Journal of Tau Alpha Pi
Volume II, 1978

Contents

Journal of Tau Alpha Pi

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Tau Alpha Pi *Journal* is the official publication of Tau Alpha Pi, National Honor Society of Engineering Technologies. Write Professor Frederick **J.** Berger (Executive Secretary), Editor, P. **0.** Box 266, Riverdale, New York 10471. The opinions expressed are those of contributors and do not necessarily reflect those of the editorial staff of Tau Alpha Pi.

Statement from the Executive Secretary

Once again it is my pleasure to greet the members of Tau Alpha Pi and again to welcome the publication of our informative *Journal.* The 1977 issue received most complimentary comments. The *Journal* reflects the activities of the society and all its chapters, and the 1978 issue continues to publish highly professional articles and even more items of chapter news.

All chapters are asked to collect and forward news items in time for our 1979 issue. Please note that our official headquarter address is now P. 0. Box 266, River-dale, New York 10471. All items, articles, and correspondence should be sent to me at the headquarters' address.

I would like to take this opportunity to express my gratitude and appreciation for the many letters of thanks for the prompt handling of inquiries and chapter materials.

Your Executive Secretary has the privilege to thank individual members who have rendered special service; limited space does not enable me to single out by name each deserving one. At this time, however, I should like to mention and thank Dr. Robert Fischer, associate editor, Drs. John S. Tumlin, George E. Kennedy, and Amos St. Germain, assistant editors, and Mrs. Anne Couch, editorial assistant, for helping to make this issue of the *Journal* outstanding. I thank Dr. Steve Cheshier for his sponsorship of the Purdue University chapter, for his service as coordinator in the Midwest, for his innovative means of publicizing Tau Alpha Pi and motivating students to attain membership by erecting in a conspicuous location a large wooden emblem of the society, and for his assistance in the induction ceremony of Pi Beta Chapter (Indiana University, Indianapolis).

I thank Dean Wilcox (College of Engineering, Clemson University) for his part in making the chartering ceremonies of Mu Beta Chapter a success and for his most appropriate talk entitled "The Excellence Symptom"; Professor So! Lapatine of Beta Zeta Chapter for his help to the Executive Council; Professor James P. Todd of Xi Alpha Chapter for his assistance in the induction ceremony of Omega Alpha Chapter (New Mexico State University); Professor Joseph DeGuilmo of Beta Delta Chapter for his service in furthering the interests of Tau Alpha Pi; Professor Jerry Nathanson for his help in establishing Omicron Beta Chapter as a dynamic chapter, which on April 6, 1978, held a most memorable breakfast ceremony to unveil its emblem and colors; Mr. Joseph J. Scalise of Beta Alpha Chapter (Academy of Aeronautics) for his part in having the chapter participate actively in the forty-fifth anniversary celebration of the college and in the dedication of the library to its founders; Professor Richard R. Phelps of Eta Beta Chapter for his design of the Eta Beta letterhead and hard work in rendering the chapter viable in so short a time.

During the past year, several of the chapter sponsors and advisers saw fit to relinquish their positions. I thank them for their years of dedicated service and for building the solid foundation upon which the society continues to flourish. I welcome and congratulate those who graciously assumed these positions and wish them success; Dr. Howard Carmiggelt (Chi Alpha Chapter of Vermont Technical College) passed the reins to Professor Robert Wonkka; Professor Less Thede (Epsilon Alpha Chapter, Missouri Institute of Technology), to Mr. Tom Calvin; Dr. James R.

•McNally (Beta Alpha Chapter, Academy of Aeronautics), to Mr. Joseph Scalise; Dr. Robert L. Boylestad (Beta Gamma Chapter, Queensborough Community College), to Dr. Nathan Chao; Professor Glenn W. Okerson (Delta Alpha Chapter, Wentworth Institute of Technology), to Professor James A. Tressel; Mr. David A. Brown (Eta Beta Chapter, University of North Carolina), to Mr. Pao Lien Wang; Professor Robert B. Abbe (Lambda Beta Chapter, State of Connecticut Thames Valley Technical College), to Professor Robert S. Golart. Thanks are due, also, to Ms. Patricia W. Samaras, managing editor of *Engineering Education,* for her cooperation in permitting us to reprint articles that acquaint students with the endeavors of our educators to bring technology programs into the mainstream of the engineering profession. During the 1977-78 year, eight new affiliate chapters were founded. In addition, there are thirty-six inquiries or petitions pending. The financial condition of the society is healthy. Although inflation has increased our costs, we managed to stay in the black.

Tau Alpha Pi has achieved official listing in the *Encyclopedia of Associations,* 11th edition, supplement issue, volume 3, no. 1 (April 1977), and in the *Directory of Education Associations* (Health, Education, and Welfare publication), Spring 1978. In addition, *Engineering Education* (ASEE), May 1977, page 796, carries a statement concerning Tau Alpha Pi.

It is clear that Tau Alpha Pi has grown significantly in its relatively short life. Our goal remains to inspire students to achieve and maintain scholarly heights. Students may be assisted and encouraged if initiations were held once each semester or trimester rather than once a year. Since admission is limited to the highest four percent, more qualified students will be reached rather than overlooked with more frequent initiations. Neither should financial inability prevent a student's election; our dues are the lowest of any honor society and so nominal that a system of loan or postponement of payment could be arranged (locally) for deserving students unable to meet initial expense. The society's growth is no reason for complacency. There are still many ECPD accredited institutions that do not have Tau Alpha Pi chapters. The honor society is an important element in the professional life of the students and the institutions to uplift the status of technology programs. It is the duty of all of us to inform, publicize, and recruit. Along these lines, alumni members can be of assistance as they can be also for job contacts and fund raising. To date no information has reached me regarding the maintenance of alumni rosters, a suggestion put forth in last year's journal. This is one area where we need to make greater strides. Not all of the news is good. The society mourns the loss of Professor Joseph F. Sitzwohl, Chairman, Electrical Engineering Technology (Milwaukee School of Engineering), a devoted friend of Tau Alpha Pi. May his memory and achievements serve as an inspiration.

I look forward to seeing many of you at the ASEE annual conference on June at Vancouver, B. C., to discuss our mutual concerns regarding Tau Alpha Pi.

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Should a Technology Graduate be called an Engineer?

Should an engineering technologist be called an engineer? A full complement of similar questions might be asked:

1. Should an engineering graduate be called an engineer?
2. When should an engineering graduate be called an engineer?
3. When should an engineering technologist graduate be called an engineer?
4. Should an engineer be called a technologist?
5. When should an engineer stop being called an engineer?

The answers to these questions will not produce uniform or consistent responses. The very dynamic nature of the changing engineering profession will continue to produce some conflict between the various members of the profession who see a different continuum within the spectrum of the engineering manpower team. The upward mobility as well as the flexibility in job functions of engineers and engineering technologists will continue to focus on the interfacing problems of these two types.

My purpose is to present one educator's viewpoint on this question — my own. It should be recognized that many other views are being expressed — and rather loudly at times — by educators who represent a wide range of educational interests, levels, and various types of technical, engineering, and scientific programs. The basis for my response to the question of the identity of the engineering technologist lies in an evaluation and comparison of the various job functions performed by both engineering and engineering technology graduates as well as an evaluation of the progress of their careers.

The Technical Manpower Team

The profession of engineering is the most dynamic profession of all and presents a moving targets whose boundaries are not constant or precise and whose- specific definition is most elusive. The engineering profession has been evaluated and studied every 10 to 11 years since the early 1900's. No other profession has received such regular attention and been so critically evaluated as to its future direction. In the early 1900's the engineer designed, supervised the construction, installed, tested, and maintained the technical equipment and systems with a minimum amount of technical support. By the 1940's we had identified the engineering manpower team concept.[2] Figure I illustrates the four basic types of technical manpower identified by the President's Commission on Engineering Manpower. The members of the team were classified as the craftsman, the technician, the engineer, and the scientist. The scientist on one end of the spectrum was highly theoretical with little or no practical skills, while the craftsman at the other end was very practical but with limited theoretical understanding. The technician may have had one or two years of specialized technical training, while the engineer of that day usually had a four-year academic program with a concentration of both theory and practice in problem solving and design.

The rapid increase in scientific knowledge led to a broadening of technical appli**cations and generated the need for more specific services by more individuals within**

the spectrum of that technical manpower team. As a result today's technical manpower team has expanded with many additional job titles. The classifications shown in Figure II still range from the craftsman to the scientist.[3] A few titles are suggested on the chart and include craftsman, industrial technician, engineering technician, engineering technologist, technical engineer, scientific engineer, engineering scientist, scientist. The specific titles will usually be determined by the personnel policies of a particular company or industry.

Industry seeks predictable, productive performers. Members of the engineering manpower team are judged on the successful and skillful application of their scientific, engineering, and technical knowledge. The financial rewards in industry are also measured in large part on the ability to get things done, to motivate people, and to effectively manage the technical enterprise. Thus individuals are personally motivated to move within the engineering manpower spectrum of industry as they expand their knowledge, develop mature judgment, improve their problem solving skills, and become adept at motivating and managing people.

Impetus for Change

In assessing the current status of the interface between engineering and engineering technology, a brief look at our history might be helpful in identifying the impetus for change. Just 23 years ago, in June 1955, we received the final report of ASEE's EVALUATION OF ENGINEERING EDUCATION.[4] The Study Committee, which was chaired by Dr. L. E. Grinter, was concerned with the rapid changes in engineering applications resulting from increasing scientific knowledge and the time conflict of including everything in a four-year curriculum. The Committee's suggestion for two curricula, one to stress engineering science and the other practice, received negative reaction and had to be withdrawn.

The preliminary report of the Committee was not published in permanent form and is not generally available. The actual wording of the preliminary report on this topic is particularly interesting today as we look at the current development of baccalaureate engineering technology curricula.

In the paragraph titled "Definitions of Professional-General and Professional-Scientific Curricula," the preliminary report reads:

There seems to be no major disagreement that an engineer cannot be trained to make effective use of modern knowledge of engineering science in creative design within a 4-year undergraduate program. It is even more improbable that effective contributors to research in the engineering sciences whose development is now an accepted responsibility of the engineering profession, can be trained in four years. It seems more probable that 4-year training may be sufficient college preparation for many students with general professional objectives.

When the proposal for bifurcated engineering programs was so soundly rejected by academic personnel, the professional-general program was dropped and the professional-scientific curricula thus became the engineering science curricula in the final report.

The fourth recommendation (of 5) in the preliminary report seems most critical today in setting the stage for the growth of baccalaureate programs in engineering technology and it reads as follows:[6] The functional divergence so evident in engineering activities, which range from

research to management, has led to the Committee's recommendation that accreditation be based upon either of two defined functions in engineering education; i.e., professional-general education and professional-scientific education.

This recommendation was also soundly criticized by the academic community and was immediately rejected and completely deleted by the Committee in the succeeding interim and final reports.

The next major study of engineering education was titled "Goals of Engineering Education." The preliminary report of the "Goals Report" was presented at the 1966 ECPD meeting and produced considerable discussion concerning its strong recommendations that the master's or advanced level degree should eventually become the first professional degree. According to the Annual Report of the ECPD President, Dr. L. E. Grinter,[7]

In all of the commotion surrounding the discussions of the Goals Report it may be that its basic import has been missed. In essence this is that the accepted professional engineer of 1986 must have a more extensive education than his predecessor of 1966. Because this view has not been rebutted we then assume that it is accepted. If so, perhaps it is relatively unimportant what names or titles are attached to a first four-year degree and a second more advanced degree.

Further concern for program content and structure is clearly identified in the newest study by ASEE — "Engineering and Engineering Technology — A Reassessment."[9] This is a report of the "REETS" Committee which appeared in the May 1977 issue of *Engineering Education:*

The Goals Report recommends that the first professional degree be the master's, and suggests that it be preceded by a "pre-professional" or basic science baccalaureate degree .

The need for clear definitions of engineering and engineering technology is evident from the increasing complexity of the spectrum of engineering manpower needs. It should be noted that the definitions currently used by ECPD were developed before the accreditation of advanced-level engineering programs and baccalaureate programs in engineering technology.

Job Functions within the Engineering Profession

The proof of an engineering or technology education is in its application to the world of work. The specific job functions performed by the members of the technical team can be simply classified in three very general functional categories, that is, people-oriented job functions, thing-or-device-oriented job functions and idea-oriented job functions. This classification was first identified in 1955 by the Relations with Industry Division of ASEE.[10] Figure III illustrates those functions in three simplified categories — research, design, and development; production and manufacturing; and sales and management. The individual's choice of a particular position will be controlled to a great extent by the personal attributes and characteristics, personality, personal motivation, and interests of that individual as they match the job functions of the position chosen.

Myron Tribus, in March 1975, presented a somewhat similar view of the various job functions in the engineering profession.[11] He called them the "doing" or

• "engineering" face of a cube representing technology. Figure IV is found in his paper "The Three Faces of Technology and the Challenge to Engineering Education." The three sides of the cube were used to illustrate the —ICS, the —TIONS,and the —INGS of technology. (Dr. Tribus credits J. Herbert Holloman with originating the three names for the faces of the cube.) The "doing" or "engineering" face identifies the job functions ranging over a wide spectrum

from the highly technical to people-oriented as well as service functions.
John D. Ryder, former Dean of Engineering at Michigan State University, has commented on this dual entry into the profession by engineering and engineering technology graduates.[12] Dr. Ryder says in the April 1976 *Junior Engineering Times* (JETS Journal) that the engineering graduate, with a more theoretical and scientific base of education must add practical experience in state-of-the-art technology to become fully prepared as a professional engineer while the engineering technologist, with a more applied state-of-the-art education~ must gain more theoretical knowledge after he starts his working career if he is to become a professional engineer.
The National Society of Professional Engineers has long recognized the diverse nature of the career paths of engineers.[13] In discussing "Professional Policy 100 —Professional Engineer Income," the 1976-77 Report on Recommended Income Ranges discusses "parallel progression." Under a "parallel progression" or "dual ladder" system an engineer may progress either by moving into management or supervision, or by increasing capabilities within his or her technical field. Suitable job titles, professional recognition, and salary scales should be provided so that the engineer who selects the technical path for advancement may achieve professional stature and salary the same as or greater than that of the engineer who is advanced along the administrative path. The position descriptions provided in the chart include language which should be applicable to either.
The functional mobility of members of the engineering professional team was highlighted by Dr. L. E. Grinter in his paper "Defining A Professional School of Engineering."[14] The continuum of the engineering manpower spectrum and the ability of its members to move within that spectrum through different job functions led him to state, "It must be emphasized that medicine and law provide only a single channel into professional practice . . . engineering remains an open profession." Thus both engineering technology and engineering graduates can seek their own level of career achievements.

Job Functions - The Third Dimension

-The preceding discussion and consideration of job functions leads to an interesting conclusion: the simple two dimensional model of the technical manpower spectrum referred to earlier must obviously now be modified to include a third dimension — job functions. Figure V illustrates this third dimension and will now allow for the appropriate identification or classification of the various members of the technical manpower spectrum having same or similar job functions but with differing entry level educational backgrounds.

Career Growth - The Fourth Dimension

There is yet a fourth dimension that is useful in evaluating the engineering manpower team. A careful review of high performers in the engineering profession indicates that they step progressively through a series of four distinct career stages while many others stagnate along the way.[16] Dalton, Thompson, and Wilson interviewed 150 engineers over a two-year period and found key differences not only in the way engineers did things in each stage, but in the specific things or functions they performed. The four stages identified in their article "An Electrical Engineer for All Seasons," which appeared in the December 1976 issue of *Spectrum,* are

Stage I — Responsibility to a Mentor
Stage II — Taking Responsibility on Oneself
Stage III — Taking Responsibility for Others
Stage IV — Responsibility for the Organization

During the first, apprentice-type stage the young professional works under fairly close supervision and must acquire technical, organizational, and personal knowledge.

Stage II. "Taking Responsibility on Oneself," usually occurs when the experience, performance, and understanding of the young professional warrants this step. A key career decision which faces the young engineer at this time is the dilemma of specialization versus generalization.

Stage III, "Taking Responsibility for Others," may be reached in a short time by some, while others may never advance to this stage during their entire careers. The engineer now begins to act as mentor for others. This stage may lead to additional responsibilities in areas such as marketing or the financial aspects of the technical endeavor.

Stage IV, "Responsibility for the Organization," is attained by relatively few technical-professional people. At this stage in their careers they have a significant influence over the future direction of the organization.

The time required to attain a particular career stage is not only time variable, but is distinctly individual and highly personal. It is based on the ability to become a predictable, productive performer, on the individual's developed skills in interpersonal relationships, and on psychological adjustments necessary to successfully advance through the various career stages.

The Four Dimensions of
The Engineering Manpower Spectrum

The utilization of the four dimensions of theoretical knowledge, practical skills, job functions, and rate of career growth all give new understanding to the interface of the various members identified in the engineering manpower spectrum. The third and fourth dimensions of job functions and career growth extend over a 40 to 45 year period and are primarily controlled by the personal characteristics and attributes of the individual.

A professional person's career encompasses a total span of from 40 to 50 years and can be considered to begin with entrance into collegiate technical/professional studies. Thus the limited period of four years of baccalaureate education is only

4/40 to 4/50 of the individual's lifetime career. It does not seem logical therefore to assume that the initial 8% to 10%0 of a person's career could have a major limiting or controlling effect on the other 90 to 92% of that person's lifetime career.

Conclusion

Continuing scientific discoveries and engineering and technical developments have resulted in expanded career opportunities in a variety of challenging jobs for the various members of the engineering manpower team. The broad spectrum of technical manpower cannot be adequately identified within a simple two dimensional chart representing only theoretical knowledge and practical skills. The third and fourth dimensions of job functions and career growth must be included in evaluating the status and performance of every member of the engineering manpower team. The close relationship between baccalaureate graduates in engineering and engineering technology will continue to exist in both collegiate studies as well as in career activities. Their four-year academic programs are generally more similar than they are different. The individual's personal traits and unique characteristics will govern that person's activities and resulting successes in the third and fourth dimension of job functions and rate of career growth.
When the engineering graduate develops the required knowledge and skill and is in fact performing in a professional engineering function he should then be called an engineer. When the engineering technology graduate develops the required knowledge and skill and is in fact performing in a professional engineering function he too should be called an engineer.

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Milwaukee School of Engineering Milwaukee, Wisconsin

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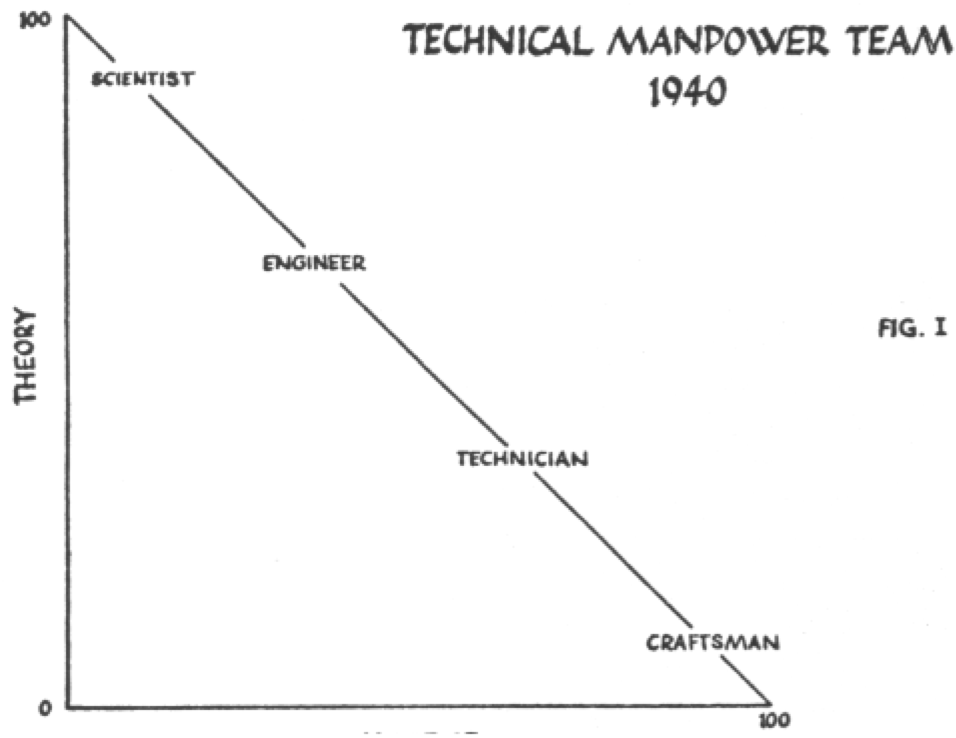

FIG. I

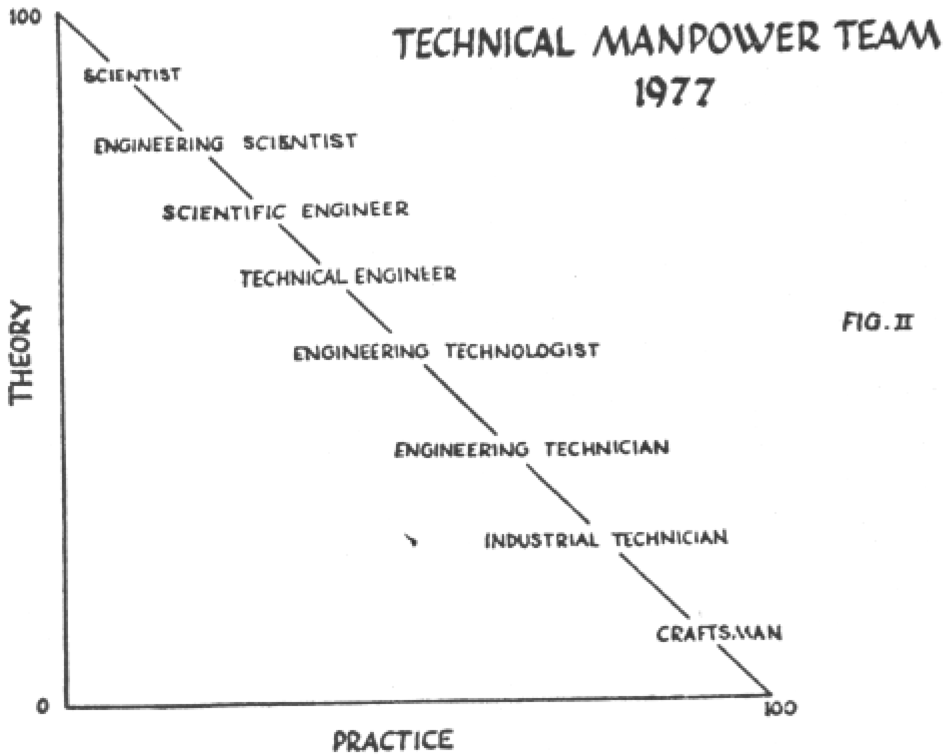
TECHNICAL MANPOWER TEAM
1977
100
SCIENTIST
ENGINEERING SCIENTIST
SCIENTIFIC ENGINEER
TECHNICAL ENGINEER
ENGINEERING TECHNOLOGIST
ENGINEERING TECHNICIAN
INDUSTRIAL TECHNICIAN
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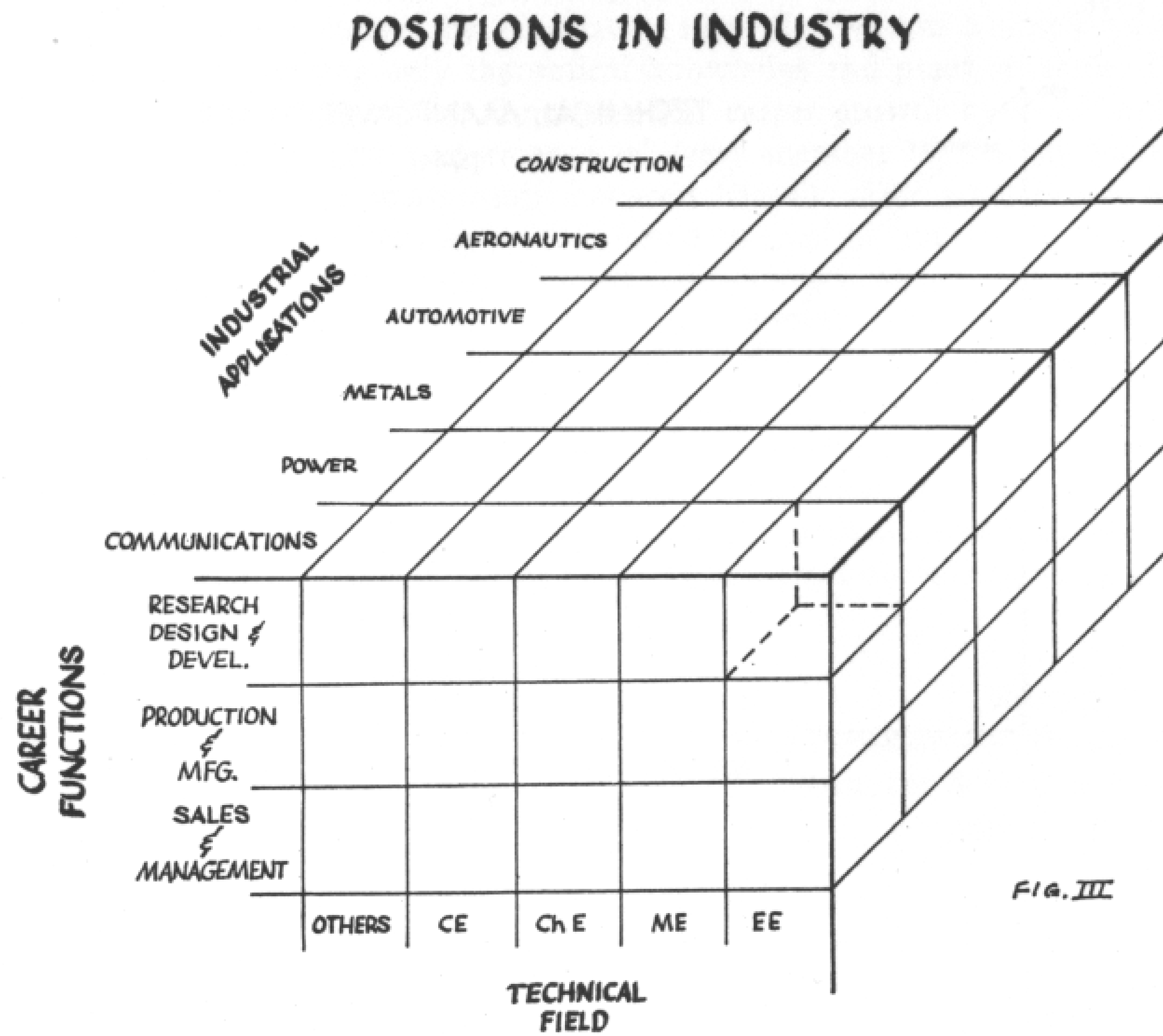
FIG. II


POSITIONS IN INDUSTRY
CONSTRUCTION
AERONAUTICS
AUTOMOTIVE
METALS
POWER
COMMUNICATIONS
INDUSTRIAL APPLICATIONS
RESEARCH DESIGN & DEVEL.
PRODUCTION & MFG.
SALES & MANAGEMENT
CAREER FUNCTIONS
OTHERS
CE
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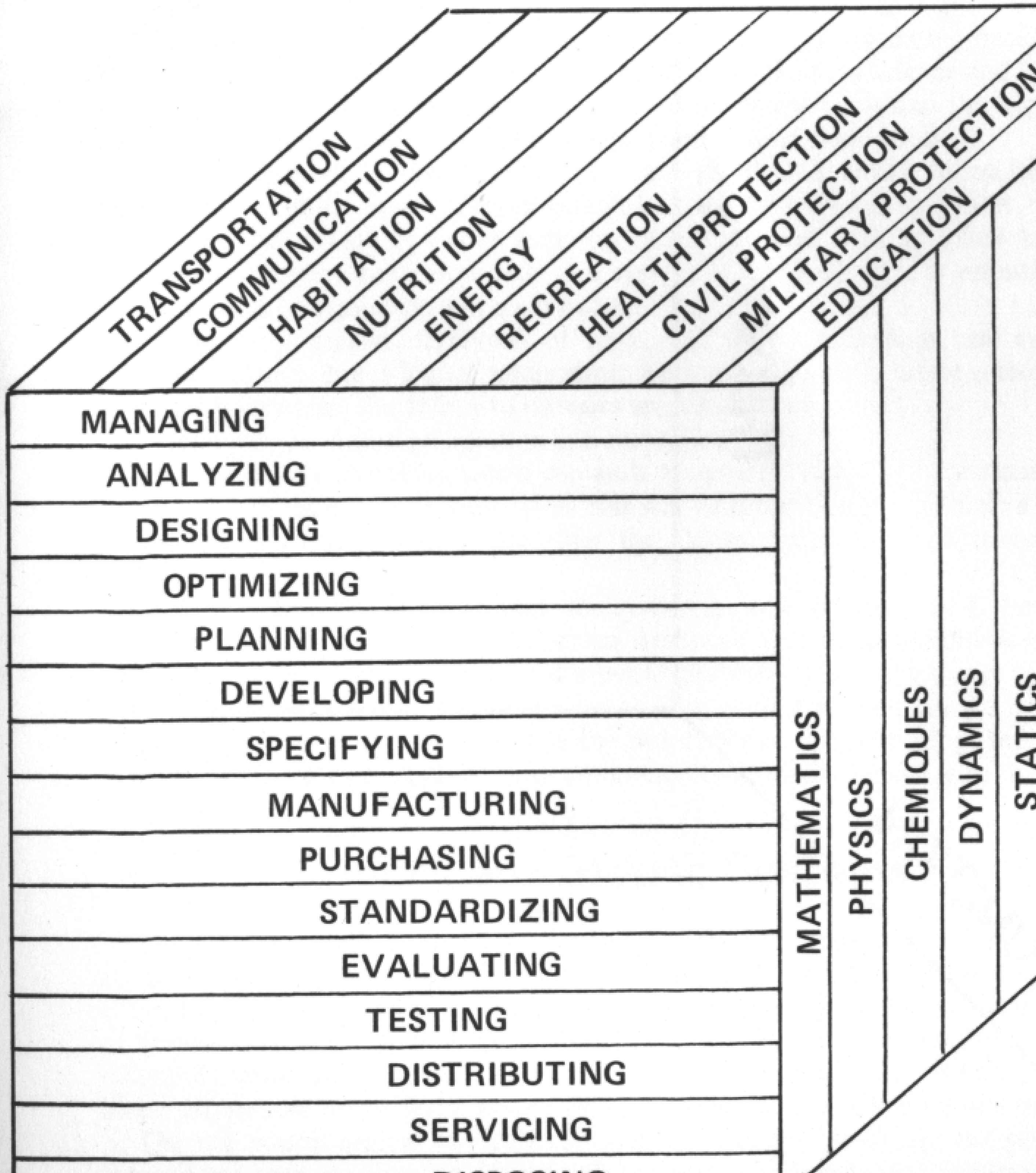
ME
EE
TECHNICAL FIELD

FIG. III

THE THREE FACES OF TECHNOLOGY



CAREER FUNCTIONS
THE THIRD DIMENSION

Introducing The Modern Metric System Into Engineering Education

The world's dependence upon measurement is an old story dating back before the pyramids. The sophistication achieved today in the fields of science and industry could not exist without efficient, accurate measurement tools and the highly developed and standardized systems of measurement behind these tools.

All measurement involves expressing some physical quantity in multiples of some standard unit, some yardstick established and understood by others through which they can create the same quantity. Since we deal with so many kinds of quantities — length, mass, time, etc. — a system of standard units is essential. The characteristics of a good system are obvious:

- Clear and precise *definition* of units, and their terminology and symbols.
- *Coherence:* direct logical relationship between units to facilitate calculations.
- *Completeness:* the ability to measure any physical quantity.
- *Acceptance:* broad recognition and understanding.

Today's rapidly shrinking world demands a common language of measurement, a good system used by everyone. How this will be achieved has long been a subject of controversy, but it is now clear that the United States will at last change its customary measurement system.

One point deserves to be stressed: the system we will be changing to, the system we must learn and use properly, is not an American system or an American problem; it is an international system and a world problem. The many things that have been said about this international system — how good it is, how simple it is, how accurate it is — are completely beside the point. We are going to adopt this system because the United States must have commonality in measurement with the rest of the world.

English and Metric Systems

The English system common in the United States has grown piece by piece over at least 3,000 years, with little relationship between units. The element of precision has been provided since the beginning of the century by the National Bureau of Standards in the U.S. and the National Physical Laboratory in England, and the individual units are adequate to any measuring task. As a system it is poor, and the many differences in its detail among English speaking countries present a problem.

The old metric system (today's common European system) also has problems. In contrast with the English system which grew in a hap-hazard fashion, it was commissioned by the French government nearly 200 years ago and designed to be an integrated, universal measurement system. The U.S. and the British Commonwealth nations refused to join in its use, but Germany, France, Italy and others proceeded to develop their industries and industrial standards around it. Many variations in the system have developed, however, because no controls were set up to unify use, and the common metric system is as awkward and varied as the English System.

The real problem, however, is that the two systems are different, and the whole world is now heading toward a third system (and you must consider it a third system), the International System of Units, called Si. You must remember that the system we're changing to is also new to the rest of the world; it is not Europe's metric system.

That this is a new system must be repeated over and over again. If you think you know the metric system because you've lived in Europe, or because you've taught physics for 20 years, you must nonetheless learn this new system, or you will not be in tune.

SI Units - The Fundamentals

SI is based on seven fundamental or base units, as they are called, and the entire system is built from them. These units, their definitions, and their symbols have complete international agreement in every nation and in international organizations. The symbols are used in every part of the world, regardless of language.

The most common unit is that of length, the *meter.* That it was established 200 years ago as a certain fraction of the distance from the pole to the equator really means nothing. Today it is defined accurately in terms of wavelengths of radiation of a particular transition in the krypton-86 atom, terms that any good metrological laboratory can reproduce exactly.

The next unit, the one for mass, is the only one that still depends on an artifact. The unit of mass, the *kilogram,* is established by a special alloy standard kept near Paris by an international organization.

The unit for time, the *second,* is completely defined in a way that can also be reproduced by any good laboratory in terms of periods of radiation of a certain transition of another element. It does not depend on a pendulum or an artifact, nor on the force of gravity.

The unit of electric current is the *ampere.* The ampere is defined in terms of the force of attraction between two parallel conductors under certain conditions.

The unit of temperature, the *Kelvin,* is very accurately defined by absolute zero and the triple point of water, fixed at 273.16 K, and everything else then follows.

The following unit is not so easy to discuss. (Although there is considerable doubt whether it really is a unit, it is usable and proper in many areas.) The unit for the amount of substance, the *mole,* is defined as the amount of substance in a system that has the same number of entities as there are atoms in 0.012 kg of carbon-12. It is a highly technical unit that the man on the street will never meet.

The next one, for luminous intensity, is much more simply defined. It is the intensity of light from a blackbody at the temperature of freezing platinum. This unit is called the *candela.*

As said before, all but one of these base units is defined in terms any good metrological laboratory can create. These are the base units of the system. There are two units, called supplementary units, that are units for angle. The unit of plane angle, the *radian,* is defined as the angle between radii of a circle that mark off on the circumference a length equal to the radius. The *steradian* is the solid angle with its vertex at the center of a sphere that marks out on the surface an area of one square radius.

Now, these units are combined by dividing, multiplying, raising to negative or positive powers, to produce the needed derived units. There are 17 of them, which have been given special names. Among these are the unit of force, the *newton* (N= kg. m/s^2), one of the new names, and the unit of power, the *watt,* with which

you are probably familiar.
An unlimited number of units can be created for any measurement. These simply obey physical laws. It is very simple to find the unit of area in SI, because you know that the area of a rectangular body is the product of the length by the width, thus the square meter. The unit for velocity is the *metçr per second,* because velocity is length divided by time.
The last feature of the system is a technique whereby any one of these units can be made any size, very large or very small, by the addition of a prefix. You can even exceed the sizes available in the system by simply using powers of ten.

Reviewing SI Characteristics
These are three important fundamental characteristics of SI:
1) *SI is a coherent system.* There are no factors relating the different units. All units of SI are related to each other by unity. For example, a force of one newton exerted through a length of one meter produces energy of one joule. If this takes place in one second, the power exhibited is one watt. Any units of the system, either those with special names or any other derived unit you produce, can all be related this way.
Such coherence is an extremely important factor in calculations. There is no need to look up factors in a book. If you have worked out engineering calculations in our customary English system, you know you always must look up factors, or memorize them.
2) *SI is an absolute system.* This is a difficult problem for engineers who are used to working within the older systems, because the conventional European and U.S. systems are not absolute. We regularly use the same units for force and mass. I am sure you know that if you buy a fishing line to a certain number of pounds' strength, you are measuring the force it takes to break that line in pounds. You also talk about the fish you catch in terms of pounds, in which case you're talking about the mass of the fish — how much fish there is. And, if you climb on a scale, you discover you weigh so many pounds. You are not the least interested in forces; you want to know how much fat you're carrying around.
That is what the general public does. Unfortunately, the technical man does it too, with the result that when he's through with a calculation he does some quick foot work to see if he's off by a factor of 32. If he is, he either included g, the force of gravity, when it did not belong there, or he forgot to use it when it did.
In SI, there is a unit of mass, the kilogram. Mass can be illustrated by a balance scale, with a pile of something on one side. You're interested in how much stuff there is; this is mass, which has a characteristic of inertia that requires a force to move it. On the other hand, a hydraulic cylinder produces force, a completely different quantity. In SI, mass is always kilograms and force is always newtons. Never do you use the mass unit for force, or the force unit for mass — a major fundamental difference between the older systems and SI.
3) *SI is a unique system.* This means that in the system, each quantity. has only one unit. Conventionally, we use entirely different units for power in mechanical, thermal, or electrical systems. SI does not work this way. Power in SI is the watt and only the watt. It is power in electricity, or in a mechanical system, or in a thermal system — for the input or output of an air conditioner — it makes no difference.
This is SI and these are its fundamental characteristics. If we are going to learn,

promote, teach, and work toward the use in this country of an international system that will provide proper communication throughout the world, it is urgent that we understand and respect these characteristics.

Some Lingering Problems

I wish the story stopped here, because so far everything has been relatively easy. We now approach the difficult part of the story. There are a number of cogent reasons for using other than SI units along with SI, such reasons as strong necessity, convenience, and “we’re used to them.” Strong necessity is a good reason; convenience is a controversial one. The last one, that we’re used to them, is absolutely wrong, because if we try to use what the rest of the world has been used to, we would drop **SI** and use the old metric system, which is entrenched everywhere. But that is not what the world is doing.

Among the non-SI units that cause problems is the liter. It is unique in that the international body that created and is responsible for SI has recognized it. There is no question that it will be used. There are many people, however, who feel that if it is going to be used, we should limit its use to the measurement of liquid — some say fluid (which of course includes both liquid and gas) — and that prefixes should not be used with it. These opinions reflect the existence of good SI units that will take the place of the liter, most particularly when we start using it with prefixes. The SI unit for volume is, of course, the cubic meter, and the cubic centimeter is exactly the same as the milliliter.

The establishment of the liter in world use is fact. The limitation of its use is still somewhat controversial. Another troublemaker is time. The SI unit of time is the second, which with proper prefixes can be used for all time measurements, but the almost mandatory use of other time units presents problems. In the first place, we live our lives by a daily cycle, and you cannot divide a day evenly into kilo seconds. You cannot make a round dial clock that repeats the same time relative to the sun’s passage, and put the number in kilo seconds. Accordingly, the world has accepted the fact that along with SI we are going to use at least two units, the minute and the hour, and keep them carefully organized and separated from SI, because they now involve a conversion factor. Remember this: they destroy coherence.

The second area where time needs other units is the calendar. I am sure that we are not going to drop the year and talk about A.D. and B.C. in mega seconds! The week and day will of course be used; people are still going to live by the calendar.

Another problem area is the plane angle. This one is more difficult, because I’m not sure there is a good reason underlying the non-SI convention, although there is a major convenience in the relationship between the degree for plane angle and the problems of geometric construction and perception. We are used to nice round numbers related to right angles, and the 30° - 60° - 90° triangle. All this is deeply ingrained and is claimed by many to be a major advantage. Whether we like it or not, the world is going to use the degree for angle in addition to the radian; this practice is well established and recognized everywhere.

Part of what we do with angles, however, is nonsense, namely the division of the degree into 60 minutes of 3600 seconds. The only possible reason for continuing this practice would be “because we’re used to it.” Many knowledgeable people are strongly urging that these units, the minutes and seconds of angles, be dropped in favor of the decimalized degree, which is perfectly useful, much easier to calculate with, and fills all the requirements for accuracy and convenience.

The next item is temperature. The SI unit for temperature is the Kelvin. It is good, well defined, and properly usable, but broad use will be made of the Celsius temperature scale. I am sure you recognize a different name for our old friend Centigrade. Fortunately, it has the same symbol — it's °C — but its proper name is degree Celsius.

Further, the degree Celsius is exactly the same as a Kelvin. The only difference is that zero degree Celsius is 273.15 Kelvin. Use of Celsius temperature gives us one less digit in most cases. When you talk about outside temperature, you can say it's 27 (degrees Celsius) rather than about 300 (Kelvin). Worldwide agreement surrounds this unit and it will be broadly used.

Here universal agreement ends and controversy begins. Many units are to be dropped by international agreement and will soon be illegal. The kilogram-force (kgf), the calorie, and the torr will be illegal in the European Economic Community (EEC) countries after January 1, 1978. There is no question that anyone who uses these units does not understand the system, has no interest in world uniformity, and is going contrary to world use.

The kilogram-force, which is the old gravimetric unit of force, is the most common of the terms scheduled for extinction. The standard kilogram force is 9.8 newtons. (You can see that it is not coherent.) It is a poor unit and must not be used, along with all the old customary European units related to it, such as kilogram per square centimeter for pressure. The calorie is in the same boat. The calorie, incidentally, had tremendous emotional backing. People wrote article after article trying to preserve their favorite. There is no question now, however, the calorie will disappear.

There are a number of units that have customary names for decimal multiples of SI units, multiples which have not been recognized by the international body responsible for SI, and about which there is much argument and discussion. I think I am safe in stating that almost all the arguments in favor of using these old units amount to "we're used to it," or "people are using it."

The bar is exactly ten to the fifth pascals, or 0.1 magapascal, or 100 kilopascals. The tonne is exactly one megagram. The hectare is a square hectometre. The reasons for making good decisions on these units are not understood by most people. As mentioned above, it is an international problem, and a very serious one. There are knowledgeable people, primarily in Europe, who are pleading with us in the U.S., since we have not yet really gotten used to any of these units, to help build good world practice and to resist the introduction of non-SI units where it is not justified, and where SI has good usable units.

Only time will tell where, such units go. These are the only ones in controversy. If I had to make a guess, I would say the tonne will not be used in the U.S., because it is so close in pronunciation to the ton. The equivalent unit, metric ton, probably will be used, although it is absolutely not needed, as the megagram is exactly the same.

As for the hectare, I would bet that it will live. It also is not needed, but it has going for it the fact that it is relatively isolated in a somewhat non-technical area. It is used in talking about large areas of land. Actually, it gets right in the middle of technical work with agricultural engineers who relate machines to field sizes, but this application is somewhat limited. I hope it dies, but I am afraid it won't.

The bar generates the most controversy, and in my opinion, is completely undecided. There are many people with good reasoning and sound sense behind them who are fighting to eliminate the bar and use the perfectly good SI unit, pascal, for pressure, I think they are in a better position to win now than they were a year ago.

Unfortunately, there are major societies and groups of industrial people who are saying that the bar is the unit of pressure and they are going to use it. Many don't understand coherence and don't care; their justification is primarily custom. Some countries have already outlawed the bar. Nonetheless, a very prestigious standards organization has suggested that we use the bar regularly in specifications and documents, but whenever we calculate, we use the pascal!

CONCLUSION

SI is devised and maintained by an international organization, the General Conference on Weights and Measures (CGPM), in which the U.S. has strongly participated. It is a system that we have to respect, work with, and support. If there are improvements needed, we should cooperate with the international controlling body.

The bible of SI is the National Bureau of Standards *Special Publication 330.* It is an authorized English translation of the official document of the international body. For U.S. use, however, there is a need for more information and guidance. We have an obligation to look more carefully at the units that will be used with SI and how we approach their use. As for the needed guidance, the most recognized document for guiding U.S. use is ASTM E380, the basis of most industrial and technical society use today. It is sound, complete, and accurate.

The key to all the problems outlined above is, of course, education. Natural human inertia resists change. We put up a fuss when something new comes along. I have a strong feeling that by the time our youngsters grow up and get to college, the textbooks will be in pretty good shape. And, when they get out of school and get into industry, science, commerce, and law, the problem will be over. They will have learned SI; they will understand it and understand why it should be respected and used properly.

In summary, SI is a clean, coherent, vitally important system, and very urgent to understand. You don't necessarily have to *learn* it — you can keep a manual handy — but you must *understand* it. Understand the urgency of using it correctly as teachers. It is an international problem, not a U.S. problem, and it is a system that we will be using when all the controversy is over. The world has grown too small for any alternative.

Norman B. Johnston
International Harvester

Developments and Trends in Four Year Engineering Technology Programs in Southern States

INTRODUCTION

Twenty-three colleges and universities in ten southern states identified as offering four-year engineering technology programs were surveyed. The institutions were located in the states of Alabama, Florida, Georgia, Kentucky, Louisiana, North Carolina, South Carolina, Tennessee, Virginia, and West Virginia (Appendix A). Equivalent full-time (EFT) enrollments ranged from 45 to 1687 with a median and average of 240 and 314 respectively.

Eighteen institutions, 78%, responded to a detailed ten-page questionnaire. The responses represented the status of the programs as of August 1977. The high percentage of return for a lengthy questionnaire, and several letters which accompanied the returns, are interpreted as demonstrating the great interest on the part of engineering technology educators in various key questions related to their program.

In the presentation of the results of the questionnaire which follows, no attempt was made to statistically analyze the data in detail by considering such factors as administrative structure, total and major enrollments, major fields, and whether the financial support was private or public. A cursory examination of the data collected did not reveal any significant trends.

Administrative Features and Programs

There are in the southern region a variety of administrative structures as shown in Table 1. There is no consistency in designating the units within an institution offering the four-year engineering technology programs. In compiling these data, "college" and "division" are used synonymously with the designation "school." At ten institutions which offer both engineering and engineering technology on the same campus, the engineering technology programs are either in the School of Engineering (c) or the School of Engineering and Technology (b). Five others are a part of a separate School of Technology (a) and one is a separate institution (e).

Table 1. Administrative Structure

		Responses
a.	Part of a Separate School of Technology	5
b.	Part of School of Engineering and Technology	2
c.	Part of a School of Engineering	8
d.	Part of a School of Science or Applied Science	2
e.	Separate Institution	

There were four questions related to the sharing of faculty and facilities (laboratories, equipment, etc.) between engineering and engineering technology programs. Of ten institutions which offer both programs, eight share faculty and all ten share facilities. One engineering technology program is planning to share to a limited extent faculty and facilities with engineering programs on other campuses. The one primarily engineering technology institution shares faculty and facilities in one program with its related engineering institution. Nine responses indicated that it is desirable to share faculty and eleven felt that it was desirable to share facilities.

The nature of the technology programs varies among the eighteen institutions. Eight institutions offer only a four-year program which does not include an associate degree as an integral part.

Seven institutions which teach all four years offer 2 + 2 programs, and three others offer only the last two years.

ECPD accreditation of engineering technology programs were apparently of importance to most institutions with ten institutions responding that their major programs were ECPD accredited. Six others reported a desire to have their programs accredited. Two respondents indicated that they were not interested in ECPD accreditation.

All institutions responding provided data on EFT enrollments and baccalaureate degrees conferred for 1976-77. As shown in Table 2, the total enrollment was 5,863, and 1,120 degrees were conferred. Enrollments and degrees in industrial technology reported are not included. Electrical and electronics engineering technology programs have by far the highest enrollments. There were no indications, however, that for these programs or any others that the supply of graduates meets the needs of industry. In contrast to engineering programs, the specialized nature of many engineering technology programs has resulted in a wide range of programs offered.

Table 2: Graduates and EFT Enrollments 1976-77

Technology	EFT Enrollment	BS Degrees Conferred
Aircraft	48	12
Apparel	29	1
Architectural	498	51
Broadcast	16	0
Civil	834	131
Computer/Computer Systems .	154	27
Construction	298	46
Electrical/Electronics	1867	234
Environmental	110	10
Forest Products	13	2
Industrial	347	55
Industrial Safety	10	2
Land Surveying	25	7
Materials Joining	20	5
Manufacturing	87	15
Mechanical	839	185
Mechanical Drafting & Design .	162	19
Mining	104	
Operations	94	23

Printing	42 . . .	2
Textile	66 . . .	4
Programs and/or Degrees Not Designated*	200 . . .	289
Totals	5,863	1,120

*Some programs and/or degrees are not designated.

The percentage of engineering technology courses which include laboratories span a wide range of percentages for the responding institutions from less than 21% to over 80% as shown in Table 3. The responses indicate that laboratory experience is generally considered to be of importance in engineering technology programs.

Table 3. Required Laboratories in Engineering Technology Courses

Range, Percentage of Courses		Responses
a.	Oto2O	1
b.	21 to4O	4
c.	41to60	4
d.	61to80	6
e.	8ltolO0	3
	Total	18

While the percentage of engineering technology students participating in co-op programs is relatively low, twelve of the respondents offer such programs and eight of the twelve give academic credit. One institution requires all students to co-op, while for the others participation varies from less than 1% to a maximum of 10%. Although the respondents were not queried on percentages of enrolled students employed full-time, several reported a relatively high percentage.
Calculus is required by all but one responding institution; however the frequency of utilization apparently varies with a majority finding it is frequently used. The responses are shown in Table 4.

Table 4. Usefulness of Calculus in ET Program

		Responses
a.	Not required and not utilized	0
b.	Required, but seldom utilized	5
c.	Not required, but needed	1
d.	Required and frequently used	
	Total	18

Three institutions have or plan to have technically oriented master's degrees programs in technology. The other fifteen have made no plans at this time. The needs to be fulfilled by existing or planned programs are:

1. Provide specialized technologists for water-treatment, environmental technology, urban systems planning, and construction management.

2. Junior and senior college technology teaching.
3. Industrial and government positions.

Industrial advisory committees are utilized by over eighty percent of the institutions. Only three do not utilize committees; however, one is planning a committee in the near future. Table 5 gives measures of the effectiveness of the committees in nine areas of interest.

	Very Effective	Effective	Ineffective	Involved
a. Curriculum planning	3	10	1	0
b. Providing loans or scholarships	1	3	6	3
c. Providing Coop Stations	2	8	1	2
d. Placement of graduates	4	7	2	1
e. Recruiting students	0	9	4	1
f. Providing equipment	3	5	4	2
Providing field trips or training materials	5	7	0	2
h. Providing employment for faculty	0	4	6	4

Funding

Financial support for all of higher education is a major concern today. The questionnaire did not attempt to make a detailed survey of financial matters of interest to engineering technology administrators, but rather asked general non-quantitative questions. No attempt was made to correlate responses as to whether the institution is private or public nor the administrative

structure.
Only three of the responding programs do not receive a recurring annual budget for capital equipment. In only two cases is capital equipment depreciated with annual replacement monies provided. The average and medial capital equipment purchases funded from “one-shot nonrecurring money” is approximately 40%.
Three programs of the eighteen responding, reported that no funds are provided for student assistants and one did not have a budget allocation for faculty travel. For fifteen programs which are part of or could make a comparison with engineering programs, nine felt that their programs were funded equitably with their engineering counterparts, considering the difference in missions and considering the number of students involved.

Engineering Technology Faculty Characteristics
Fifteen respondents felt that the minimum educational background for ET faculty should be the master’s degree; however, two would consider the bachelor’s degree plus extensive, applicable industrial experience. One indicated that approximately half the faculty should possess the doctorate, but should be industry oriented. Three respondents accept the bachelor’s degree as a minimum requirement.
It is interesting to note that twelve respondents indicated that it will be desirable in the future to continue to have engineers as technology teachers. Three did not agree; one indicated that it depends on several factors including education; and one indicated that a BET graduate with an MS in engineering may be acceptable. Seventeen respondents would not hesitate in hiring a qualified technology graduate as a faculty member, but one indicated that in addition a degree in engineering would be desirable.
While fourteen of eighteen respondents feel that professional licensure is important for technology teachers, only four feel that licensure should be a requirement. Industrial experience is an important requirement for technology teachers as shown in Table 6.

Table 6. Industrial Experience Expected for Technology Faculty

Years	Responses
a. None	0
b. One Year	1
c. Several Years	13
d. Five or More Years	.4
Total	18

Eleven respondents indicated that they require continuing professional development for technology faculty, and seven do not. For those having the requirement, its uses are given in Table 7.

Table 7. Uses of Continuing Professional Development

Use	Responses
Promotion	12
Tenure	9

Pay Raises	9
Continuation	4
None of the Above	*5*

Professional development takes on a number of forms as shown in Table 8. Individual institutions utilize a variety of forms for faculty development.

Table 8. Forms of Required Experience Form

Form	Number Using
Academic Training	10
Degree Oriented	6
Non degree Oriented	8
Industrial Work Experience	13
Summers	11
During School Year	7
Publishing Article or Textbook	6
Consulting	9
Participating in Conferences and Workshops	16
Public Service	1

Fourteen of the eighteen respondents encourage faculty updating through one or more of the provisions shown in Table 9.

Table 9. Mechanisms for Encouraging Faculty Updating

Mechanisms	Responses
Paid sabbatical leaves	10
Unpaid leaves of absence	8
Faculty exchange	1
Reduced teaching loads	1

Considering all things (e.g. backgrounds, teaching loads, salaries, and promotion), thirteen of sixteen respondents feel that their technology faculty members are treated as fairly as engineering faculty members.

Teaching loads with weighting laboratory hours in comparison with lecture hours are of continual faculty interest. Typical equivalent loads vary widely as shown in Table 10. Scale factors for the conversion of laboratory hours to equivalent lecture hours were left to the discretion of the respondents. In Table lithe wide variation in weighting of laboratory teaching is shown for seventeen respondents. It is noteworthy that two of the six institutions designating a full-time teaching load of 12 or fewer equivalent hours, weigh laboratory hours the same as lecture hours.

Table 10. Typical Faculty Teaching Loads

Equivalent Contact Hours	Number
12 or fewer	6
13—16	9
l7or more	.3
	Total 18

Table 11. Weight of Labs in Establishing Teaching Loads

Same as lectures	4
One and one-half hours equivalent to one lecture hour	*5*
Two hours equivalent to one lecture hour	.8
Total	17

Eight of seventeen respondents have from ten to fifty percent of their faculty on temporary, non tenure tracks. Eleven of fourteen respondents think that it is desirable to have from five to fifty percent (median 20 percent) of their faculty on a non tenure track.

Difficulty in recruiting temporary faculty is experienced by nine respondents, while seven have no problems. In a similar fashion for permanent faculty, ten have difficulties while seven do not. Some of the problems and the degree of these problems encountered in hiring new faculty are shown in Table 12. Problems with respect to salary, academic background, industrial experience, and technology orientation are encountered by most institutions, while geographic location in most cases is no problem.

Table 12. Problems Experienced in Hiring Faculty

Problem	Major	Some	No
Candidate's salary requirement	7 . . .	7 . . .	4
Finding candidates with current academic background	2. . .	12. . .	4
Finding candidates with correct industrial experience	6 . . .	ii . . .	1
Finding candidates with a technology orientation	5 . . .	8 . . .	5
Candidate does not like geographic location	0 . . .	2 . . .	16

Student Characteristics

An attempt was made to obtain quantitative data (SAT scores, ACT scores, high school rank, and grade point index) on beginning technology freshmen, but the responses were fragmentary and no useful information was obtained.

The approximate percentage of technology freshmen who would meet engineering entrance requirement was estimated by fourteen respondents to vary widely from eight to one hundred percent, with a median of fifty percent. Fourteen respondents reported transfers from engineering programs. Estimates of transfers varied from five to twenty-five percent, with a median of 6 percent. Four indicated no transfers.

Most programs have part-time students enrolled as estimated in Table 13.

Table 13. Part-time Enrollment by Headcount

Percentage	Responses
0	3
1	1
5	5
10	3
20	1
30	4
80	1
	Total 18

It was estimated that the average age of students in programs as reported by eighteen respondents varied from 19 to 30, with a median of 23. All but one program reported female enrollments varying from two to ten percent, with a median of three percent. Four programs have minority enrollments of 40, 50, 80, and 95%. Of the other fourteen, one program reported no minorities, while for the others the percentage ranged from two to ten percent, with a median of five percent.

Recruiting, Retention, Placement, and Follow-Up

In the south in all but one special purpose program with only five percent state residents, the percentage of state residents varied from 65 to 98%, with a median of 90%. Au respondents were bullish on the prospects of increasing enrollments over the next decade. Seven project a great increase and eleven project some increase.

There was no significant difference in retention rates between the three programs offering only the last two years; median 75%, and a median of 70% for fifteen programs offering all four years.

A very high percentage of ET graduates, median *95%,* have discipline-related placements at or near graduation. In one case the percentage was at a low of 10% and in the maximum case, it was 100%. A high percentage of ET graduates have “engineer” in their first job title. The range is from 10 to 90% with a median of 70%.

The optimistic outlook for future increasing engineering technology enrollments is to a great extent predicated on existing demands by industry for graduates. Six respondents report that the supply of graduates is much less than demand, ten report that the supply is a little less than demand, and only two report that supply and demand are about equal. In no case was the supply reporte.d to exceed the demand.

Starting salaries for four-year engineering technology graduates reflect the demand exceeding supply. Reported salaries ranged from $8,500 to $25,000 per annum during 1976-77, with a median average starting salary of $13,200. In Table 14 minimum, average and maximum starting salaries are tabulated. Although overall averages are given for each of the three categories, they are not weighted.

Table 14. BET Graduate Annual Starting Salaries 1976-77

	Minimum Salary	No.	Average Salary	No.	Maximum Salary	No.
	$ 8,500	1	$10,000	2	$13,000	1
	9,400	1	11,500	2	13,500	1
	9,500	1	12,000	2	14,000	1
	9,600	1	12,500	1	14,700	1
	10,000	4	13,000	1	15,500	1
	10,800	1	13,100	1	15,600	1
	11,000	3	13,400	1	15,900	1
	11,400	1	13,500	1	16,000	2
	11,500	1	13,700	1	17,000	3
	12,000	3	14,000	1	17,800	1
			14,200	1		
			14,500	1	18,000	1
			15,000	2	19,000	2
			16,000	1	25,000	1
Average	10,865		13,050		16,706	
Median	10,800		13,250		16,000	

All but two responding institutions have a formalized placement process. Ten have a formalized follow-up procedure for their graduates, while eight do not. As many alumni groups participate in ongoing departmental activities as those who do not. Alumni donate money for only six schools, while for eleven they do not. This would be expected because engineering technology programs are relatively new, and it takes a long time to develop alumni interest in donating money to schools from which they have graduated.

Summary

Engineering technology educators have demonstrated that they are very much interested in the present and future status of their educational programs. While, in some respects, distinct differences exist in programs, the similarities far outweigh the differences. An optimism prevails for the future based on the fact the demand for graduates exceeds the supply, and that it is expected that the demand will continue into the foreseeable future. This also demonstrates that the graduates and employers of these graduates are well served by existing programs.
Significant differences do exist in administrative structures; however there is no evidence that this is a significant factor in the results achieved. A wide variety of degree programs is offered, but they best serve the students and industry in the community in which the institution is located. There is also a wide variation from institution to institution in defining equivalent teaching loads and the extent to which calculus is used in technical courses.
Distinct similarities and strengths exist in that laboratory experience is an essential component of engineering technology programs, faculty have had and continue

to maintain appropriate industrial experience, and that needs of employers are continually evaluated as inputs toward program improvement.

It is felt that the results of this survey of four-year engineering technology education in the south, together with similar surveys from other sections of the country, will provide faculty and administrators with useful information in future program planning.

Walter 0. Carlson Dean/Executive Director
Southern Technical Institute
Marietta, Georgia

APPENDIX A

Bachelor of Engineering Technology Programs by State and Institution, Southern Region, 1976-77. (All listed institutions were sent questionnaires; an asterisk denotes no response.)

State	Institution	City
Alabama	Alabama A&M	Normal
	*University of Alabama	University
Florida	Embry Riddle	Daytona Beach
	*Florida A&M	Tallahassee
	Florida International	Miami
	Florida Tech. Inst.	Orlando
	Univ. of Florida	Gainesville
	*Univ. of South Florida	Hillsborough
Georgia	Georgia Southern	Statesboro
	Savannah State	Savannah
	Southern Tech. Inst.	Marietta
Kentucky	Western Kentucky	Bowling Green
Louisiana	Louisiana Tech	Tech Station
	Southern A&M	Baton Rouge
North Carolina	Univ. of North Carolina at C.	Charlotte
South Carolina	Clemson	Clemson
	*South Carolina State	Orangeburg
Tennessee	Memphis State	Memphis
	University of Tennessee	Martin
Virginia	Old Dominion University	

Norfolk		
	*Virginia Polytechnic Inst.	Blacksburg
West Virginia	Bluefield State	Bluefield
	Fairmont	Fairmont

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Articulation Between Associate and Baccalaureate Programs in Engineering Technology Education

To engineers the word articulation is one of the friendlier terms in our vocabulary. It means the working together of separate parts of a system, each capable of moving with respect to the others, yet intimately connected toward a common purpose. The use of the word to describe the process of students transferring credit from one institution of higher education to another recognizes the fact that there is a great deal more to the process than the simple forwarding of transcripts.

Not too long ago, few people in engineering education worried much about articulation. In our field, transferring from the sophomore level at a junior college to the junior level at a four-year college was natural. It was sometimes difficult to tell the difference between the “native” students and the “transfer” students. Transfer was more an issue of student records than a real instructional one. All juniors, native or otherwise, were in fact transfers from some incubation process to their degree-granting engineering departments.

Now that engineering technology has entered the picture, the process of transfer has become much more complicated. After their two years of study, engineering technicians are very different from the regular engineering students who have completed the sophomore level. Associate degree engineering technicians are trained for employment; they do not come from transfer programs. As a result, they lack some skills which native students have, but they possess other skills that are not exploited by the baccalaureate programs in engineering. As a consequence, some universities dismiss engineering technicians as unqualified and do not attempt to accommodate the associate degree technician with much other than a start-over program. Others do attempt to accommodate technicians in their baccalaureate engineering technology programs. If and when such accommodation is made, articulation must take place in the truest sense of the word.

A survey was undertaken to test the agreement between representatives of two-year and four-year engineering technology programs on critical issues related to articulation. Before reporting the results, a brief outline of the growth of these programs is offered to place the issues in perspective.

Historical Perspective

Associate degree programs for engineering technicians were well established before 1960. A spurt of development occurred in the early 1 960s. The growth in the number of programs is

attributable to three things.
1) There was at that time an apparently insatiable demand for scientific and technical personnel. Two-year associate degree technicians were seen as a means to supplement the limited number of engineering graduates.
2) Both the launching of Sputnik in 1957 and the advent of the digital computer had a tremendous impact upon engineering education. There was a movement to

focus the education of an engineer more upon science and less upon shop, laboratory, drafting, and design. Analytical techniques, which had previously been only theoretical exercises, were made practical by the digital computer. Consequently, the education of an engineer underwent a conversion toward science and analysis. Two-year associate degree technicians were needed to fill the vacuum that then occurred in the arts of design, testing, and manufacturing.
3) During the 1960s community colleges were being established at a very rapid rate. These low-cost, open.door, two-year colleges of convenience were perfect for the task of educating associate degree engineering technicians. Many community colleges established the labs and acquired the faculty to enter this field of education.
By the 1970s, some colleges and universities began to offer bachelor's degree programs in engineering technology. Since 1970 the growth of new programs in engineering technology has been at the baccalaureate level rather than at the associate degree level. Two factors contributed to this new development.
1) Many industrial demands were not being satisfied by either the post-1960 B.S. degree engineer or the associate degree engineering technician. B.S. degree engineering programs were no longer focused upon design, testing, and manufacturing where developments were occurring as rapidly as in the more theoretical areas. Some employers were reporting dissatisfaction with the scientific and analytical engineer in certain jobs. Meanwhile, the associate degree technician, although trained in these areas, did not have the depth of knowledge and technical judgment that comes with four years of college. The four-year baccalaureate program in engineering technology offered a solution to the dilemma.
2) Higher education was beginning to see new kinds of students. In today's jargon, they are called "non-traditional students," i.e. they are something other than the college track students fresh out of high school for whom most engineering programs are designed. Included are minorities, those seeking to broaden their job horizon, and women and others wishing to re-enter the work force. Two-year programs can be worked into their plans. But many of these people raise their aspirations as they approach the associate degree. They then desire transfer opportunities to bachelor's degree programs. Engineering curricula, geared for the traditional students, have been unable to accommodate the associate degree technicians as an entry stream. Some baccalaureate technician programs, however, were designed in a two-plus-two mode in order to accept the transfer student with an associate degree at the junior level.
Baccalaureate programs in engineering technology are still controversial among engineering educators. Graduates are called "technologists," a name contrived to distinguish between the two-year technicians on one hand and the four-year engineers on the other. Graduates and those who teach in B.S. technical programs would prefer the name "applied engineers."

The Articulation Question

Associate degree technicians are not very competitive as transfer students in engineering programs, owing to irreconcilable curricular constraints on both sides of the transfer. In B.S. engineering technology curricula, on the other hand, favorable transfer options often do exist for the associate degree technician. Impediments to articulation are more likely to exist in the lower division institution than in the upper division one. One curriculum leader from a two-year college wrote

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on the questionnaire used in this study of engineering technology, “Improve the associate degree programs and forget about the B.S. programs.”

That view is not uncommon among two-year faculty who have designed their curricula to be “terminal” and geared for job entry. Two-year faculty want to preserve their freedom to adjust their curricula to job needs without being encumbered by transfer implications. If articulation is to be successful, two things must occur. Two-year faculty must feel that they retain their option to accommodate the employers of technicians, and four-year faculty must be Willing to adapt their curricula to the two-year graduate. The purpose of the study reported below was to test the agreement between two-year and four-year schools on these critical issues related to articulation.

The Survey

A survey form was sent nationally to curriculum leaders of ECPD-accredited programs in engineering technology at both the associate and baccalaureate levels. About 500 questionnaires were sent out; more than 260 were returned. Those surveyed were not addressed by name. The questionnaires had to be sent blindly to deans, directors, or engineering technology department heads with requests that the forms be forwarded to the appropriate “curriculum leaders.” Under these circumstances the return of more than 50 percent is a fairly good level of participation.

Survey Format

The questionnaire consisted of 16 statements in the following form:

	Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
Associate degree programs in engineering technology should not be a dead-end academically	___	____	_____	_____	_______

Respondents were asked to check the appropriate blank to show the extent of their agreement or disagreement.

Additional comments were solicited. More than half of those responding took the opportunity to comment. Comments indicated a wide divergence of views on every issue.

About 80 percent of the respondents chose to identify themselves. Those who did were sent a summary of results. Those who were identified were put in either the associate group or the baccalaureate group. In this report the category “All Respondents” includes not only those identified as associate or baccalaureate curriculum leaders, but also those who did not choose to identify themselves.

Data Reduction
A “Strongly Agree” response was given a value of 5.
An “Agree” response was given a value of 4.
A “Not Sure” response was given a value of 3.
A “Disagree” response was given a value of 2.
A “Strongly Disagree” response was given a value of 1.

By assigning the above numbers to responses, “average response” values were computed for each statement. Furthermore, a standard deviation was calculated for each statement. This is offered as a crude index of the spread of opinion on each issue. Standard deviations ranged from 0.61 to 1.37.

Analysis Results
1) *Associate degree programs in engineering technology should not be a dead-end academically.*

	Number Responding	Average Response	Standard Deviation
Associate Degree Curriculum Leaders	124	4.66	0.51
Baccalaureate Curriculum Leaders	93	4.65	0.76
All Respondents	258	4.65	0.66

Conclusion: Both associate and baccalaureate curriculum leaders strongly agree that there should be transfer opportunities for associate degree technicians. This is the maximum agreement attained by any of the 16 statements. The spread of opinion indicated by the standard deviation is the smallest of all.

Lawrence J. Wolf
St. Louis Community College
at Florissant Valley

Need for a Master's Degree Program in Engineering Technology

The following is a proposal to establish a program for the master's degree in mechanical engineering technology at the University of Houston.

Although the Department of Mechanical Technology at the University of Houston has been training and graduating students since 1968 with significant success, it is becoming increasingly clear that the present 51 semester hours in specialized areas of mechanical technology are not sufficient to meet the rapid advances in technology both in theory and application. Graduates in the field indicate a strong desire for a graduate program. Continuing education programs do not fill the need because they are not competitive with degree granting programs. The advantages of graduate work for students in many areas both technical and non-technical are documented and accepted throughout the educational, business, and industrial areas, both nationally and internationally. Surely some of the elements in establishing the need for master's degree programs in business, industry, and engineering apply to establishing a master's degree program in mechanical engineering technology.

The following examples are cited to demonstrate the need of extra course work in the curriculum of the Department of Mechanical Technology:

1. Although fluid mechanics is one of the most significant courses in the curriculum, time does not permit a detailed consideration of practical applications of basic principles. Additional course work would permit a significant presentation of practical problems involving the use of actual measuring instruments, hydraulic machines, and fluid mechanic systems. A course in non-compressible fluids and a course in compressible fluids at the graduate level would permit the student an opportunity to develop greater sophistication in the practical applications of fluid mechanics. Laboratory projects designed to simulate industrial applications would decrease time necessary for training on the job. Frequent visits by the graduates of the Department confirm the need for added emphasis on actual specific problems in the field. Other courses, such as thermodynamics, strength of materials, heat-energy systems, mechanical design, and industrial production methods can be cited as examples of areas where courses with emphasis on application would be profitable at the graduate level.
2. Graduate courses designed to explore the potential for application of the computer to practical mechanical problems would make the graduate student more useful to employers. More sophisticated courses in the use of computers are necessary to complement the existing bachelor program's offerings.
3. Since mechanical engineering technology is fundamentally oriented toward application, it is particularly significant that liaison between industry and education be established in connection with mechanical technology. A master's degree program should require special education projects, within the student's area of specialization, to contemplate needs within business and industry.
4. Faculty members in the Mechanical Technology Department have many years of academic training and industrial experience. These backgrounds provide a great

of science and engineering principles. A master's degree program would surely develop a viable research arm in Mechanical Engineering.

Only one other factor contributes to the argument for establishing a master's degree program at the University of Houston: precedent. Texas A & M University and the Clear Lake branch of the University of Houston have already begun master's degree programs in engineering technology. The State of Texas clearly saw the need, or understood the need, for graduate programs in engineering technology before now. The University of Houston should not fall behind in this necessary and growing trend.

B.C. Kirklin, Ph.D., Sponsor
Zeta Alpha Chapter and
Associate Professor
Mechanical Technology
University of Houston
Houston, Texas

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The Energy Crisis: A Problem for Technology

The following article was submitted by James L. LaGarde, a student at Virginia Western Community College and a member of the Theta Alpha Chapter of Tau Alpha FL

Throughout the history of the United States, our nation has been faced with many seemingly insurmountable problems. Without citing particular examples, I do not hesitate in saying technology has played an important role in the development of solutions to these problems. We are now faced with another problem of great concern needing a solution. In short, our nation is in the grasp of an energy crisis which could bring an industrialized nation to its knees.

Several years ago, the Arab nations imposed an oil embargo on our nation. Our supply of oil ran short, and we received our first taste of an energy shortage. There were long lines at the gas pumps, long waits for heating oil, and many Americans were inconvenienced for a short while. The words "energy crisis" began to surface for the first time.

A few years later, in the winter of 1976-77, the weather for a large part of America was terribly cold. Supplies of natural gas dwindled across the nation. Our people didn't have the means to heat their homes, people died, many were inconvenienced, and the words "energy crisis" surfaced again.

Many Americans either don't believe or don't want to believe the energy crisis is a reality. We, as a nation, are too used to having and wasting our natural resources. You've heard it before, "America, the land of plenty." Well, we don't have plenty of energy resources, and as long as people believe we do, they will continue to waste the energy available.

Our national leaders have tried time and time again to make the energy crisis a fact of national concern. Unfortunately, they are having a hard time being heard over the countless special interest groups.

As engineers and technicians, we should not have to be persuaded into believing there is an energy crisis. Common sense dictates that the fuels we are surviving on are depletable and therefore temporary. The time has come for looking ahead to an age where we are not dependent on fossil fuels such as oil, gas, and coal to meet all our energy needs. It is time to begin developing alternative sources of energy on which an industrialized nation may survive.

The most obvious alternative source of energy is that of the sun. We need to develop ways of harnessing this vast amount of untapped energy and converting it into useful, economic energy for homes and industry. Many devices have already been developed as can be seen in magazines such as *Fopular Science, Mother Earth News,* and *Science Digest.* But, these are not necessarily economical or practical. Most solar devices have been developed in backyard projects and do not have the proper financing or the latest up-to-date technology.

Another alternative that comes to mind is the use of hydrogen. Technology has already proven to mankind that hydrogen is useful as a fuel. It is one of the most abundant elements on earth; therefore, supply would not be a problem. Once again, research is needed to develop hydrogen as an economical, useful fuel for both home and industry.

I feel it is imperative that both government and industry come to terms on solving our energy situation. It is obvious that we have no definite direction in coming up with a solution as yet. We should first realize that our choice of direction should lead us away from dependence on fossil fuels. These fuels are environmentally dangerous to both our earth and its atmosphere. Fossil fuels are depletable resources and should be conserved for better use.

In essence, I am proposing a sense of direction for solving the energy crisis —establishment of a goal, then development of necessary technology to reach that goal. At this point, the responsibility of solving the energy crisis will, and should, fall on the shoulders of engineers and technicians. It will be left up to us to use the available information to develop the necessary technology to transform the United States into an energy wealthy nation.

In all previous crises, the people of our nation have looked to the engineers and technicians to develop economical, feasible solutions. The energy crisis should be no exception, for we have been trained to solve problems. We, as professionals, have an obligation to make our superiors, politicians, and citizens aware of the seriousness of the energy crisis. Our profession could then go about developing the necessary technology.

It should be clear to all those reading this article that all of the answers to our problems are not obvious. But this problem is obvious and has been for some time. I am not writing to give people answers or false hopes. We may have some of the answers already, but our false concepts will become inconceivable realities if we continue in the manner in which we are headed. I am writing only to give a sense of direction.

Energy is not necessarily the problem, for it surrounds us every day. The problem is developing the necessary technology to harness this energy. Our first step as engineers and technicians is to become aware of the energy crisis facing us. I am certain technology will answer the demands of society and come up with the necessary solutions.

James L. LaGarde
Virginia Western
Community College,
Roanoke, Virginia

Books of Interest

Zen and the Art of Motorcycle Maintenance, by Robert M. Pirsig, New York, William Morrow & Co., Inc., 1975.

This unusual book, subtitled "An Inquiry Into Values," was a bestseller when first published in 1975 and has already gone through 18 printings. To quote the author:

The real cycle you're working on is a cycle called 'yourself'. The study of the art of motorcycle maintenance is really a miniature study of the art of rationality itself. Working on a motorcycle, working well, caring, is to become part of a process, to achieve an inner peace of mind. The motorcycle is primarily a mental phenomenon.

While the author is presumably describing a father's motorcycle trip with his young son, he is also examining the attitudes of people who fear an imaginary monster called "technology" — people who want all the benefits of technology provides, but who do nQt wish to understand it or learn how to manage it. The book also looks at the "spectator mechanics," those uninvolved with their work and uncaring. The writer explores "that strange separation of what man is from what man does" in order to find some clues as to what has "gone wrong in this 20th century." A detective story of a man in search of himself, in search of his son; a man concerned with the quality of life and appreciation of the everyday world.

It is a highly original mixture of basic mechanical details, descriptions of nature as experienced from a speeding cycle, and philosophical insights which weave them all together.

Quoting the book jacket, this is "the extraordinary story of a man's quest for truth, which will change the way you think and feel about your life." You don't have to be a motorcycllist to enjoy this book.

Ruth Schuldenfrei

The Existential Pleasures of Engineering

The Existential Fleasures of Engineering; by Samuel C. Floman, New York, St. Martin's Press, 1976.

The title of Samuel C. Florman's book, *The Existential Fleasures of Engineering,* gives only a partial indication of its contents. Florman begins the volume with a brief history of engineering and then proceeds to a thorough presentation and refutation of the position of those social theorists he calls the antitechnologists. Only in the last third of his study does he assert and describe the existential pleasure of engineering.

The years 1850 to 1950 were, Florman contends, the Golden Age of engineering, an occupation that had evolved from a collection of crafts to a single profession only with the dawn of the Industrial Revolution. The dams, bridges, and machines of the Golden Age inspired not only engineers and embryo engineers, but also poets, painters, and statesmen, as well as the common citizen. It seemed clear to everyone that the horizons for human well-being were limitless, thanks largely to the work of the engineer, and the engineer himself found his work thrilling, "in an elemental existential way."

Then, on 31 January 1950, President Truman announced that work on the hydrogen bomb was under way, and the engineer and his work were metamorphosedirom the saviors of humanity to its scourge. Now it was not only a few romantics who cursed technology, the medium of the engineer, but numerous scientists, social scientists, and even the fickle citizenry. Professional engineering journals began to urge a newly sensitized conscience upon their subscribers, and morale amongst engineers began to slide. Not only had the dangers of sophisticated weaponry become evident, but industrial pollution, urban sprawl, and depletion of natural resources were beginning to frighten a large segment of the population. Having demanded separate houses with surrounding plots of private land, removed from urban centers but easily accessible to them by large, comfortable automobiles on fast, multi-laned highways, and with insatiable appetites for consumer goods of ever increasing novelty and complexity, the American citizenry turned to look at the byproducts of the fulfillment of their demands, and cursed the engineer. But it was not the technologist alone who was seen to be responsible; he shared the blame with his medium. Technology itself came to be perceived as a power in its own right — a Frankenstein that had come to rule its creators.

A new school of social critics was born, the antitechnologists, among whom Florman gives primacy to Jacques Ellul, Lewis Mumford, Rene' Dubos, Charles Reich, and Theodore Roszak. Florman devotes considerable space to a vigorous and thorough refutation to the antitechnologists' position, first dealing with their propensity to treat technology as a self propelling force with an existence separate from its use as a tool. This illusion, he says, results from the often unforeseen consequences of technology, which seem to be the result of the medium and not of the situation to which technology was applied. Thus, for example, it may appear that technology is to blame for the air pollution resulting from numerous private automobiles, when a more reasonable and productive location for blame would be

the people who demand and continue to use those millions of private automobiles, all the while complaining bitterly about the pollution they create.

Addressing the specific contentions of the antitechnologists, Florman responds to their first argument that technology has robbed the average citizen's work of meaning by observing that pretechnological labor, most of which was agricultural, was clearly more deadening, uncertain, monotonously ill rewarded, and constant than that of the laborer in the technological age. Agricultural and other "traditional" labor, Florman contends, has been romanticized by modern observers, victims of the agrarian myth. Certainly it is hard to argue with the millions of rural inhabitants all over the world who have flocked to cities ever since the commencement of the Industrial Revolution, and have preferred even the most menial urban labor to their rural, nontechnological labor.

To the argument that technology has created artificial needs and desires among the consumer population, Florman responds that alternatives to flashy automobiles and electric can openers are equally easy to acquire. Surely it is not the fault of technologists that most people do not purchase oboes and oil paints. And to the critics who complain of a surfiet of consumer goods, regardless of variety or value, Florman points out that there is nothing but people's own desires to prevent them from spending their surplus income on something like a kidney machine for their neighbors.

The establishment of a technological elite and the further repression of the masses is the next contention of the antitechnologists. Florman replies that though this is now technically possible, it has not in fact come to pass anywhere in the world. Further, he argues that repression of the masses is extreme in many less technologically developed societies; that is, that exploitation and repression of the masses is frequently in inverse proportion to technological advances.

Florman next takes up the argument that technology has cut people off from "nature." True, he says, most people in urbanized societies are less in touch with nature, but, as he discussed earlier, many people seem to tire of the loneliness and hard physical labor that goes with rusticity — for them, "nature" is not pleasurable. Furthermore, there are many ways for nature to be experienced. National parks and rural vacations — even houseplants — provide an experience of nature for those who choose to live urban lives. And, asks Florman, is "nature" really necessary for everyone?

Finally, Florman responds to the antitechnologists' argument that technology has replaced our "natural" traditional recreation with artificial pleasures requiring a massive compliment of paraphernalia and a minimum of participation. Who, Florman asks, is to say what constitutes pleasure, or prescribe what we ought to enjoy? Who has the right to say that the modern sport of skiing, for example, requiring hundreds of dollars worth of equipment, travel, and accommodation per person, not to mention chairlifts that greatly reduce exertion, is an inferior pastime compared to such traditional sports as bear baiting or chicken pulls?

In sum Florman contends that much of the technological problem is simply that it is the nature of human beings to want. The destitute who today want food and housing tomorrow will want to eat in fine restaurants and have cottages by the sea, (that is, they will want the very things we ourselves want). It is this spectre, that motivates the antitechnologists. The Blacks rioting in the ghettoes for a share in American bougeois pleasures and the bricklayers who demand (and receive) more money than college professors will not accept the prescriptive "bucolic idyll" of the antitechnologists, who themselves want trips to London and evenings at the opera.

The promises of art, religion, and philosophy have not been kept; the promises of technology have been kept only too well.

Having effectively defended technology against its attackers, Florman turns to a defense of engineers, the practitioners of technology, against a charge of dullness. In this, as in his defense of engineers against a charge of moral laxity (a topic he takes up somewhat earlier in the book) Florman succeeds less well. He admits that sociological studies have shown that engineers are, by any accepted definition, indeed duller than the population at large, but he contends that this is caused by "the stultifying influence of engineering schools" and/or the possibility that dull people choose engineering — it does not choose them. Neither of these arguments does anything to refute the charge of dullness;both merely support it. And Florman's assertion that engineers are bright, dedicated, and unassuming does not address the problem at all. An accusation of dullness must be the least of the problems engineers have to deal with, but having seen fit to take it on, Florman fails dismally to refute it.

Similarly, Florman does poorly when he attempts to defend engineers against the far more serious charge, that having at last realized that the unforeseen results of technology were outstripping our resources and willingness to deal with them, engineers were amoral at best and immoral at worst in not calling a halt to practices that were proving dangerous. The arguments Florman advances are of three kinds: first, he argues that engineers are usually only employees, whose employers have the last word about what will and will not be done, and whose job security will suffer if they protest; second, he argues that where learned opinion disagrees no single standard of technological ethics is possible; third, he claims that the engineer will be unable to perform at his best if he is excessively apprehensive and anxious about his work. These arguments, especially the last, appear extraordinarily weak and flaccid. Florman is eager to assert the professional status of engineering, and yet he seems unwilling to accept the sense of responsibility, that must accompany that status. Among the other trades that call themselves professions, notably medicine and law, the public not only expects but has a legal right to a standard of personal responsibility from the practitioners of those professions. Many doctors are employed by hospitals, most lawyers are employed by corporations, and certainly there are varying theories of medical and legal practice, yet that does not absolve doctors and lawyers from the obligation of personal responsibility. Surely some measure of the same quality can reasonably be expected from engineers.

The last part of *The Existential Fleasures of Engineering* is devoted to a persuasive statement of those pleasures. Most urbanized westerners, contends Florman, are convinced that materialism is shameful, thanks to the Graeco-Christian stress on pure thought and pure goodness unsullied by material activities or production. But, he points out, without the farmer or the artisan the philosopher could not exist. Nor is technological achievement " a gross and desensitizing activity," but "the very essence of the good life —joyous, fulfilling, and holy."

Analysis, rationality, materialism, and practical creativity do not preclude emotional fulfillment. They are pathways to such fulfillment. They do not "reduce" experience, as is so often claimed; they expand it. Engineering is superficial only to those who view it superficially. At the heart of engineering is existential joy.

Aff1n~nt llrh2ni7ed humanity suffers from "seeking ineffable fulfillment in

mystical realms to which (it has) no access except *through* the material life our philosophers scorn." It is the work of the engineer to provide that access, which task is in itself fulfilling. The general obligation imposed upon all of us by birth is the particular concrete obligation of the engineer: "to cope creatively with our environment, to help our fellow humans survive with dignity, to undertake necessary tasks with courage and determination In this way we can all "live out our destiny and fulfill our existential yearnings." Most readers will be convinced.

Chapter News

Nancy McKee

ALPHA ALPHA: (Southern Technical Institute) Alpha Alpha, located on the campus where Tau Alpha Pi was founded in 1953, has had an interesting year. The chapter has fielded a team in intramural sports and has provided volunteer help for the Veterans Club book exchange. The chapter seeks comment from other chapters on the question of professional recognition. Alpha Alpha's officers are Tom Sam-ford, President; Ed Mussinan, Vice-President; Linda Hammond, Secretary-Treasurer and David Steele, Public Relations.

ALPHA ALPHA Chapter (Southern Technical Institute) Kneeling: Rose Snow, David Steele, Davina Henderson. Row 2 left to right: Dr. Robert Fischer (Advisor), Linda Hammond, Ralph Thomas, Pat Moss, Russell Bell, Joe Morgan, and Tom Samford. Row 3 left to right: George Smith, Dwain Penn, Anthony Adibe, James

Lawless, Allen Lewis, George Eckel, John Hollis.

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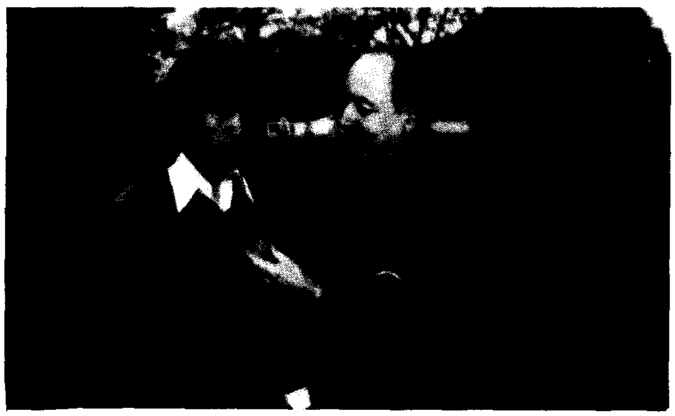
ALPHA BETA: (De Vry Institute of Technology — Atlanta) Alpha Beta is providing DeVry students with files of practice tests so that students can diagnose their weaknesses and improve their performances. Officers are Brad Menz, President; Randy Yates, Vice President; and Matthew Brocco, Secretary.

BETA ALPHA: (Academy of Aeronautics) Beta Alpha ran a tutorial service for freshmen seeking special help in math, physics, and engineering drawing. The membership also drew up plans for a peer advisory service to help other students choose courses and majors. Officers are Robert R. Mayo, President, and Albert Torressen, Vice President and Secretary.
BETA ALPHA Chapter (Academy of Aeronautics) 45th Anniversary celebration.
Left to right: Raffalleo Cecere, Albert Torressen, Joseph Scalise (Chapter Advisor), Imad Itani, James Pyle (Academy Trustee), Robert Mayo, Dr. Walter Hartung (Academy President), Col. George A. Vaughn (Chairman of the Board of Trustees).
BETA DELTA Chapter (Bronx Community College of the City University of N.Y.) Tau Alpha Pi scholarship medallion was presented upon graduation in June 1978 by Prof. Frederick J. Berger to Mr. Cuong Dinh of Beta Delta Chapter for recognition of his high scholastic achievement. His future plans are to continue his education
BETA DELTA CHAPTER (Bronx Community College of the City University of N.Y.)



BETA EPSILON: (Hudson Valley Community College) Beta Epislon celebrated its third anniversary this year. Since 1975, the chapter has inducted some 128 members. Honorary members include Dr. Leonard Spiegel, Department Chairman; Dr. John Nagi, Vice President of Student Affairs; and Mrs. Virginia van Dyck, a staff member of the college. New officers are David Unverhau, President; William Knowlton, Vice-President; Joseph Rossier, Secretary; and Stephen Macia, Treasurer.

BETA ZETA: (College of Staten Island) Beta Zeta has sponsored two guest lectures this year and has taken excursions to local commercial and industrial facilities. More such lectures and visits are planned for the future. Officers of Beta **Zeta are** Anthony R. Terrace, President; Rebecca L. Stulfi, Vice-President; Lois Aurigemma, Secretary; Frantz Napoleon, Treasurer; and Thomas S. Auriemma, Public Relations.

BETA THETA: (Broome Community College) Beta Theta has inducted fourteen new members this year. At press time the election of officers had not been held. Broome President, Peter Blomerley, and Dean of Engineering Technologies, Edward Dougherty, were special guests at the initiation. Professor Arthur Stankevitz was inducted as an honorary member.

GAMMA BETA: (University of Dayton) Gamma Beta has sponsored the L. Duke Golden Award named in honor of the former chapter advisor. The award is given to the outstanding senior in the B.E.T. program. The chapter's initiation banquet was April 7. The chapter would like to receive hints on how to make the initiation ceremonies more newsworthy and prestigious. Officers are Brent Hanf, President; Theresea Bergman, Vice President and Treasurer; and Ronald Duke, Secretary.

DELTA ALPHA: (Wentworth Institute) This year Delta Alpha administered the college's blood drives. The chapter also provided guide-hosts for the annual open house. Delta **Alpha is now planning** a guest speaker program for the college. Officers are John Lepointe, President; Bancroft Winsor, Vice-President; Steve Landry, Secretary; and Mike Pederson, Treasurer.

EPSILON ALPHA: (Missouri Institute of Technology) Epsilon **Alpha** installed new officers: Pamela Newberry, President; Jeffrey Campbell, Vice President; William Davidson, Secretary; and James Kinslow, Treasurer.

ZETA ALPHA: (College of Technology — University of Houston) Zeta Alpha played an important part in the fiftieth anniversary celebration for the College of Technology, Members served as guides and demonstrators in their brand new building. The chapter is planning ways to recognize faculty and students for excellence on a yearly basis.

ZETA BETA: (DeVry Institute of Technology Dallas, Texas) **Zeta Beta** has organized a computer club for their school. The last of the chapter's charter members has graduated and the ranks are being filled with new faces. Officers are James E. Chabreck, President, and Frank Bower, Secretary-Treasurer.

ETA BETA: (University of North Carolina at Charlotte) Eta **Beta** continues to grow though it has an unusual problem. Students in engineering technology are all junior transfers. All members of the chapter are only active for the senior year. The chap-

ter has planned a senior banquet. New officers are Vance E. Poteat, President; David Hawkins, Vice-President; Sharon Young, Secretary; and Dennis Silver, Treasurer.

IOTA BETA: (Pennsylvania State University — 12 campuses) Iota Beta has a unique problems; its members are scattered over 18 regional campuses. The chapter cannot elect officers, but events are being planned to bring members from the various campuses together for social meetings.

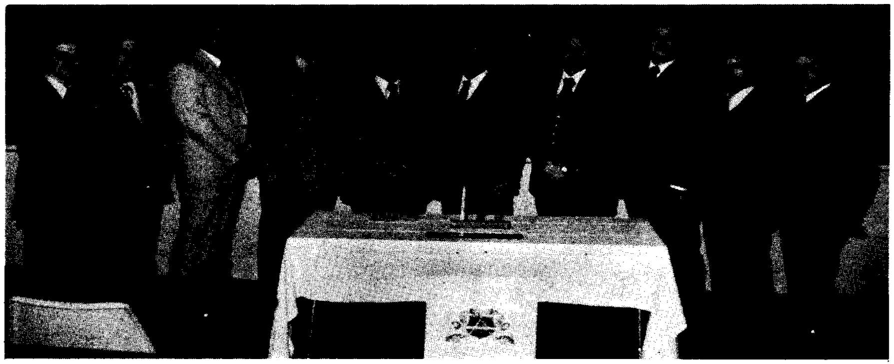
LAMBDA BETA Chapter: (Thames Valley State Technical College) Lambda Beta is holding a special membership banquet this year. Two induction ceremonies were held: one in March and one in April. Lambda Beta's officers are Walter Hyde, President; John Brown, Vice President; and Sam Saleem, Secretary-Treasurer.

MU BETA: (Clemson University) Mu Beta is flourishing. Five new members were initiated in March. In April the chapter helped to coordinate the engineering technology display for Clemson's Engineering Open House for South Carolina students. Officers are Ed Allen, President, and Russ Gardo, Secretary-Treasurer.

MU BETA (Clemson University) Chartering Ceremonies 1977; left to right: Russell E. Gardo, Eric E. Lindsay, James M. Hatley, Canton E. Furr, Edwin W. Allen, Dr. Lyle C. Wilcox (Dean of Engineering), Dr. James A. Chisman (Advisor), Prof. Carl R. Lindenmeyer, William M. Sibley, Prof. Daniel L. Ryan.

NU **ALPHA:** (Lake Land College) Nu Alpha announces that it has initiated four new members: Steve Malehorn, President; Lylah Fallert, Vice-President; Dora Foltz, Secretary; and Larry Cimino, Treasurer. Congratulations.

OMICRON BETA: (Union County Technical Institute) Omicron **Beta** inducted twelve new members this April. Mr. Paul K. Stearns, senior section head of Exxon research and engineering, was inducted as an honorary member. Plans are being made for a joint function with the Omicron Alpha chapter of the New Jersey Institute of Technology. This combined effort should strengthen Tau Alpha Pi in New Jersey. Officers are Glen Brons, President, and Eileen Allen, Secretary**Tm QV1 rat**



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OMICRON BETA (Union County Technical Institute) Officers Eileen Allen, Secretary-Treasurer, Glen Brons; and Faculty Advisor, Professor Terry Nathanson stand before the chapter banner made by Mrs. Shiela Schultz on induction day, April 6, 1978.

P1 ALPHA: (Purdue **University) Pi Alpha** is a very active chapter. The chapter publishes a resume book listing all current engineering technology graduates. This effort has been very well received by industry. The chapter also publishes a monthly "Engineering Technology Newsletter" to keep members abreast of matters of local and national importance. Officers are Dan Schroeder, President; Charles Shultz, Vice-President; and Tim Turk, Secretary-Treasurer.

P1 BETA: (Indiana University-Purdue University at Indianapolis) Pi **Beta** was formed last year with 21 students initiated. Graduation and work have depleted that number. New life is expected with the spring initiation. The chapter would appreciate hints on keeping working students involved. Officers are Randy L. Simpson, President; Michael W. Lavengood, Secretary; and Joan E. Schackel, Past President.

RHO ALPHA: (Colorado Technical College) A full scholarship was awarded to Mr. James Kashkoska in the name of the Rho Alpha chapter. The chapter also sponsored a high school science competition with chapter members serving as judges. New officers are David Bernadini, President; James Brooks, Vice-President; and Greg Sonju, Secretary-Treasurer.

RHO BETA: (University of Southern Colorado) Rho Beta cosponsored a symposium, "Modern Technology and You," in May 1978. The symposium dealt with contemporary culture and technology issues. New officers are John D. Murray, President; Greg Weller, Vice President; and Riley M. Bryan, Secretary-Treasurer.

RHO GAMMA: (Metropolitan State College) Rho **Gamma is a new** chapter (1977). Dr. James D. Palmer, President of Metropolitan State, and Dr. Richard G. Netzel, Vice President for Academic Affairs, were guest speakers at the charter member dinner. Officers are Randall B. Hahn, President; Michael S. Dungan, Vice-President; and Andrew M. Schlager, Secretary.

CHI ALPHA: (Vermont Technical College) Chi Alpha has inducted its second "class" of members. Prospects are that five more will soon be inducted. Officers are Henry Lee, President; Katherine Gilman, Vice President; and Patrick Kirby, Secretary-Treasurer.

Honor Roll

The officers and members of Tau Alpha Pi National Honor Society hail and greet the following affiliate chapters newly elected during the year 1977-1978. We congratulate the institutions for having the foresight to initiate affiliate chapters of Tau Alpha Pi at their respective campuses.
We congratulate these charter members and say to them that they should be proud of their designation, for Tau Alpha Pi National Honor Society for students in Engineering Technologies is the most selective of all honor societies, accepting only the top 4% of all technical students enrolled at a college or university.
We hope that the charter members will establish a solid and firm foundation so that those who follow them will be able to build upon it. Our best wishes for a success in the endeavors of Tau Alpha Pi.

Frederick J. Bergen
Executive Secretary
Tau Alpha Pi

MU BETA CHAPTER

Chartered December 9, 1977, Clemson University; Dr. James A. Chisman, Sponsor; Carl R. Lindenmeyer, Daniel L. Ryan, Faculty Advisors.

Charter Members
Edwin Wilber Allen
Carlton Eugene Furr

Russell Eugene Gardo
James M. Hatley
Eric Evan Lindsay
William Milton Sibley

Pt BETA CHAPTER
Chartered May 8, 1977, Indiana University-Purdue University at Indianapolis; Paul K. Sharp, Sponsor; Bob Randal, Ronald Frank, Bob Menz, Faculty Advisors.

Charter Members

Dale W. Brown	James R. Moseley
Graig T. Chambers	James D. Peck
Ronald P. Cooper	Steven L. Ritter
Paul H. England	Joseph K. Scanlan
Jack Engene Forbes	Joan E. Schakel
G. Dwight Klippel	Ann Hardin Sembach
Michael W. Lavengood	Tim F. Shuppert

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Kim Mathews
Dan McDermet
Carol Dee McKinley
Randy L. Simpson
John W. Talbott
John Ward III

CHI ALPHA CHAPTER
Chartered May 10, 1977, Vermont Technical College; W. Faculty Advisor; Bernard Carmiggelt, Sponsor.
Robert Wonkka,
Charter Members
Jannet Lynn Rudolph
Nancy Lou Davis
Timothy Charles Darling
Samuel Irving Griesmer, Jr.
Patrick Norman Keith
Steven Douglas Dc Long
Cathy Suzanne Bassler
Craig Neil DeVarney
Paul Frank Newton
Peter William Lind
John Jay Waite
Douglas K. Morris
Dean Paul Guillette

Michael James Bassette
Glen Steven Randall
William 0mm Giel

LAMBDA GAMMA
Chartered April 28, 1978, Hartford State Technical College, Hartford, Connecti cut; Ralph L. Boyers, Dean/Sponsor; Bryant Boyd, Faculty Advisor. Other Advisors: Charles A. Rodgers, Raymond M. Lugli, Joseph R. Madden, Gram **M. Hayes, Gerald J. Lettieri.**
Charter Members
Edward S. LaVoie
Joseph E. Seymour
Deborah Monahan Napier
Susan B. Krajewski
Robert L. Baran
Mark Richard Fisher
Steven Kamm
John F. Forella
Michael A. Toth
John J. Coleman
Wayne P. Kapprodt
Linda M. Roberts
Linda M. Roberts
Gerald R. Dufault
Thomas W. Piantek
Anthony J. Rackie Jr.
Edward J. Carley
John A. Derwonko
Nancy Hebert
Bruce H. Mynick
Christopher D. Gerath
Lawrence A. Sanford
Jane E. Karp
Lawrence Bojarski
John Gerard Janco
Jacquelyn Simone St. Cyr
Michael **G.** Smith
Richard A. Karl
Samuel Junno
Eugene R. Psoter
Robert Thibault
Peter S. Oliver
Thomas W. Horan
Craig A. Paradis

BETA IOTA CHAPTER

Chartered May 16, 1978; Rochester Institute of Technology, Rochester, New York; Robert McGrath Jr., Sponsor.
Charter Members
Richard A. Kent
Arthur E. Herman, Jr.
Patrick J. Plassel
Daniel Tarshus
Richard S. Bird, Jr.
Leo W. Conboy

GAMMA DELTA CHAPTER
Chartered May 12, 1978; Franklin University, Columbus Ohio; James D. McBrayer, D.Sc., P.E., Faculty Advisor and Sponsor; Robert L. Merrill, Faculty Advisor.
Charter Members
Larry A. Grove
Linda Guthnie
David F. Latimer
Gary L. Meyer
David A. Scott
Brian L. Shaffer
Gene W. Thorne
Gary L. Young

PSI ALPHA CHAPTER
Chartered May 10, 1978; Memphis State University, Division of Engineering Technology, Memphis, Tennessee. Weston Terry Brooks, Sponsor
Charter Members
James R. Driver
Barry E. Neal
R. Douglas Bemryhill
David L. Rickard
Kathleen M. Kidd
Jerry W. Morgan

OMEGA ALPHA CHAPTER
Chartered May 5, 1978; New Mexico State University, Las Cruces, New Mexico; Myron E. Cherry, Sponsor; Louis Kleine, Faculty Advisor; Quentin **C.** Ford, Advisor.
Charter Members
Mark D. Stephens
James W. Moore
Thomas R. Shubert
Robert G. Tillman

Helmuth G. Zander

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1978

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NATIONAL HONORS

FOR

ENGINEERING TECHNOLOGY STUDENTS

Tau Alpha N National Honor Society has affiliate chapters on the campuses of many of the country's leading technical colleges and universities. The Society is intended to be for the engineering technology student what Phi Beta Kappa is for the arts and sciences student and what Tau Beta P1 is for the engineering student.

The Society was founded in 1953 to provide recognition for high standards of scholarship among students in technical colleges and universities and to engender desirable qualities of personality, intellect, and character among engineering technology students by offering membership in the society to those with outstanding records.

Membership is restricted to students with averages in the top four percent in engineering technology programs. Both associate and baccalaureate degree students are eligible. Membership in Tau Alpha P1 does not conflict with membership in any local honor society.

Recognizing student achievement is an important aspect of every educational institution. Tau Alpha Pi wifi serve as a further recognition of academic excellence, and it welcomes new chapters. If you are interested in establishing a chapter at your institution or in obtaining additional information, please contact Professor Frederick J. Berger, Executive Secretary, Tau Alpha Pi, P. 0. Box 266, Riverdale, New York 10471, or telephone: 212—884-4162.