned was the supply and demand of engineering technicians for industry in Tulsa County. The supply aspect of the study involved eight state supported educational institutions located within a one-hundred mile radius of Tulsa and which offered post secondary technician education. The demand aspect of the study involved 150 selected industrial firms located in Tulsa County.

Summary

The purpose of the study was to determine the number of electronics, electromechanical, and instrumentation technicians presently employed by Tulsa industry as well as to investigate the potential supply of engineering technicians for Tulsa industry. And the present and future needs for engineering technicians for Tulsa industry. The study was designed to answer the following questions.

1. Does Tulsa industry presently employ engineering technicians? If so, how many are employed by selected industries?
2. How many new engineering technicians will be employed by Tulsa industry each year for the next five years?

3. Will graduating engineering technicians have a choice available to them as to the type industry with which they wish to seek employment within the selected industries.
4. Will graduating engineering technicians have a choice available to them as to the size industry with which they wish to seek employment within the selected industries?
5. Is there a sufficient number of engineering technicians being educated by schools within a 100-mile radius of Tulsa to meet the needs of local industry?
6. What percentage of the total number of engineering technicians available are apt to seek, or find, employment in Tulsa?

The design of the study was ex-post-facto and of a descriptive nature. Data was received through the use of self-administered questionnaires. Questionnaires, developed for both educational institutions and industry, were mailed and collected during the fall semester of the 1973-74 school year. Data received was expressed in both quantitative and qualitative form.

Limitations

In descriptive research there are certain limitations that should be considered when analyzing or interpreting the results of this type of study. Descriptive research may be useful in spotting trends, describing specific conditions and practices which may exist, detecting weaknesses, and evaluating relationships; however, the accuracy of the analysis is limited by the ability of the researcher to critically examine source materials, to make clear the technical terminology used in gathering and presenting data, to make observations,

and to make predictions.

Conclusions

Answer to six research questions were sought in this study. After analyzing the data presented in Chapter IV, the following conclusions were drawn. The research question will be stated first, followed by the summary and conclusion.

Research Question One: Does Tulsa industry presently employ engineering technicians? If so, how many are employed by selected industries?

Summary and Conclusion: Of the eighty-eight companies which responded to the questionnaires, thirty-nine (26 per cent) stated that they employed engineering technicians. Thirty-five companies provided the information requested. These thirty-five companies stated that they employ 1320 engineering technicians which represents 9.90 per cent of the total employment of these thirty-five companies. These same companies stated they employ 1706 engineers and scientists. This represents an 0.774 to 1 ratio of technical to engineering and scientific personnel. The ratio nationally was 0.7 to 1 technical to engineering and scientific personnel. It was concluded that industry in Tulsa County employs engineering technicians at or above the national ratio of technical personnel to engineering and scientific personnel.

Research Question Two: How many engineering technicians will be employed by Tulsa industry each year for the next five years?

Summary and Conclusion: Thirty-five of the thirty-nine companies returning the questionnaire and replying in the affirmative regarding

employment of engineering technicians responded to this question. These thirty-five companies stated they would need a total of 727 engineering technicians over the next five years. Of this total, 523 electronics technicians, 125 electromechanical technicians, and 79 instrumentation technicians will be needed. The total number of electronics, electromechanical, and instrumentation technicians needed per year was as follows: 1974--129 total, 1975--135 total, 1976--146 total, 1977--157 total, 1978--166 total. It was concluded that without making any predictions beyond the data supplied by respondants to the questionnaire a large number of engineering technicians will be employed by Tulsa industry over the next five-year period.

Research Question Three: Will graduating engineering technicians have a choice available to them as to the type industry with which they wish to seek employment within the selected industries?

Summary and Conclusion: The data supplied by the respondants shows that seven of the nine categories of industries studied employed engineering technicians. Approximately 71 per cent of the sales and service organizations which responded stated that they employed engineering technicians, however, this represented only 16.7 per cent of the 1320 engineering technicians employed by the selected industries. The major employers of engineering technicians in Tulsa were manufacturing firms which employed 51.5 per cent of the total number of engineering technicians employed by the selected industries. The remainder were employed by oil related industries (23.9 per cent), public utilities (6.2 per cent), federal, state, and local government (0.7 per cent), and the remaining 1 per cent by all other industries responding. It was concluded that virtually all the types of

industries included in the 150 selected industries employed engineering technicians, therefore, graduating engineering technicians should have a wide range of employment possibilities open to them.

Research Question Four: Will graduating engineering technicians have a choice available to them as to the size industry with which they wish to seek employment within the selected industries?

Summary and Conclusion: The information received from the respondants showed that all sizes of facilities from those with fewer than twenty-five employees to those with over 1000 employees, utilize engineering technicians. The data showed that a greater per cent of the facilities with fewer than twenty-five or more than 1000 employees used engineering technicians while a lower percentage of the facilities with from 101 to 250 employees used engineering technicians. It was concluded that facilities of all sizes employed engineering technicians. The size facility one seeks employment with would therefore be a matter of personal preference.

Research Question Five: Is there a sufficient number of engineering technicians being educated by schools within a 100-mile radius of Tulsa to meet the demands of local industry?

Summary and Conclusions: The schools which responded to the questionnaire stated that they expected to have a total of 145 engineering technicians graduating in May, 1974. Of this total, 137 will be electronics technicians and 8 will be electromechanical technicians. There will be no instrumentation technicians graduating. The Tulsa industries which responded to the questionnaire stated that they would need a total of 129 engineering technicians during 1974. Of this total, 95 will be electronics technicians, 21 will be electromechanical

technicians, and 13 will be instrumentation technicians. It was concluded that 89 per cent of all the engineering technician graduates of the responding schools would be required to meet the needs of the Tulsa industries which responded. Considering each technology separate, 69 per cent of all the electronics technology graduates would be required to meet local needs, while there will not be a sufficient number of electromechanical or instrumentation technician graduates to meet local needs.

Research Question Six: What percentage of the total number of engineering technicians available are apt to seek, or find, employment in Tulsa?

Summary and Conclusion: The information received from the responding schools showed that approximately 27 per cent of the total number of engineering technician graduates each year for the past three years had sought and found employment in Tulsa. There was no way to determine from this data whether a larger percentage than this actually sought but did not find employment in Tulsa. It was concluded that the employment pattern noted over the past three years will probably continue which means that only about 39 of the 145 graduating engineering technicians will seek, or find employment in Tulsa.

Recommendations

After a careful evaluation of the study the following recommendations are offered:

1. There are many opportunities for electronics, electromechanical, and instrumentation technicians in Tulsa County. It is recommended that interested schools work together, and with industry,

to provide industry with engineering technicians when manpower needs arise. Tulsa Junior College (TJC) receives a number of requests for engineering technicians which they are often unable to fulfill. If schools worked together, names of interested students at other schools could be furnished industry when TJC receives such requests.

2. Twelve of the responding industries stated that they had never had any contact with any of the schools included in the study. It is recommended that schools spend time interacting with industries, which are prospective employers of their graduates.

3. With regard to the question asked of industry as to their major sources of engineering technicians, very few companies indicated that the junior college was one of their major sources. The junior colleges should spend time visiting industry to promote their engineering technician programs.

4. Tulsa firms should encourage promising employees presently on their payroll in positions less rewarding than their engineering technicians to enroll, at least on a part-time basis, in an associate degree engineering technician program.

5. With regard to the first recommendation regarding schools working together to supply engineering technicians when manpower needs arise, a study should be performed to determine if the level of the engineering technician programs at the various schools are comparable.

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APPENDIX A

ONE HUNDRED FIFTY SELECTED INDUSTRIES

IN TULSA COUNTY

A. B. Dick Co.

AHK Division of Kerr Glass

Abbott Heat Exchanger Corp.

Addressograph - Multigraph Corp.

Air-X-Changers

Amerada Hess Corp.

American Airlines

Amoco Production Co.

Armco Steel Corp.

Ashland Chemical Co.

Atlas Instruments and Mfg. Co.

Atkins and Merrill, Inc.

Autopilots Central, Inc.

Auto Crane Company

AVCO Electronics

Badger Meter, Inc.

Beverage Products Corp.

Borg-Warner Industrial Drives

Born Engineering Co.

Braden Industries

Braden Steel Corp.

Burrought Corp.

Burtek, Inc.

Byron Jackson Pump Dic.

Cardinal Instruments

Carnation Co.

C-E-In-Val Co.

C-E Natco

Center Line, Inc.

Century Electronics and Instruments

Chandler Engineering

Cities Service

City of Tulsa Personnel Dept.

Computek Computer Corp.

Computer Congererics Corp.

Con-Rad Division of U. S. Industries, Inc.

Continental Airlines

Control Data Corp.

Cooling Products, Inc.

County of Tulsa Personnel Dept.

Crane Carrier Co.

Crest Engineering

Cuno Division of A.M.F.

Curtin Scientific Co.

Custom Engineering and Mfg. Corp.

Data Systems Corp.

Dorsett Electronics, Inc.

Dover Corp.

Dow Chemical

Dresser Engineering

Ecodyne Corp.

Econo-Therm Corp.

FWI, Inc.

Federated Metals Division of American Smelting and Refining Co.

Flint Steel Corp.

Flow Measurements Company, Inc.

Flow-Quip Company

Ford Glass Plant

Fram Corp.

General Electric Medical Systems

Geophysical Research Corp.

Gulf Oil Corp.

Hammond Organ Studios of Tulsa

Honeywell, Inc.

IBM Corp.

Ideal Specialty Co.

Interstate Electric Corp.

John Zink Co.

KRMG Radio

KTEW Television

Kaiser Magnesium

Kennedy Engineering

Klockner Moeller Corp.

Knight Industries, Inc.

LVO Corp.

Labarge, Inc.

Lee G. Moore Corp.

Leeds and Northrup Co.

Linde Division of Union Carbide

Lowrance Electronics Mfg. Corp.

Lucas Controls

Magaelectric Corp.

Malony-Crawford Corp.

Maxco, Inc.

McClain Mfg. Co.

McDonnell Douglas Corp.

McKesson Chemical Co.

Meadow Gold Dairies

Medco Products Co.

Memorex

Mentor Corp.

Metropolitan Life Insurance Co.

Midwestern Instruments

Mobile Oil Corp.

Mohawk Data Systems

Myers-Aubrey Co.

National Cash Register Co.

Nelson Electric Division of Sola Basic Industries

Newspaper Printing Corp.

Oil Dynamics, Inc.

Oklahoma Natural Gas

Oklahoma Steel Casting Co.

Patterson Steel Co.

Petroleum Publishing Co.

Power Electronics Mfg., Inc.

Precision Products and Controls, Inc.

Public Service Company of Oklahoma

RCA

Rainey Corp.

Remington Rand

Resources Science Corp.

Riverside Industries

Rockwell International

Rogers Galvanizing Co.

Ross-Martin Co.

SCM Corp.

Scam-Riley Instrument Corp.

Sears, Roebuck and Company

Seiscor Division of Seismograph Service Corp.

Shell Oil Co.

Slagle Manufacturing Corp.

Southwestern Bell Telephone Co.

Southwestern Controls

Sperry Rand Corp.

Sun Oil Co.

TK International

Telex Computer Products

Telstar Instrument Corp.

Terac Controls, Inc.

Tesco Engineering Co.

Texaco, Inc.

Thermal Engineering Co.

Thermodyne Products, Inc.

Tri-Ex Thermal Division of Zurn Industries

Tulsa Gauge and Instrument Co.

U. S. Corps of Engineers

Unit Rig and Equipment Co.

Univac Division of Sperry Rand

University Computing Co.

Vickers Tulsa Products Division

Warren Petroleum Co.

Webster Engineering

Welex

Western Supply Co.

Westinghouse Electric Corp.

Williams Companies

Worral Engineering

Xerox Corp.

Yuba Heat Transfer

Zebco

APPENDIX B

QUESTIONNAIRE FOR SCHOOLS

SUPPLY AND DEMAND OF ENGINEERING TECHNICIANS
(Electronics, Electromechanical, and Instrumentaion)

QUESTIONNAIRE FOR SCHOOLS

1. In which of the following programs is an associate degree offered at your institution?

   (a) Electronics technology _____

   (b) Electromechanical technology _____

   (c) Instrumentation technology _____

2. At the beginning of the 1973-74 school year how many students at your institution indicated plans to major in one of the following programs?

   (a) Electronics technology _____

   (b) Electromechanical technology _____

   (c) Instrumentation technology _____

3. How many second year students do you have in each of the following programs?

   (a) Electronics technology _____

   (b) Electromechanical technology _____

   (c) Instrumentation technology _____

4. How many graduates do you expect to have in May, 1974, in each of the following programs?

   (a) Electronics technology _____

   (b) Electromechanical technology _____

   (c) Instrumentation technology _____

5. How many graduates have you had in each of the following programs each year for the past three years?

	1970-71	1971-72	1972-73
(a) Electronics technology	_____	_____	_____
(b) Electromechanical technology	_____	_____	_____
(c) Instrumentation technology	_____	_____	_____

6. How many of your graduates have accepted employment offers with companies in Tulsa county at the time of graduation in each of the following programs for the past three years?

	1970-71	1971-72	1972-73
(a) Electronics technology	_____	_____	_____
(b) Electromechanical technology	_____	_____	_____
(c) Instrumentation technology	_____	_____	_____

7. How many of your graduates have accepted employment offers with companies in Oklahoma City in each of the following programs for the past three years?

	1970-71	1971-72	1972-73
(a) Electronics technology	_____	_____	_____
(b) Electromechanical technology	_____	_____	_____
(c) Instrumentation technology	_____	_____	_____

8. How many of your graduates have accepted employment offers with companies in Oklahoma, but outside of Oklahoma City and Tulsa, in each of the following programs for the past three years?

	1970-71	1971-72	1972-73
(a) Electronics technology	_____	_____	_____
(b) Electromechanical technology	_____	_____	_____
(c) Instrumentation technology	_____	_____	_____

9. How many of your graduates have accepted employment offers with companies in other states in each of the following programs for the past three years?

	1970-71	1971-72	1972-73
(a) Electronics technology	_____	_____	_____
(b) Electromechanical technology	_____	_____	_____
(c) Instrumentation technology	_____	_____	_____

10. What percentage of your total combined 1973 graduates in Electronics, Electromechanical, and Instrumentation technology graduated from a high school in the city in which your institution is located?

_____

APPENDIX C

QUESTIONNAIRE FOR SELECTED INDUSTRIES

SUPPLY AND DEMAND OF ENGINEERING TECHNICIANS
(Electronics, Electro-Mechanical, Instrumentation)

QUESTIONNAIRE

1. Does your company have persons classified as engineering technicians on their payroll?

   ( ) Yes ( ) No

2. If your company does NOT hire graduates of 2-year electronics, electromechanical, or instrumentation programs, please indicate why?

   ( ) A. The company has no work in these areas.

   ( ) B. Company organization does not have job classifications.

   ( ) C. We are not familiar with the abilities of engineering technicians.

   ( ) D. All technical jobs in our company are performed by engineers.

   ( ) E. Starting pay for graduates of 2-year technician programs is above our pay scale.

   ( ) F. Other (Please specify) _____

3. If you marked C on question 2, would you like to receive information on engineering technicians?

   ( ) Yes ( ) No ( ) Later, at our request

4. If your company does NOT presently hire engineering technicians, do you anticipate that they might in the future?

   ( ) Yes ( ) Perhaps

   ( ) No ( ) I don't know

5. Does your company have job classifications other than engineering technicians for which graduates of a 2-year technician program would be considered for employment?

   ( ) Yes ( ) No

6. How many persons are presently employed by your company in Tulsa or through your Tulsa division? _____

7. How many persons were employed 5 years ago? _____

   Two years ago? _____

If your answer to question 1 was "no", please stop at this point. Thank you for taking time to fill out this questionnaire.

8. How many of the following types of engineering technicians does your company presently employ?

   (a) Electronics _____

   (b) Electromechanical _____

   (c) Instrumentation _____

9. How many engineers or scientists are presently employed by your company in Tulsa or through your Tulsa division? _____

10. How many engineers or scientists were employed 5 years ago? _____

    Two years ago? _____

11. How many skilled craftsmen are presently employed by your company in Tulsa or through your Tulsa division? _____

12. How many skilled craftsmen were employed 5 years ago? _____

    Two years ago? _____

13. What is the major activity of your company?

    ( ) Construction
    ( ) Federal Government
    ( ) Manufacturing
    ( ) Mining
    ( ) Public Utilities
    ( ) Sales and Service
    ( ) State Government
    ( ) Trade
    ( ) Other (please specify) _____

    _____

14. What is the major source of technicians for your company?

( ) Military

( ) State Employment Office

( ) Private Employment Agencies

( ) Junior Colleges

( ) Technical Institutes

( ) Four-year Colleges and Universities

( ) In-plant promotions

( ) Newspaper advertisements

( ) Walk-ins

( ) Other sources (please specify) _____

_____

15. Of the total number of engineering technicians employed by your company, how many are graduates of a two-year education program? _____

16. What percentage of the engineering technicians in your company work directly with engineers or scientists? _____

17. Would an engineering technician employed by your company be required to join a union?

( ) Yes

( ) No

( ) Perhaps

18. How many graduates of two-year technician education programs do you anticipate hiring over the next five-year period?

	1974	1975	1976	1977	1978
Electronics					
Electromechanical					
Instrumentation					

19. Indicate below what relationship your company has had with the following schools. If you had has no relationship with any of them, please check here ( ).

INSTITUTION	Received information about their technical programs	Received inquiries about employment possibilities from their graduating technicians	Employed their technical students part-time during school year and summer	Sent a representative to interview and recruit graduating technicians	Made job offers to graduating technicians	Hired graduating technicians
Tulsa Junior College Tulsa						
OSU Technical Institute Oklahoma City						
Oscar Rose Junior College Midwest City						
Oklahoma State Tech Okmulgee						
Northeastern Oklahoma A&M Miami						
Eastern Oklahoma A&M Wilburton						
OSU Technical Institute Stillwater						
Northern Okla. College Tonkawa						

20. Has your company hired engineering technicians from schools other than those listed in question 19?

( ) Yes, other schools in Oklahoma

( ) Yes, schools outside of Oklahoma

( ) No

21. Approximately how much per month would an engineering technician initially earn with your company?

( ) Less than $500

( ) $500 - $600

( ) $600 - $700

( ) More than $700

APPENDIX D

TRANSMITTAL LETTER FOR SCHOOLS

Dear Mr. _____:

As a faculty member of Tulsa Junior College I talk regularly with technical students who express concern about employment prospects upon graduation from TJC. To ensure myself, the college, and our students that opportunities for employment do, in fact, exist in Tulsa I am doing a study entitled "Supply and Demand of Electronics, Electromechanical, and Instrumentation Technicians in Tulsa County" as my thesis.

In order that I might accurately determine the potential supply of engineering technicians for Tulsa industry I would very much appreciate a few minutes of your time to complete the enclosed questionnaire. For your convenience in returning the questionnaire a self-addressed, stamped envelope is enclosed.

Thank you very much for your cooperation.

Sincerely,

Larry Jones, Coordinator
Industrial Technologies
Tulsa Junior College

APPENDIX E

FOLLOW-UP LETTER FOR SCHOOLS

Dear Mr. _____:

Several weeks ago you received a questionnaire having to do with your electronics, electromechanical, and instrumentation technician programs. The response to the questionnaire has been very good for which I am certainly appreciative, however, a couple questionnaires have not been returned to date. If you have failed to return yours for some reason I would be most appreciative of a few minutes of your time to complete and return the questionnaire.

In the event you may have misplaced the earlier form, I am enclosing another along with a self-addressed stamped envelope. Thank you very much for your cooperation.

Sincerely,

Larry Jones, Coordinator
Industrial Technologies
Tulsa Junior College

APPENDIX F

TRANSMITTAL LETTER FOR SELECTED INDUSTRIES

August 22, 1973

Dear Sir:

As a faculty member of Tulsa Junior College, I work regularly with young people of Tulsa who are concerned with prospects for employment upon graduation. To satisfy myself, the college, and our students that employment opportunities for engineering technicians do in fact exist in Tulsa County, I am doing a research project entitled "Supply and Demand for Electronics, Electromechanical, and Instrumentation Technicians in Tulsa County" as my thesis.

The data will be of real value to TJC and a few minutes of your time to complete the attached questionnaire will be greatly appreciated. Information provided by you or others in completing the questionnaire will not be referred to by individuals or organizations in any form of communication.

For your convenience a self-addressed, stamped envelope is enclosed. Those organizations indicating a desire to do so will receive a summary of the study by including a return address.

Sincerely,

Larry Jones, Coordinator
Industrial Technology
Tulsa Junior College

LJ:mw

APPENDIX G

FOLLOW-UP LETTER FOR SELECTED INDUSTRIES

September 18, 1973

Dear Sir:

A few weeks ago I mailed a questionnaire to you concerning employment opportunities for engineering technicians in Tulsa County. I am very appreciative of the tremendous response to the questionnaire by local industry; however, there are still some questionnaires out. If you have, for some reason, failed to return yours, I would greatly appreciate a few minutes of your time to complete and return the questionnaire.

We at Tulsa Junior College are very excited with the challenge of meeting the tremendous needs in this field as indicated by local industry. Again, thank you for your cooperation with regard to the questionnaire.

Sincerely,

Larry Jones, Coordinator
Industrial--Technologies
Tulsa Junior College

LJ/nlk

VITA

Larry Dean Jones

Candidate for the Degree of

Master of Science

Thesis: A STUDY OF THE SUPPLY AND DEMAND OF ELECTRONICS, ELECTRO-MECHANICAL, AND INSTRUMENTATION TECHNICIANS OF SELECTED SCHOOLS AND INDUSTRIES

Major Field: Technical Education

Biographical:

Personal Data: Born in Perkins, Oklahoma, August 21, 1936, the son of Lyle and Maurine Jones.

Education: Graduated from Perkins High School, Perkins, Oklahoma, in May, 1954; received an Associate degree from Oklahoma State University with a major in Electronics Technology in May, 1962; received the Bachelor of Science degree from Oklahoma State University with a major in Technical Education in May, 1968; completed requirements for Master of Science degree in Technical Education in May, 1974.

Professional Organizations: Oklahoma Technical Society, Institute of Electrical and Electronic Engineers, Instrument Society of America.

Professional Experience: Electronics Technician, Los Alamos Scientific Laboratory, Los Alamos, New Mexico, 1962-1966; Electronics Technician, Research Foundation, Oklahoma State University, Stillwater, Oklahoma, 1966-1968; Electrical Engineer, McDonnell Douglas Corporation, Huntington Beach, California, 1968-1970; Electronics and Physics Instructor, Tulsa Junior College, Tulsa, Oklahoma 1970-1974.

Publications: Co-author of Mathematics for Technicians, Charles Merrill Publishing Company, Columbus, Ohio, February, 1974.