AN EVALUATION OF THE KANSAS TECHNICAL INSTITUTE CIVIL TECHNOLOGY PROGRAM

by

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Approved by:

Edwin C Smith
Major Professor

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PURPOSE

My relationship with Kansas Technical Institute (KTI) has provided me the opportunity of returning to school on a full-time basis to complete the requirements for a Master's Degree in Civil Engineering. Because of this and the fact that I will be resuming my duties at KTI following graduation, it is my desire that this report fulfill a dual purpose. First, it is a way of offering my thanks to KTI for this opportunity to grow intellectually and professionally. Secondly, I desire the contents of this report to be a set of guidelines which can be employed by myself and others in directing the future development and growth of the Civil Technology Department at KTI.

To fulfill the primary purpose of this report it has been necessary to evaluate the present Civil Technology program at KTI. This evaluation gave consideration to the relevance of curriculum content, the adequacy of laboratory facilities, student performance on national examinations and on the job, as well as the purpose and direction of the program as related to the needs of industry and the general public.

In addition to the material necessary for the fulfillment of its stated purpose, this report contains much information and numerous references which can be used to develop a better understanding of technical education. Working definitions of the various skill or knowledge levels within technical education are provided. The responsibilities of each member of an engineering team are given in an effort to clarify the misconceptions that are often held by the general public, as well as by many practicing engineers. Also, the standards which should be met by institutions involved in the various sectors of technical education are given as an additional means of clarifying roles within technology.

HISTORY OF KTI AND THE CIVIL TECHNOLOGY PROGRAM

The 1965 session of the Kansas Legislature enacted House Bill No. 1101, thereby establishing a state technical school at Salina, Kansas. It was to be known as the Schilling Institute with its programs to be housed in facilities formerly utilized by the United States Air Force.

House Bill No. 1101, later amended in 1968 by Senate Bill No. 670, defined technical education as it pertained to the Institute. It was to be "vocational or technical education and training or retraining which is given in or by Kansas Technical Institute and which is conducted as a program of education designed to educate and train individuals as technicians in recognized fields."(1) It went on to list possible programs that could be offered at the Institute but in no way restricted the Institute to the ones listed. Authorization was also given for the formulation of a "State technical plan" as deemed necessary "to plan and guide Kansas Technical Institute and programs offered thereby."(1) The amendment of House Bill No. 1101 in 1968 by Senate Bill No. 670 officially changed the name from Schilling Institute to Kansas Technical Institute (2).

The enabling legislation passed in 1965 provided the Institute with the freedom to offer courses of technical, vocational, or a combined nature. The latest revisions to the State technical plan have narrowed the educational range of Kansas Technical Institute. Its present mission is to provide "technical education and training in the fields of Engineering Technology, Science Technology and related fields. The principal mission of the Institute shall be the education of Technologists and Technicians in the general field of Engineering and Science. The mission of the Institute shall include programs approved by the Board of Regents and special institutes, seminars, short courses and workshops at appropriate locations in Kansas as approved by the Extension Officer of the Board of Regents."(3)

1977 marks the beginning of the twelfth year of existence for KTI and the Civil Technology program. The program has been under the guidance of three department heads during that time. Initially headed by Mr. Curt Bowie, the original curriculum was formulated and the laboratories equipped. Both were done with the future accreditation of the program by the Engineer's Council for Professional Development (ECPD) in mind. In 1968, Mr. Charles May became Department Head and during his six years with the school many modifications were made to the curriculum. Due to a lack of growth in student enrollment in the program, several early modifications were later reversed. Since my appointment as Head of the Department in January 1975, very few changes have been implemented. The reason for this has been primarily due to the soundness of the present curriculum, but partially because of my need for knowledge and understanding of the goals of technical education.

This lack of knowledge concerning technical education and the definitions involved with it is not uncommon. While technical education and all it encompasses may be clear to those working in that field, it is still poorly explained for the general public. The overlap of responsibilities and qualifications of individuals on the engineering team often puzzles both the prospective student and the potential employer of graduates from technical education programs. It is not always clear as to the level of knowledge or skill that separates the engineer, the technologist and the technician into distinct vocations. These are hurdles that Kansas Technical Institute and higher education in general are going to have to help the public overcome if its mission of educating and training technologists and technicians is to be accomplished successfully. Clear and precise definitions of each member of the engineering team must be transmitted to the public and to potential employers. These definitions should include the type and amount of education required by each team member, as well as the minimum employment qualifications required. The public must also be educated to the benefits of industry's efficient utilization of appropriate numbers of each group.

Such definitions are available and are presented in the following section. It is hoped that this collection of definitions relevant to technology and technical education can be helpful in transmitting to the public the scope of technical education and its many benefits.

TECHNICAL EDUCATION: DEFINITIONS

Before a study of any subject can be undertaken in any depth it is generally necessary to define important terms to provide a common base of knowledge. In this section are presented the most widely accepted definitions of the terms necessary for the development of a rudimentary understanding of technical education and its components. While this list is rather extensive, it is not offered as being complete and all inclusive of the terms relevant to the subject. It should also be remembered that many of the definitions presented are not static and, therefore, will need to be modified as technical education continues to develop.

Engineering: "The profession in which a knowledge of the mathematical and natural sciences gained by study, experience, and practice is applied with judgment to develop ways to utilize, economically, the materials and forces of nature for the benefit of mankind."(4)

Engineering technology: "That part of the technological field which requires the application of scientific and engineering knowledge and methods combined with technical skills in support of engineering activities; it lies in the occupational spectrum between the craftsman and the engineer at the end of the spectrum closest to the engineer."(4)

Engineer: "A person who, by reason of his or her special knowledge and use of the mathematical, physical, and engineering sciences and the principles and methods of engineering analysis and design, acquired by engineering education and engineering experience, is qualified to practice engineering. The engineer will normally have earned a baccalaureate degree in engineering and gained appropriate experience in the field."(4)

Engineering technologist: "A member of the engineering team who by reason of his or her knowledge and applications of the well established mathematical, physical science, engineering principles, and methods of technological problem solving, acquired by engineering technology education and engineering technology experience, is qualified to practice engineering technology. The engineering technologist will usually have earned a baccalaureate degree in engineering technology or gained considerable technical experience."(4)

Engineering technician: "A person who, in support of and under the technical direction of professional engineers, scientists, engineering technologists, or senior engineering technicians can carry out in a responsible manner either proven techniques which are common knowledge among those who are technically expert in a particular technology or those techniques especially prescribed by professional engineers which are mastered through considerable experience in the field or educational laboratory situations."(4)

Technical Institute: Educational institutions offering college level engineering type programs of two or more years in length which generally lead to an Associate or Baccalaureate degree in Engineering Technology.

Technical education: Education dealing with practical knowledge of a mechanical or scientific subject and characterized by specialized instruction of scientific principles.

Engineering Council for Professional Development: The agency recognized by the Institutional Eligibility Unit of the Office of Education of the Department of Health, Education, and Welfare as the accrediting agency for engineering and technology programs within educational institutions (5).

Regional Accrediting Association: One of six national associations whose major activity is the accreditation of the academic institution as a whole and whose membership consists of high schools and institutions of higher education which are accredited by the regional association (5).

Institute for the Certification of Engineering Technicians: The national body responsible for the certification of engineering technicians, founded in 1962 under the sponsorship of the National Society of Professional Engineers.

Basic Sciences: "Subjects including physics and chemistry as well as selected subjects from the areas of the life sciences and earth sciences. The objective of these courses is to acquire a fundamental knowledge about nature and its phenomena."(5)

Engineering Sciences: Subjects rooted in mathematics and basic sciences which bridge between the basic science and engineering practice (e.g. statics, dynamics, mechanics of materials, fluid mechanics, soil mechanics, etc.)(5).

Engineering Design: "The process of devising a system, component, or process to meet desired needs. It is a decision-making process, in which the basic sciences, mathematics, and engineering sciences are applied to convert resources optimally to meet a stated objective."(5)

Technical Sciences: Subjects taught in an engineering technology curriculum, covering the same general areas as engineering sciences but taught from a more applied approach and with a lower level of mathematics (5).

Technical Specialty: A general classification of technical courses within an engineering technology curriculum composed of three subdivisions: Technical skills and techniques, technical design, and technical electives (5).

TECHNICAL EDUCATION: THE ENGINEERING TEAM

"Engineering applications of science to practical problems have resulted in more new developments than in all prior history. Each American now has the equivalent of 70 mechanical slaves and the United States, with only 7 percent of the world's population leads in the production and consumption of the things which distinguish our present civilizations from earlier forms."(6) This rapid growth rate of new developments has placed increased demands on the engineer's time. He is being asked to spend more time in creative thinking and to give less time for laboratory work, detailed design, or project supervision. Much of the work that once required an engineer has now been reduced to a standard procedure. Complex technology has created a demand for skilled individuals, educated and trained in the practical application of engineering technology, to assist and supplement the engineer.

As these skilled individuals enter the labor force, they become an important part of what has been labeled "the engineering team." In its broadest sense it includes the research scientist, the engineer, the technologist, the technician and the craftsman. Our discussion will be limited to the middle three, as they constitute the teams dealing with most engineering projects (4).

The main objective of the engineering team concept is to provide the engineer time "to concentrate on engineering efforts by assigning repetitive, time-consuming tasks to specially trained/educated technicians." Much of the shortage of engineers in the past can be attributed to the shortage of qualified engineering technicians (7). Congress recognized the shortage of engineering technicians when it passed P.L. 88-204, the Higher Education Facilities Act of 1963. In it, twenty-two percent of the grants went for the construction of public community colleges and technical institutes in each state (8).

The real significance of the engineering team concept can be seen more clearly if we compare the role of the engineer to that of the doctor. It is the doctor who has the authority and responsibility to designate which tests will be needed to supply sufficient information for diagnosis. He alone has authority to prescribe a specific drug of a particular dosage to be administered in a specific way on a specific time schedule. At this point he relies upon laboratory technicians, X-ray technicians, pharmacists and nurses to perform these functions which have been reduced to basic procedures. The doctor is now freed to deal with the more complex procedures and the unexpected conditions that arise (4).

If the engineering team concept is to be effective, the activities of the various members must be coordinated based on their specialized roles. This requires that functional definitions exist for the role of each member. While definitions have been developed for each team member, they have lacked the precision necessary for complete understanding by employers, students, and even the various team members themselves. This is clearly evidenced by the confusion shown toward the roles of the technologist and the technician.

The role of the engineer has come to mean the performance of creative work such as "consultation, investigation, evaluation, planning and design of engineering works and systems, planning the use of land and water, teaching of advanced engineering subjects, engineering surveys and the inspection of construction for the purpose of assuring compliance with drawings and specifications."(4) Much of his work involves safeguarding life, health and property. Often the engineer is the project coordinator or supervisor and the demands on his time require that he delegate responsibility to project superintendents and foremen.

Engineering technologists are often employed in supervisory positions working in close support of engineers in translating conceptual ideas into functional systems. They also provide direction for the implementation of these ideas by technicians and craftsmen. Technologists are often responsible for project design, planning, estimating, as well as project inspection or product quality control. Because of the similarities in the educational background of the technologist and the engineer, the technologist may in some cases make the subsequent transition to the level of professional engineer (9). "Some educators feel that the engineering technology degree is better preparation than the engineering degree for the work many engineers are performing."(10)

Engineering technicians often work under the supervision of a professional engineer, engineering technologist, scientist or senior engineering technician. Their work involves the application of principles, methods, and techniques appropriate to their field of technology. It requires a practical knowledge of construction, fabrication, properties, operations and limitations of the engineering systems with which they deal. Through certification by ICET, the engineering technician can advance from the level of Associate to Senior Engineering Technician. As with the technologist, a few aggressive technicians have made their way to the level of professional engineer.

The term "Engineering team" suggests the effective and efficient utilization of individuals with varying qualifications to achieve an objective. Each industry must develop a way to maximize production through the use of an appropriate number of engineers, technologist and technicians. Industry's plan for profitable utilization of the engineering team must also provide a way to satisfy the career objectives of each individual. One such program developed by the Corporate Engineering Department of Monsanto Company is presented here as an example of what industry can accomplish through wise utilization of their team (10).

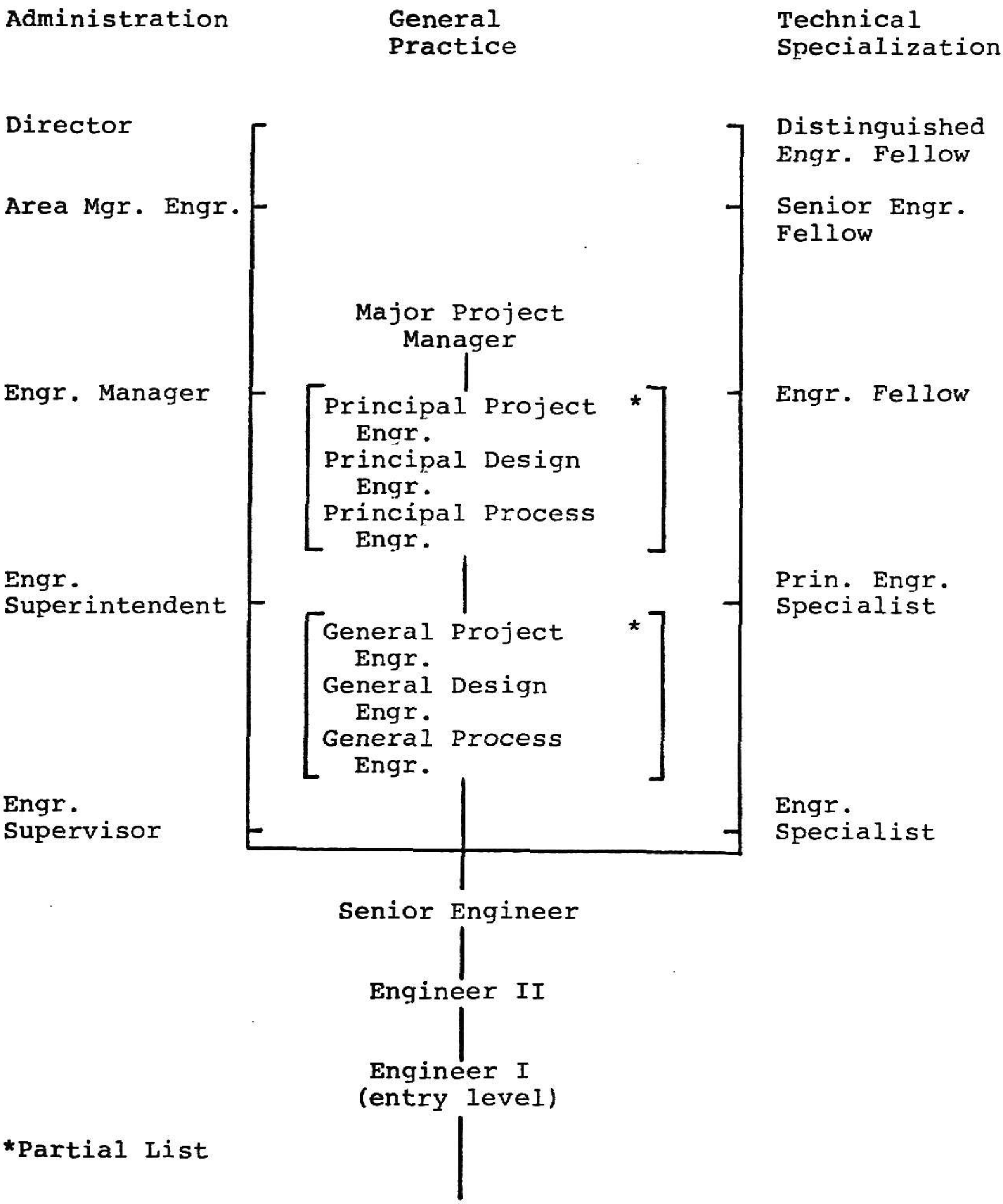

Figure 1. PATHS FOR PROFESSIONAL ADVANCEMENT

Administrative	General Practice
	Advanced Designer Advanced Planner Advanced Estimator
Drafting Supr.	
	Senior Designer Senior Planner Senior Estimator
Const. Coord. III	
	Designer II Estimator III Planner III
Squad Leader	
	Designer I
Const. Coord. II	Senior Draftsman Estimator II Planner II
	Senior Technician
Const. Coord. I	Estimator I Coordinator I

Technician (with technology or equiv. degree)

*Draftsman Technician

*Draftsman Technician

*Training Technician
Training Draftsman

*Non-Exempt Grades

Figure 2. PROGRESSION LADDER
(For individuals not holding an engineering degree)

TECHNICAL EDUCATION: EDUCATION OF THE ENGINEERING TEAM

Lines separating the responsibilities of members of the engineering team are not always clearly defined. Confusion which arises because of these job overlaps cannot always be removed by injecting a job definition or description. Another approach to understanding the roles or responsibilities of the engineer, as well as the engineering technologist and the engineering technician is to view the educational programs for each. The program requirements as specified by ECPD are presented below. It is hoped that the educational background of each member of the engineering team will be indicative of the level of performance and responsibility for which he is qualified.

Engineering Curriculum Requirements

An ECPD approved engineering program should include as a minimum for accreditation:

1. The equivalent of approximately two and one-half years of study in the area of mathematics, science, and engineering. The course work should include at least one-half year of mathematics beyond trigonometry, plus one-half year of basic sciences, one year of engineering sciences, and one-half year of engineering design.
2. The equivalent of one-half year as the minimum content

in the area of humanities and social sciences.

3. An additional time equivalent to one academic year for the implementation of educational objectives of the individual and the institution (5).

Presented below is an example of an ECPD accredited Civil Engineering curriculum.

FRESHMAN

Fall Semester
Course

Anal. Geom. & Calc. I	4	Anal. Geom. & Cal. II	4
Chemistry I	4	Chemistry II	4
English Comp. I	3	English Comp. II	3
Engineering Concepts	2	Oral Communications I	2
Graphical Comm. Anal. and Des. I	2	Economics I	3
Concepts of Phys. Ed.	1	Engineering Assembly	0
TOTAL	16	TOTAL	16

SOPHOMORE

Anal. Geom. & Calc. III	4	Series & Diff. Equ.	4
Engineering Physics I	5	Engineering Physics II	5
Statics	3	Mechanics of Materials	3
Tech. Elective	2	Geology I	3
Elementary Surveying	3	Engineering Assembly	0
Engineering Assembly	0	Tech. Elective	2
TOTAL	17	TOTAL	17

JUNIOR

Route Location & Design	4	Intro. Struc. Anal.	4
Dynamics	3	Fluid Mechanics	3
Thermodynamics I	3	Soil Mechanics I	3
Hydrology	2	Sanitary Engg. Fund.	3
Hydrologic Meth. Lab.	1	Hum. or Soc. Sci. Elec.	3
Tech. Elective	3	Engineering Assembly	0
Engineering Assembly	0		
Mech. of Materials Lab.	1		
TOTAL	17	TOTAL	16

SENIOR

Engineering Assembly	0	Engineering Assembly	0
C. E. Electives	12	C. E. Electives	6
Hum. or Soc. Sci. Elec.	5	Hum. or Soc. Sci. Elec.	6
		Tech. Electives	5
TOTAL	17	TOTAL	17

Number of hours required for graduation - 133

Engineering Technology Curriculum Requirements
(Baccalaureate Degree Program)

An ECPD approved engineering technology program leading to a baccalaureate degree should include as a minimum for accreditation:

1. The equivalent of three-fourths academic year of basic sciences with the proportion of mathematics to be dependent on the needs of the particular technology.
2. The equivalent of one and one-half academic years of technological courses, including technical science, technical specialty, and technical electives.
3. The equivalent of three-fourths academic year in communications, humanities, and social sciences.
4. An additional time equivalent to one academic year for the implementation of educational objectives of the individual and the institution.
5. A minimum of 120 semester hour credits (5).

On Page 21 is an example of a baccalaureate program in Civil Engineering Technology designed to meet ECPD accreditation requirements.

I. CORE COURSES (80 Hours)

Communications 8
- English Composition I 3
- English Composition II 3
- Oral Communication I 2

Physical Science 12-13
- General Chemistry .... or
- Chemistry I 4-5
- General Physics I 4
- General Physics II 4

Mathematics and Statistics 14
- College Algebra 3
- Plane Trigonometry 3
- Technical Calculus 5
- Elements of Statistics 3

Engineering Technology 14
- Graphical Communications I 2
- Computers and Data Processing 2
- Properties of Engg. Materials 3
- Electrical Circuit Tech. I 4
- Instru. and Measurement Tech. 3

Management Electives 6

Humanities/Social Science Electives 15

Free Electives 9-10

Concepts in Phys. Educ. 1

II. AREA OF SPECIALIZATION (40 Hours)

Required Courses 20
- Elementary Surveying Engg. 3
- Statics A 3
- Strength of Materials A 3
- Strength of Materials A Lab 1
- Route Location and Design 4
- Mechanics of Fluids 3
- Graphical Communications II 3

Area Electives 20
- Geology I 3
- Elementary Geology Lab 1
- Soil and Foundation Constr. 3
- Sanitary Engineering Fund. 3
- Energy Conversion Technology 3

Wastewater Treatment Technology	3
Water Treatment Technology	3
Air Pollution Control Tech.	2
Production Processes	3
Occupational Safety & Health	3
Theory of Structures I	3
Timber Structures	3
Theory of Structures II	4
Theory of Structures III	4
Thermal Systems	3
Lighting Systems	3
Sanitation Systems	3
Acoustic Systems	2
Site Construction	3
Construction Drawings	3
Construction Problems I	3
Construction Estimating	3
Construction Management I	3
Construction Management II	3

Number of hours required for graduation - 120

Engineering Technology Curriculum Requirements
(Associate Degree Program)

An ECPD approved engineering technology program leading to an associate degree should include as a minimum for accreditation:

1. The equivalent of one-half academic year of basic sciences, about half of which should be mathematics that includes carefully selected topics suited to each curriculum from appropriate areas of college algebra and trigonometry, and going beyond to include the basic concepts of calculus.
2. The equivalent of one academic year of technical courses.
3. The equivalent of one-fourth academic year of non-technical subjects such as oral and written communications and humanistic-social science subjects.

4. An additional time equivalent to one-fourth academic year for the implementation of the education objectives of the individual and the institution.
5. A minimum of 60 semester credit hours (5).

Presented below is an example of an ECPD accredited associate degree program in Civil Engineering Technology.

FIRST SEMESTER

Course Name	Semester Credits
College Algebra	3
Materials Sampling & Testing	1
Plane Trigonometry	2
Applied Chemistry	3
Technical Drafting	3
Written Communications	2
Oral Communications	2
TOTAL CREDITS	16

SECOND SEMESTER

Course Name	Semester Credits
Technical Physics	4
Analytic Geometry & Calculus I	2
Soils & Foundations	2
Plane Surveying	4
Survey Drafting	1
Report Writing Lab	1
Industrial Relations	3
TOTAL CREDITS	17

THIRD SEMESTER

Course Name	Semester Credits
Statics & Strength of Materials	5
Analytic Geometry & Calculus II	2
Fluid Mechanics	3
Route & Construction Surveying	4
Photogrammetry	1
Technical Writing	3
TOTAL CREDITS	18

FOURTH SEMESTER

Course Name	Semester Credits
Structural Design	5
Construction Methods & Estimating	2
Civil Design & Construction	4
Economics	3
Management & Human Development	1
TOTAL CREDITS	15

Total semester credits required for Associate of Technology Degree - 66

PROGRAM EVALUATION: COMPARISON WITH ECPD MINIMUMS

The point of beginning for evaluating the Civil Technology program at KTI will be the comparison of the present curriculum with the ECPD required minimums. The ECPD guidelines have been setforth in the previous section. A minimum curriculum acceptable for accreditation is 60 semester credit hours. Table No. 1 shows the comparison between the ECPD minimum and KTI's current Civil Technology curriculum.

TABLE 1

COMPARISON OF CURRICULUM CONTENT

Curriculum Division	ECPD Minimum*	KTI Civil Tech.*
Basic Sciences	7-8	7
Mathematics	7-8	9
Technical Courses	30	35
Communications and Social Sciences	7-8	8
Individual or Institutional Electives	7-8	7
TOTAL	60	66

*Semester Credit Hours

It can be seen from the table that the Civil Technology curriculum at KTI is meeting or exceeding the ECPD minimum for each curriculum division. Note should be taken that in only one of the five areas is the minimum appreciably exceeded. This might suggest a closer examination of those areas which appear to be only adequate by ECPD standards. A re-evaluation of the need for certain technical courses might also be justified.

PROGRAM EVALUATION: ENROLLMENT

It has been said that nothing remains static. Either it flourishes and grows or it ceases to grow and begins to die. So it is with programs in an educational institution. For the program to reach its full potential it must have a consistent increase in enrollment. It is often the growth of a program that justifies revisions, modifications and expansion that make the program more effective and financially efficient. Below, Figure No. 3 shows the freshman enrollments for the years the Civil Technology program has been in existence.

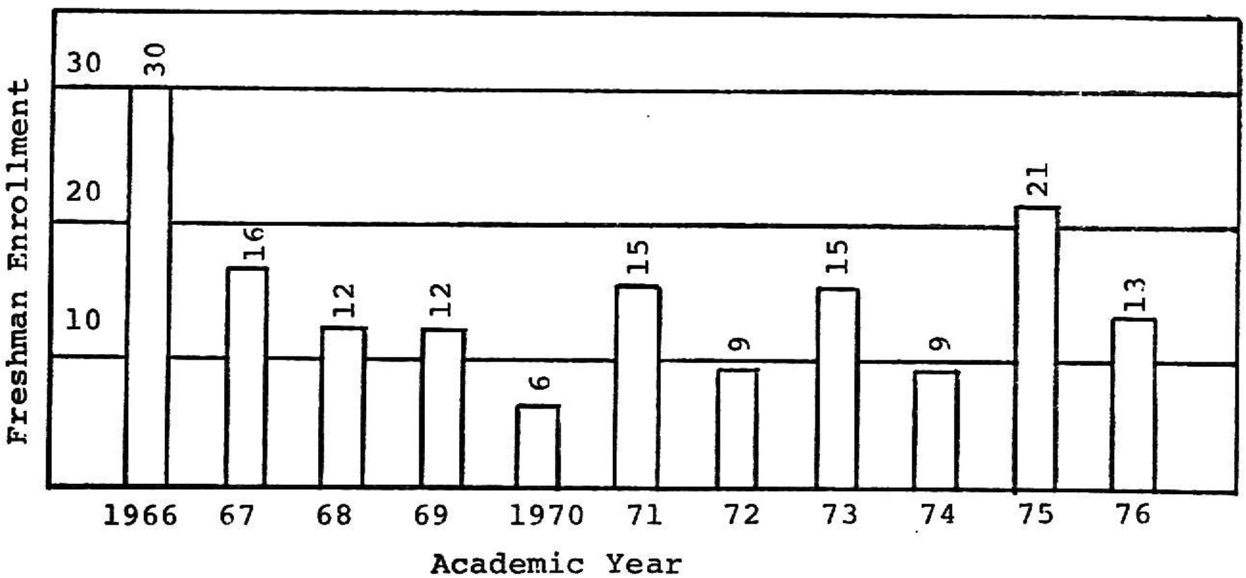

Figure 3. CIVIL TECHNOLOGY ENROLLMENT

It is evident from the graph that while enrollment has not been static, it also has not shown any trend toward a consistent increase. Fluctuation in enrollment can be attributed to several factors, but the most significant of these seems to have been the school's political uncertainty. A school that is here today but maybe gone tomorrow is not a readily marketable quantity to the prospective student.

If KTI and its programs are to develop a consistent growth pattern, its major short term goal must be to implement a program to foster public confidence in the permanence of the institution. The school must also strive to develop its individuality both in the educational and physical communities. A good point of beginning might be to formulate a plan for transforming an Air Force base into a college campus. It will be very difficult for an individual program to steadily increase its enrollment without the total involvement of the entire institute.

PROGRAM EVALUATION: STUDENT ICET EXAMINATION SCORES

It seems necessary for us to consider the end product if we are to adequately evaluate the Civil Technology Program. One means available for student evaluation is on the basis of scores received on a national, standardized examination. The examination scores that have been used are from the Certified Engineering Technician Examination which is annually administered nationwide by the Institute for the Certification of Engineering Technicians. Comparisons of KTI Civil Technology student Test scores have been made with the most recent national mean values available. Figure No. 4 and Table No. 2 present these comparisons.

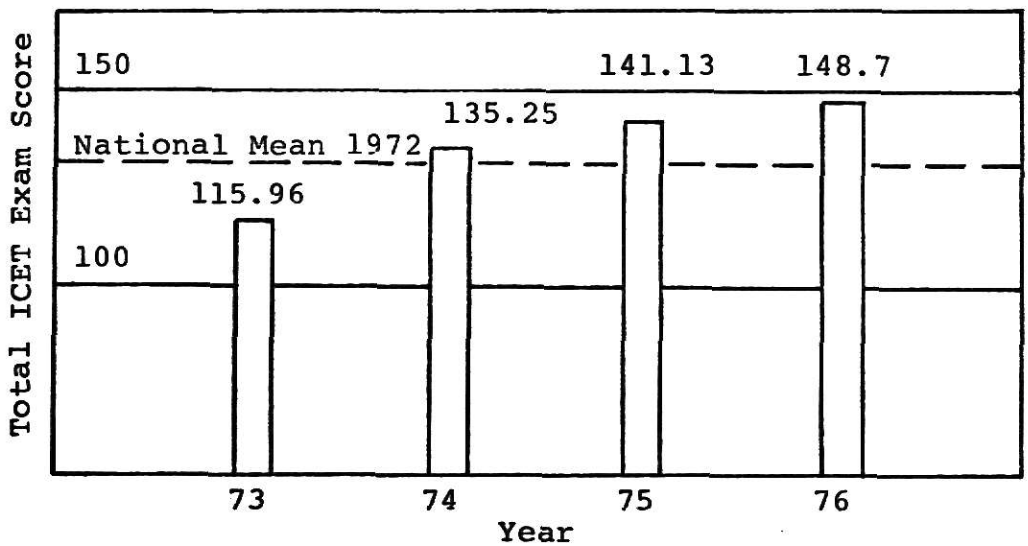

Figure 4. CIVIL TECHNOLOGY STUDENT ICET EXAMINATION SCORE

TABLE 2

BREAKDOWN OF CIVIL TECHNOLOGY STUDENT ICET EXAMINATION SCORES

Content of Section		Section Number	National Mean	1973	1974	1975	1976
Part A:	All Skills	Total Part A	60.52	53.71	66.00	59.25	63.6
	Communications	1	13.56	13.14	14.77	14.00	13.0
	Mathematics	2	26.16	22.29	29.31	28.50	28.8
	Physical Science	3	20.80	18.29	21.92	17.75	21.7
Part B:	Civil	Total Part B	70.44	62.25	69.25	73.38	85.1
	Basic Technology	4	25.94	23.50	28.00	29.99	32.8
	Spec. Technology	5	44.70	38.75	41.25	40.38	52.2

The ICET Examination has been given since 1972. During that period twenty-seven Civil Technology students have taken the examination. The cumulative percentage passing has been approximately ninety-three percent. This fact taken by itself would indicate that KTI has been very successful in educating Civil Technicians to a level determined adequate by the recognized certifying organization. Based upon the steady increase in the mean test scores for the past four years it would appear that the continuing improvement is being made in the effectiveness of the program.

Care must be taken not to assume that there has been significant improvement in all areas of the Civil Technology program. A close look at the individual test sections seems to indicate significant improvement in the area of Basic Technology, but little if any real improvement in the Specialized Technology area. While it may require several more years to prove this out, it could be an area for possible curriculum modification in the future.

PROGRAM EVALUATION: GRADUATES' SALARIES

While salaries are not direct indicators of the quality of the graduates a program produces, they are of interest and concern to the Institute. If KTI is to compete successfully with other institutions of higher education, it must be able to prepare its graduates for attractive futures. The prospective students must have a tool they can use to evaluate the rewards of a career in engineering technology. While money is not the best indicator of an individual's success and achievement, it is the one most easily quantified. For this reason the Institute is concerned about the starting salaries of its graduates and the rate at which they advance following graduation.

High initial salaries are good indicators of the demand for a program's graduates. While it is often tied directly to the state of the economy, it also reflects the feelings of industry towards the quality of graduates produced by the institution. The rate of salary increase after graduation is a good indicator of the long term value of the educational program. If the rate of salary increase begins to level out too early in a graduate's career, this could indicate too much emphasis has been placed on the practical and too little on the theoretical. Too much effort may have been expended in training an individual who can make the employer a profit immediately upon graduation. This results in the graduate technician reaching his productivity peak too early in his career and tends to lower his maximum earning level.

The prospective student will be concerned with the long range potential of a career as well as its initial rewards. This places the responsibility upon the institute of providing programs that will equip the graduate for many years of advancement. Some feeling for the success KTI has had in this area can be developed from the graph below.

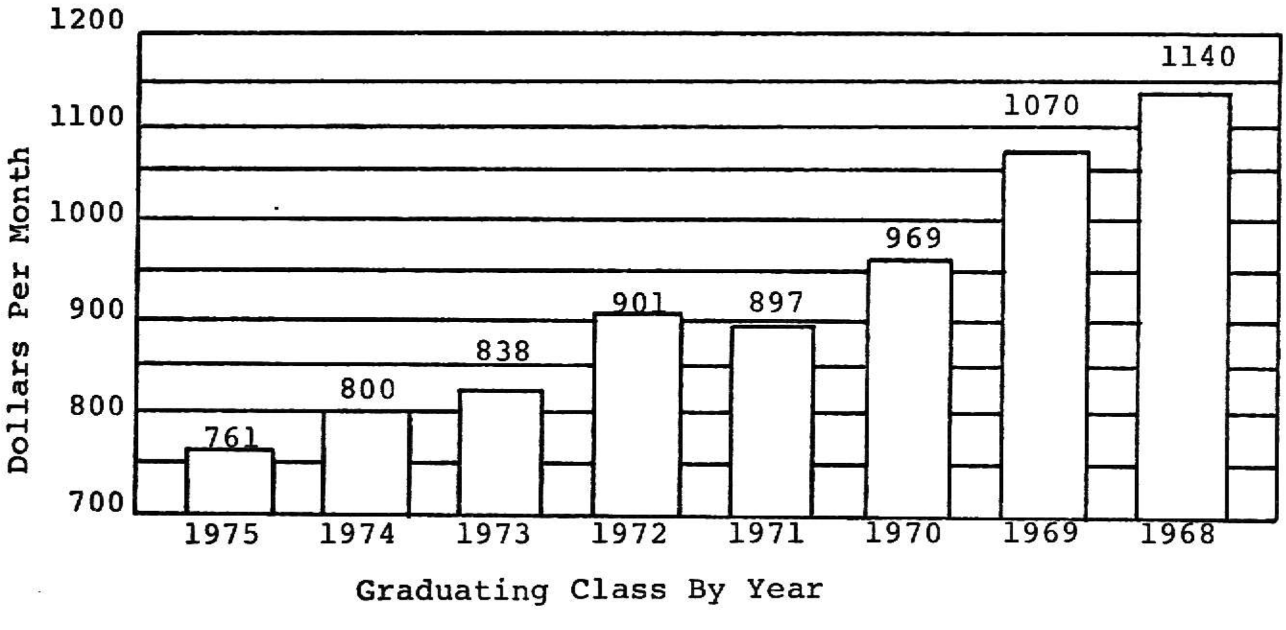

Figure 5. AVERAGE MONTHLY SALARIES OF KANSAS TECHNICAL INSTITUTE GRADUATES

Information shown on this graph reflects a steady pattern of advancement for KTI graduates. While this graph tends to show an average salary increase of six percent per year, it was found by comparing the data from several such studies made in previous years that the actual annual increase is close to eight percent. For the last study made in 1975 the average monthly salary for all graduates of the Civil Technology program was $897.45. It should also be noted that the average monthly starting salary for all 1975 KTI graduates was the $761.00 shown on the graph.

PROGRAM EVALUATION: FACILITIES AND EQUIPMENT

There are no fixed requirements specifying the minimum facilities needed to provide a quality educational program. The variation from institution to institution and from program to program within an institution makes the setting of minimum standards impractical if not impossible. There are certain areas, however, which should be given consideration when evaluating the adequacy of a program's physical facilities. These are the size and arrangement of lecture rooms; the size, arrangement, and lighting of drafting rooms; the size and arrangement of laboratories; the adequacy of laboratory equipment; and faculty office space available and the individual privacy it affords.

At KTI, the Civil Technology program has never suffered from a lack of space for its classrooms and laboratories. Its major concern has been to determine the most effective way to utilize the facilities that were already in existence. Often during the early years, the department, as well as the entire institution spread itself out across the campus in an effort to justify its needs for such a large number of buildings. During the recent years of rising utility costs, effort has been made towards consolidation of facilities. It appears that there is room for more work in this area. It would seem that certain additional benefits could be received from this condensing of the campus. In addition to reducing the number of structures that would need to be maintained, it would bring students closer together, possibly promoting more interaction between disciplines. The departments would be forced to review the layouts of their laboratories and the need for various pieces of equipment. This could result in more efficient arrangement of equipment that is frequently used, and hopefully the elimination of equipment no longer in service or relevant to the program. Consolidation of the various physical facilities could also result in a more centralized campus, making it possible to afford the structural modifications and landscaping needed to remove the military base image that now exists.

The adequacy of laboratory equipment in the Civil Technology program varies from course to course. Currently, the laboratory classes requiring drafting facilities appear to be equipped satisfactorily. Rooms are available to handle maximum class sizes of 20 or 30. Should a significant increase in student enrollment in these classes occur, it would require adding additional class sections, as the drafting rooms will not accommodate additional equipment. The section sizes in the drafting and design courses are, therefore, limited due to room size or availability as opposed to availability of equipment.

Section sizes for the remaining laboratories are very much limited or controlled by the amount of equipment as opposed to the space available. Laboratory sections in Materials Sampling and Test, Soils and Foundations, and Plane Surveying have generally been restricted to twenty students. This number has been selected because it was felt that this was the maximum number that could be taught effectively with the equipment available. If adequate equipment had been available, this number could have been increased by fifty percent to the point where it was then limited by the instructor's ability to cope with the size of the group. Laboratory sections in Route and Construction Surveying and Photogrammetry have in the past been limited to sixteen and thirteen students respectively. Both of these values make it difficult to increase departmental efficiency by increasing the student faculty load ratio. Due to the high costs of adding sufficient equipment to bring these courses up to the maximum size of the other laboratory courses, they will no doubt continue to be restricted by the amount of equipment available.

Facilities for officing the departmental faculty are adequate based on minimum standards. It would seem, however, that as in curriculum content, the minimum should serve only as a lower bounds of acceptability and not as a point of desireability. The present facilities are not only inadequate with regards to space, but also in the amount of privacy afforded. This is an area that needs consideration and attention, due to its possible effects on faculty performance and the students' willingness to consult with faculty when privacy is lacking.

PROGRAM EVALUATION: CURRICULUM RELEVANCE

The primary function of the Civil Technology program is to educate and train civil engineering technicians who will be immediately employable upon graduation. Employment as a civil technician generally involves working with, and in support of a civil engineer. This would indicate that the technician should be well educated in the technology relevant to the primary areas of civil engineering. Areas would include construction, soil mechanics and foundations, municipal and sanitary, surveying and mapping, and hydraulics.

It must be recognized that each of these is a complete field in itself and that a student could spend his entire two years studying only one area. Many technical institutions offer areas of specialization within their individual departmental programs. This allows the student to select the area that has the greatest appeal to him and delve more deeply into it. KTI's Civil Technology program has been designed with the opposite philosophy in mind. Its aim is to produce a well rounded individual with a broad background in all the areas of civil technology. In this way it is felt that he will be more readily marketable and that he will be better able to shift from one area of civil technology to another should he choose to do so.

The Institute has placed a ceiling of sixty-six semester hours on all of its associate degree programs. Using the criteria for curriculum content setforth by ECPD, this allows the department approximately thirty-three credit hours to provide the student with the background in civil technology it is felt he needs. Because of this limited number of hours, it is necessary that only the most relevant subject matter be dealt with. This requires that from time to time, course content must be re-evaluated to remove any outdated topics or procedures and replaced by material which better reflects the current state of the art.

Two such areas which have recently caused need for course content modification are transportation and surveying. Until recently the primary focus in the transportation field had been in the area of highway design and construction. With the completion of the interstate highway system in sight, emphasis is now being shifted to consider airport and railway design as well. In the surveying field, the development of the new electronic measuring devices and the increased use of computers has placed a need for course revision. While it is necessary for students to become familiar with traditional methods, some time must now be made available for studying the new techniques.

For a curriculum to remain current requires a system of continual course modification. Need for modification is not always readily apparent to the faculty due to their somewhat isolated state from industry. To remedy this it is necessary to work closely with a departmental advisory committee composed of industrial representatives from the various technical areas. This committee can serve the department in many ways but two in particular are by monitoring and reporting the changes taking place in industry, and by serving as a sounding board for proposed curriculum modifications.

PROGRAM EVALUATION: CONCLUSION AND RECOMMENDATIONS

Based upon the material in the various sections of the program evaluation portion of this paper, it would seem that the Civil Technology program at Kansas Technical Institute is fulfilling its stated purpose. By meeting or exceeding the ECPD requirements for accreditation and by offering a broad spectrum of civil engineering technology courses, it is supplying Kansas industry with a readily employable product. Recognition of the success of the program resulted in receiving its accreditation during the fall of 1976.

The fact that the program has received ECPD accreditation should not be misinterpreted by the administrators responsible for it as reflecting its proximity to perfection. Several apparent weaknesses still remain in the program and will require attention if the program is to grow.

As noted earlier in the section titled "Comparison With ECPD Minimums," only the area of technical courses was significantly above the minimums set. While judging from the scores on the ICET Examination, this has not hurt the students' performance significantly. It appears that consideration could be given to converting three hours from the technical courses to the electives area. This would give the student some freedom to explore his individual interests in an area of his own choosing.

The area of enrollment is another area of concern. Much of the reason for not offering students electives within the department has been the program's enrollment. Teaching elective classes for five to ten students could not be economically justified. To stimulate growth and interest in the program, the faculty could be called on to accept a greater share of the public relations and recruiting for the department. The offering of first or second semester courses at night could also be a possible means of increasing enrollment by making courses available to the working public. Offering of more short courses could also be a possible stimulus to enrollment.

Another concern should be the findings related to the evaluation of ICET examination scores in the area of specialized technology. The lack of consistent increases in test scores for this area would suggest the need for further study and research in this area. If this situation was found unique to KTI, it would certainly indicate a need for examination of the content and teaching procedures in the technical courses offered.

In the area of graduate starting salaries it appears that improvements could be made in this area with thorough effort by the faculty. Many of the students accept lower starting salaries because they either prefer to remain relatively close to home or because they are leery of taking jobs in the construction field. Faculty could do much to remedy this by relating the advantages of seeking out better job opportunities and the benefits of entering the construction industry. Personal contact between faculty and prospective employers could also result in an increased interest in and demand for civil technology graduates.

Effort should be made in the area of laboratory equipment to secure a sufficient number of pieces to enable the laboratory groups to be kept to three or four persons per group. Very few exercises will require groups larger than this and it appears that three or four is the maximum that can be expected to work together with all members participating. Because of the expense involved to increase the capacity of the photogrammetry course consideration should be given to eliminating it and including the basic principles involved in one of the surveying courses.

Course content in most subjects appears relevant and attempts are being made to keep the material current. There seems to be a tendency for the courses to be moving towards more theory and less application. This is not occurring only in the Civil Technology Department or only in technical institutes, but throughout the field of education. In light of this it would be prudent to view all further curriculum modifications with respect to their impact on the practical aspects of the program.

In the ten years since KTI opened its doors the Civil Technology Department has placed graduates in many facets of civil engineering technology. Employers have in general been very satisfied with the graduates they have hired. Many have come back for additional graduates year after year. A few employers are becoming very interested in helping the program and have begun giving scholarships and equipment. This along with the stability that has come about due to the Institute being placed under the control of the Board of Regents is very encouraging. Enrollment projections indicate significant growth in the school during the next two years. It appears KTI has a bright future ahead of it in engineering technology.

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AN EVALUATION OF THE KANSAS TECHNICAL INSTITUTE CIVIL TECHNOLOGY PROGRAM

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ABSTRACT

An evaluation of the Kansas Technical Institute Civil Technology Program. Evaluation is based upon a comparison of the curriculum with ECPD minimum accreditation standards, enrollment trends, student performance on ICET Examinations, graduates' salaries and advancement, facilities and equipment, and curriculum relevance to industrial needs.

Material is also presented which includes the most widely accepted definitions of the terminology relevant to a general understanding of technical education. The concept of the engineering team is presented along with the job description for each member. Also included are the minimum requirements for ECPD accreditation of programs designed for educating the engineer, the technologist, and the technician, and examples of each type of program.