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ABSTRACT

In the last decade, industrial arts departments have come to serve a comprehensive "industrial technology" function by giving greater attention to the technical aspects of industrial education. This comprehensive report focuses on current trends and conditions and likely future developments in industrial arts and industrial technology in the nine California State Colleges offering undergraduate programs. A section on industrial arts touches on the general education function of industrial arts at the secondary level, the expansion of college programs with attendant problems of recruitment, retention, and industrial experience and the Bachelor of Vocational Education degree. The section on industrial technology is based on the findings of an extensive survey of industry, a comparison of similar curriculums in selected institutions, the literature of the field, and the deliberations of the Consultative Committee over a period of many months. As a result, five elements of a proposed policy were developed. Twenty-two recommendations for industrial arts and technology in California state colleges are included. An extensive bibliography and related materials such as the industry survey are appended. (CD)

INDUSTRIAL ARTS/ INDUSTRIAL TECHNOLOGY

February, 1970

THE CALIFORNIA STATE COLLEGES
OFFICE OF THE CHANCELLOR
DIVISION OF ACADEMIC PLANNING

CONSULTATIVE COMMITTEE ON INDUSTRIAL ARTS – INDUSTRIAL TECHNOLOGY

Committee Members

Dr. Carlisle Anderson	Professor of Industrial Arts San Diego State College
Dr. René Dennemeyer	Professor of Mathematics California State College, San Bernardino
Dr. Tudor Jones	Professor of Education California State College, Hayward
Dr. Eugene H. Kopp	Professor and Dean, Engineering California State College, Los Angeles
Dr. J. M. McRobbie	Professor and Chairman, Industrial Technology California State Polytechnic College, San Luis Obispo
Dr. Henry Paulin	Professor and Chairman, Design and Industry San Francisco State College
Dr. Joseph Wagner	Professor of Speech California State College, Long Beach Liaison Representative, Educational Policies Committee Statewide Academic Senate
Mr. John R. Banister	Associate for Special Studies, Division of Academic Planning, Chancellor's Office Chairman and Principal Investigator

Committee Consultant

Mr. Louis Kelo	Professor of Industrial Studies San Jose State College

Staff Assistant

Mr. [illegible]	[illegible], Division of Academic Planning, Chancellor's Office

POLICY ON INDUSTRIAL ARTS/INDUSTRIAL TECHNOLOGY PROGRAMS

RESOLVED, By the Board of Trustees of the California State Colleges, that the report on *Industrial Arts/Industrial Technology* be received, and that the following principles shall apply to academic planning and curricular development in these areas:

1. The preparation of teachers shall continue to be the primary function of Industrial Arts/Industrial Studies departments. A secondary objective at some State Colleges shall be to offer "industrial technology," a broadly-based, four-year curriculum designed to prepare supervisory and middle-management personnel for industry.

2. Existing programs in industrial arts and industrial technology shall be continued, and supported in a manner that will ensure high quality, including provision for internship or work-study arrangements with industry.

3. No additional industrial arts curricula shall be authorized until existing programs that are reasonably accessible approach maximum enrollment within the limits of authorized capacity under the campus master plan.

4. Within the context of academic master planning, State Colleges operating strong industrial arts programs but not projecting engineering technology may develop an industrial technology program, and the Colleges with strong professional engineering programs but without industrial technology may develop an engineering technology program, which shall meet accreditation standards. However, no master's degree in technology shall be authorized.

5. State Colleges which offer industrial technology programs shall review areas of possible proliferation and incorporate appropriate engineering courses in the industrial technology curriculum, and State Colleges which offer two or more technology/management-oriented programs shall explore consolidation of such programs or reorientation of them.

6. The Academic Planning staff of the Chancellor's Office in consultation with the Academic Senate, California State Colleges, shall maintain a continuing review of engineering technology and industrial technology. Pending any specific recommendation from this study, as well as from the evaluation of the experimental offering of both programs at California State Polytechnic College, San Luis Obispo, no college shall be authorized to offer both industrial technology and engineering technology programs.

7. Inasmuch as State Colleges grant the Bachelor of Vocational Education degree and are well qualified to offer all the courses required for the Standard Designated Subjects Teaching Credential with Specialization in Vocational Trade and Technical Teaching and in Industrial Arts and Occupational Subjects, complete responsibility for administering these credentials should be vested in the State Colleges.

Adopted May 27, 1970

INTRODUCTION

A study of industrial arts-industrial technology was mandated by the Board of Trustees in the *Master Curricular Plan for the California State Colleges* (1963). Appendix A contains particulars. This comprehensive report has been prepared in full consultation and with the involvement of the respective faculty and the Statewide Academic Senate. All pertinent issues were explored, and guidelines for the future direction and growth of industrial arts, industrial technology, and technology-related curricula are now proposed.

Four special reports concerning these curricular areas were previously completed under the auspices of the Chancellor's Office, namely: Clifford Dobson's *Industrial Arts and Industrial Technology in the California State Colleges* (1962), Robert Vivian's *Engineering Education in the California State Colleges* (1962), H. H. Wheaton's *Report to the Chancellor, California State Colleges on an Investigation of Industrial Technology Programs* (1964), and *Industrial Arts* (1966), prepared by the Division of Academic Planning and including a history of industrial arts education in California. These background documents have proved useful. but they have no official status – the first three were preliminary reports submitted by consultants and the fourth was deferred by the Academic Senate pending completion and submission of a report on industrial technology as well as on industrial arts. Another report, Lathrop and Farr's *A Study of the Relationship of Industrial Arts Education to Vocational Trade-Technical Education in California* (1969). has likewise been helpful. by providing coverage of the curricular experimentation and innovation taking place across the country and in California.

Insofar as possible, this report focuses on current trends and conditions and on likely future developments. It recognizes the traditional and primary aim of industrial arts in the State Colleges – the preparation of teachers – and the more comprehensive function that industrial arts departments have come to serve in the last decade: giving greater attention to the technical aspects of industrial education, with the result of a distinctive "industrial technology" curriculum. Although the latter has in some cases separated, forming its own administering unit, faculty, and courses – as at California State College, Long Beach – the relationship with industrial arts teacher education continues to be complementary. Consequently, this report is to be viewed as a composite one, though divided for convenience into two sections, one on industrial arts and one on industrial technology.

It is not possible to treat industrial technology without reference to that segment of engineering education designated as "engineering technology," baccalaureate programs in which are now belatedly accreditable by the Engineers' Council for Professional Development. Similarities and differences between these programs – and with regard to others usually entitled "industrial administration," offered by Schools of Engineering and sometimes by Schools of Business – are explored, and guidelines for handling possible duplication are proposed.

The section on industrial technology is based on the findings of a rather extensive survey of industry (which was conducted expressly to help clarify some of the issues), on a comparison of similar curricula in selected institutions across the country, on the literature of the field (which is relatively meager), and on the deliberations of the Consultative Committee over a period of many months.

A section on the Bachelor of Vocational Education degree is included, both because it is usually administered by industrial arts departments and because the resurgence of occupational programs in high schools as a result of Federal funding has significant implications for collegiate industrial arts education. In this regard Dr. Lee Bodkin's dissertation, *The Professional Development of Trade and Industrial Educators as Influenced by Senate Bill 752, 1943* (1966), is pertinent, as are two very recent studies: Dr. Nicholas De Witt's *Manpower Guidelines for Educational Policy Planning in the State of California* (February 1968) and the Arthur D. Little report, *Vocational Education in California: Yesterday, Today, and Tomorrow* (October 1968).

The magnitude of the industrial arts operation in the public secondary schools of California should be noted. Of a national total of over 4.2 million students enrolled in industrial arts classes and taught by 42,000 teachers, California alone accounts for 12 percent, or 550,000 students and 5,500 teachers; an additional 50,000 students are enrolled in occupational classes. As practically the only institutions in California preparing teachers for this vast enterprise, the California State Colleges have a very important responsibility. The nine State Colleges with industrial arts undergraduate programs presently enroll close to 2,000 majors, and the industrial technology component an additional 1,600 majors, a total which is about the same as that for home economics, mathematics, and physical sciences, and more than one-third that for engineering sciences.

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PART I: INDUSTRIAL ARTS

Definitions

The generic term for programs that teach industrial subject matter is "Industrial Education." The field is broad in scope and interacts with other disciplines, yet maintains its own identity and integrity. The discipline evolved as a result of the rapid changes which are characteristic of a highly industrialized nation, and became an accepted part of the curriculum in educational institutions at all levels.

At present, industrial education includes three generally discrete areas: industrial arts, vocational trade-technical education, and industrial technology. An industrial arts department in a large institution may include curricula in all three areas.* The Industrial Studies Department at San Jose State College, for example, offers programs in industrial arts (teacher preparation), industrial design, business and industry, vocational education, driver and safety education, and photography.

Industrial technology is defined in Part II. Trade-technical education is specifically designed to equip students for employment in trade, service, and technical occupations in industry. It is offered in the 10th through 12th grades of senior high schools, in adult schools, in community colleges, and to a limited extent in some State Colleges through the Bachelor of Vocational Education degree. It includes preemployment and extension training. Preemployment training consists of high school or community college programs which prepare students for industrial occupations. Such programs, particularly at the community college level, tend to be flexible and to respond readily to the specialized needs of industry and the community. Extension courses—which are designed to improve an employed person's present competence, retrain him for another job, or prepare him for advancement—are offered as part of the trade-technical program at the adult school or community college levels. Passage of Public Law 88-210, the Vocational Education Act of 1963, has spurred the development of many new programs in California, particularly in the 11th and 12th grades of high school, by providing funds to reimburse states and school districts which maintain vocational education programs of certain types.

Industrial arts and trade-technical education are differentiated by their principal purposes and to some extent by their methods. *The Washington Report* of April 16, 1965, points out that "Industrial arts is a field of study in which the student is introduced to the use of techniques and devices which, with further training, will be useful to him in industrial employment . . ."; whereas trade-technical education . . . is designed to fit individuals into gainful employment as semi-skilled or skilled workers or technicians in recognized occupations." A brochure published in 1968 by the American Industrial Arts Association (AIAA) describes industrial arts as:

> . . . unique in that it helps students prepare for living in an industrial democracy and provides a foundation for specific occupational and educational opportunities. It offers basic education to the future technician, engineer, scientist, and for the several vocational programs. It is not confined to the learning of a specific trade or skill as emphasized in vocational industrial education, but rather it educates boys and girls to become versatile and adaptable to the rapidly changing world.

In nature and scope, then, industrial arts in the public schools is conceived to be general educational, that is, prevocational or non-vocational, open to any student regardless of his occupational goal. It enables a student to learn something about drafting, for example, but does not make him a draftsman. The latter objective is the function of trade-technical education. However, it is not uncommon in high schools where trade-technical classes are not offered for industrial arts classes to provide students with opportunity to develop occupational skills and knowledge.

*See chart, Appendix B

The General Education Function of Industrial Arts at the Secondary Level

The AIAA further defines industrial arts as:

> . . . a significant part of general education which provides students an opportunity to learn about the theoretical and practical aspects of industry and technology, two basic elements of our society. It acquaints them with the history, growth, and development as well as materials, products, and processes of industrial organizations. Industrial arts helps develop in students an awareness and appreciation of tools and machines involved in past and present methods of production. It also emphasizes problem-solving experiences to help students become alert contributors and consumers and provides a means by which they can apply in meaningful situations the principles of science, mathematics, and other related subjects.

And:

> Industrial arts is a study of the broad aspects of industry, such as construction, transportation, communication, manufacturing, and research and development. More specifically, it includes subjects like ceramics, design, drawing, power mechanics, electricity-electronics, graphic arts, leather, lapidary work, metalworking, plastics, textiles, and woodworking. Each of the preceding areas may involve a study of several sub-areas. For example, metalworking may include opportunities to investigate foundry, welding, machining, sheet metal, wrought iron, and art metal.

The AIAA takes pains to explode the "shop" myth, indicating that industrial arts

> . . . is actually a classroom-laboratory combination, providing students with the opportunity to study the materials, processes, products, and related problems . . . through such activities as planning, organizing, creating, constructing, experimenting, testing, servicing, and evaluating.

About the general education aspect of industrial arts, as developing in students what may be termed "technological literacy," Dr. Dobson has stated:

> The American of today without an understanding and appreciation of industry and technology in our culture is ill-equipped to face the world of today—and tomorrow. As technology advances and our industrial society becomes more complex, this need becomes more acute.

In spite of a well-articulated rationale for inclusion, industrial arts continues to be pretty much an outsider in the colleges' general education program, or on the fringes, if participating in the elective part of the program. Yet academia's wider acceptance of it as part of the general education program of all students would certainly be a truer reflection of the actualities of American society and culture.

The leaflet entitled "Industrial Arts . . . a vital part of every student's education," published by the California State Department of Education in 1967, sets forth the integrative role envisioned for industrial arts:

> Industrial arts in California schools is an integral part of the total program of education, and is designed specifically to help prepare individuals to meet the requirements of an industrial-technological culture. In this program, which involves study, experimentation, and application, students learn through participation in activities in which they use industrial-technical tools, machines, materials, and processes, as well as language arts, mathematics, sciences, and social sciences in solving meaningful problems.

It should be noted that curricula designed to do much of what the foregoing statement calls for, namely, correlate several areas of study, have been developed and are being tried in several Bay Area high schools under the auspices of the staff of the Center for Technological Education affiliated with San Francisco State College.

However, the Little report points out that such an expanded conception of industrial arts is mostly a rhetorical exercise: "Between philosophy and promise, and action and achievement a significant gap . . . remains today." In practice, the report maintains, industrial arts generally continues to devote "approximately 80% of class time . . . to shop practice" and "only 20% to related instruction, demonstrations, class discussions, investigation, and study." The reasons this "appealing philosophy" did not take hold, the report asserts, is that industrial arts received no Federal funds, as vocational education did, and was

> . . . not supported with research to develop the innovative curriculum and pedagogy it called for. Moreover, the philosophy of industrial arts called for but did not receive a new kind of teacher-training and retraining that industrial arts credentialing programs were not providing.

Industrial Arts in the California State Colleges

In January 1968, the California Council on Industrial Arts Teacher Education (CCIATE) published a position paper on "Industrial Arts in California State Colleges" which is such a pertinent and succinct overview as to deserve incorporation, in its entirety, into this report. The position paper reads as follows:

> In the California State Colleges, industrial arts education is a study of industry primarily designed to prepare elementary, secondary, and junior college teachers who will help the students (1) gain an insight and understanding of industry and its place in the American culture and (2) discover aptitudes and develop knowledge and skills useful for occupations, professions, and other activities. In the elementary school, the study of industrial arts is integrated with other subject matter. In grades 7 through 14, separate industrial arts curriculums are offered. College industrial arts programs, although principally concerned with preparing teachers, provide a portion of the general education curriculum on some campuses and/or offer service courses for other majors.
>
> Industrial arts education includes a wide spectrum of viewpoints and activities and spans all educational levels from kindergarten through graduate school. Programs in industrial arts education in the state colleges are primarily designed to prepare teachers of industrial arts for public schools of the state. The teaching of technical facts and manipulative skills and other laboratory activities are aspects of industrial arts which, while concerned with subject matter peculiar to industrial education, also make use of knowledge and concepts from the natural and physical sciences, mathematics, the social sciences, the fine arts, and other disciplines, thus providing the prospective teacher with sufficient skills to give sound demonstrations and instruction to the classes he teaches.
>
> The nature and scope of industrial arts education programs are largely governed by requirements for the appropriate teaching credentials. In addition, the state colleges are challenged and guided by the viewpoints of administrators and industrial arts supervisors as to what constitutes appropriate teacher preparation, by the range of industrial arts subject matter taught in the public schools, and by what industrial arts leaders feel should be taught on the basis of changes taking place in industry and technology.
>
> The nature and scope of a typical college industrial arts education program includes the following:
>
> (1) Technical courses in industrial arts. Skills and technical competence are of great importance; just as music teachers are expected to be competent musicians, so industrial arts teachers are expected to be skilled artisans.
>
> (2) Related sciences. Since industrial arts education draws its content from the science

and technology of industry, the study of science and mathematics is an essential part of its curriculum.

(3) Liberal arts. Industrial arts education is firmly committed to the liberal arts; course work in the liberal arts is an integral part of preparation of every industrial arts teacher.

(4) Professional education. Foundation courses in the sociological or historical or philosophical, plus psychological and the curricular and instructional aspects of education form the basis for the professional preparation of all industrial arts teachers. In addition, students receive instruction in career guidance, testing, and other professional education courses.

College industrial arts education programs not only emphasize the acquisition of adequate skills, but also the broad knowledge and understanding needed by industrial arts teachers in the elementary and secondary schools and the junior colleges. With this preparation, the teacher can help the students at each educational level acquire and use this knowledge of industry for career guidance and for understanding industry and its place in industrial-technological culture.

The success of the industrial arts program in California public schools reflects the quality of industrial arts teacher preparation in the institutions of higher learning in the state. Teacher educators have done commendable work in making this program outstanding.

Ten institutions of higher learning in California have departments for industrial arts teacher preparation which are accredited for credentialing purposes by the California State Department of Education. Nine of these institutions are California State Colleges: Cal Poly San Luis Obispo, Chico, Fresno, Humboldt, Long Beach, Los Angeles, San Diego, San Francisco and San Jose. The tenth institution is Pacific Union College.*

All indications point to an increasing need for additional industrial arts teachers in the future. Over the last several years, an annual survey which is conducted by the State Bureau of Industrial Education has consistently indicated that approximately 50 percent of the needs for teachers of industrial arts are filled by graduates of California institutions.

Industrial arts education programs are appropriate offerings in the California State Colleges. The state colleges are the major source of industrial arts teachers in California.

Common Misconceptions About Industrial Arts

Industrial arts has been subject to two slow-dying misconceptions. One is the perennial, not entirely resolved, issue of liberal versus vocational or occupational education. Nothwithstanding the fact that the stated objectives of the state colleges properly include both training for occupational competence and humanistic pursuits and, as Dr. Delmar T. Oviatt, former academic vice president at San Fernando Valley State College, notes, the "elevation of the state college to full university status, accomplished from Washington to Florida within the past decade, can, in large measure, be traced back to the tremendous impetus of the vocational curricula in the post war years," there still persists among many liberal educators the idea that occupational curricula are not appropriate offerings at the college level. Efforts of occupational educators to upgrade curricula or meet new responsibilities have often been suspect and strenuously resisted as, to use the phrase of one opponent, "another attempt of the activity-recreation camel to poke its nose into the education tent."

*Loma Linda University also offers a program in industrial education, which was recently accredited by the State Department of Education for credentialing purposes.

In the past the fears of liberal arts educators could be better understood. For a while the occupations appeared to be growing and attracting students at a surprising rate, to be filling students' programs with more and more applied arts and sciences and less and less liberal arts studies, and to lay claim to a greater share of the support dollar. Now that the pendulum has swung back and the humanities and the arts are again on an ascendant course, with the professions and occupations recognizing the important contribution liberal studies make to the education of their majors, there seems less reason for continued suspicion or hostility.

Many prominent educators argue that it may be as good for the liberal arts students to be aware of technology's impact on their lives as for engineers to be more conversant with culture. Indeed, our culture depends on more than one type of education. Both liberal and occupational or technical education are essential to the goal of preparing individuals to live and to earn a living, to know *how* as well as *why*. In *The Aims of Education* Alfred North Whitehead, the distinguished philosopher and mathematician, points out:

> The antithesis between a technical and liberal education is fallacious. There can be no adequate technical education which is not liberal, and no liberal education which is not technical; that is, no education which does not impart both technique and intellectual vision. In simpler language, education should turn out the pupil with something he knows well and something he can do well. This intimate union of practice and theory aids both. The intellect does not work best in a vacuum.

Dr. Oviatt similarly affirms the compatibility of the two types:

> The question of liberal education versus vocational education is no longer an either/or proposition. It is no longer a matter of which shall be dominant and which shall be recessive. It is essentially a matter of how these two traditional streams of learning can be most strategically integrated. It is the question of how the funds shall be divided so that neither need suffer at the expense of the other. It is how the time and energy of both faculty and student can be allocated, so that as our graduate steps forward on Commencement Day, he represents not only a man of merit, but a man of competence.

Nicholas De Witt, professor of economics and government at Indiana University, in a report on "Manpower Guidelines for Educational Policy Planning in the State of California," prepared for the State Committee on Public Education, goes even further, insisting that:

> . . . education and employment must be related. Many people, particularly those in the educational establishment, confuse education with formal schooling as an end in itself. The acquisition of knowledge, the development of productive skills, and the mastery of occupational tasks depend on many variables and many institutions. Public education, both in the nation and in the State of California, must be guided by and geared to the exogenous demand for its products—the educated people who are needed by society in the world of work.

While not all the state colleges need to become multi-purpose institutions of the kind referred to, those campuses which are at present offering both academic and applied programs, or may choose to do so in the future, should strive to keep these functions clearly co-equal partners in the educational enterprise.

The second misconception, related to industrial arts as a subject-matter field, is pinpointed by Dr. Dobson:

> Industrial arts is seen as an extension of an image from our remote past when our material needs were almost entirely met by manual labor with little or no intellectual activity. The change from manual skills to the specialized arts and sciences we call technology is not yet fully recognized or appreciated. This is an unfortunate image that leaves many uninformed people with a concern as to whether industiral arts is an appropriate kind of education to offer at the college level.

In other words, industrial arts must be recognized as an appropriate as well as a necessary part of the collegiate curriculum.

Appropriate Terminology

The term "industrial arts," as applied to the teacher education function, has a long history, and there are thus many advantages to retaining it. The term is certainly meaningful to the profession and to the public, and almost all national and state associations, agencies, publications, and studies concerned with this area of study employ it. Title III of the National Defense Education Act utilizes this terminology. A change might lead to confusion in an area where clarity is very much to be desired.

Further, the B.A. of 124 units and the M.A. of 30* units are the commonly accepted types of degree for teacher preparation programs. Switching to the B.S. and M.S. at a time when the academic status of the field is challenged in some quarters, and to require more than 124 units for graduation when the prospective teacher's program is already crowded, would be a mistake.

For its master's degree, California State College, Los Angeles, employs the title "Industrial Education." The rationale is that, in addition to serving as the advanced degree for industrial arts teachers and supervisors, the program offers a specialization described as follows: "*Industrial Studies* for industrial educators with an interest in a broad study of industry, including industrial materials, industrial services, production processes, consumer needs, personnel management, and the role industry plays in an industrial-technical society." While this rationale is a cogent one, the recent trend in nomenclature in the state colleges has deliberately been away from including the term "education" in degree titles, since degree majors are now clearly distinct from credential requirements. Thus "Science Education" has given way to "Natural Science," "Health Education" to "Health Science," and serious consideration is being given to subsuming the separate master's in "Business Education" under the Master of Science or the Master of Business Administration degrees.

In view of this trend and for the sake of achieving comparability in degree terminology, it is recommended that California State College, Los Angeles consider changing the title of its master's degree to accord with the practice of other institutions. The question of appropriate terminology for the master's degree is discussed more fully in Part II. However, while uniform nomenclature in type and title of the degree is highly desirable, reasonable diversity in the contents of individual programs is to be preserved and encouraged.

It is not within the purview of this report to make recommendations on the administration of industrial arts and related programs. Departmental titles and administrative configurations may differ among the colleges. Recently, California State College, Los Angeles, and San Jose State College changed the titles of their departments from "Industrial Arts" to "Industrial Studies," reflecting the more comprehensive function the departments have come to serve in large institutions--encompassing not simply teacher preparation, but general education and service functions and varied curricula as well. Such a broader departmental designation would not appear appropriate to a small college at which the teacher preparation function is paramount.

Variety also marks the larger administering unit, the school or division which houses departments of industrial arts and other occupationally-oriented curricula. The School of Applied Arts and Sciences is a common designation, but at Fresno State College the Industrial Arts and Technology Department is included in the School of Professional Studies, and at Cal Poly, San Luis Obispo, in the School of Engineering and Technology. Of course, the curricular range and the administrative structure of the colleges differ considerably.

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*For consistency, the report refers only to semester units. To convert to quarter units, multiply by 3/2.

Expansion of Industrial Arts Programs in the California State Colleges

Of the nine State Colleges with programs in industrial arts teacher education, seven offer both the baccalaureate and the master's degrees; Humboldt offers the baccalaureate, and Cal Poly, San Luis Obispo offers an option under the industrial technology curriculum (see chart, Appendix B). The only other programs in the State—and at the baccalaureate level only—are offered by Pacific Union College and Loma Linda University, which are private, church-related institutions located in Angwin and the San Bernardino-Riverside areas respectively.

Do the existing programs constitute sufficient coverage for the State? The answer depends largely on whether there is or will be any discernible increase of interest among students to become industrial arts teachers, and, if so, whether the nine State Colleges can accommodate them, and, further, whether existing programs adequately serve the different geographical regions of the State.

Industrial arts teacher preparation programs are not attracting students in sufficiently large numbers to indicate any dramatic acceleration in the future. Indeed, some colleges have experienced a drop in enrollments. Overall, a moderate growth over the past few years is observable, but it is very modest in comparison to the tremendous influx of students over the same period. The expectation, then, is for continued moderate growth in the future.

On the other hand, it should be noted that Dr. Robert Woodward, consultant in industrial arts education for the State Department of Education, is confident that "at the conclusion of the present war the teacher education institutions will be able to provide a greater number of teachers [including industrial arts teachers] as they did after World War II." The De Witt report has shown that California has drawn on the other states to fill its teacher needs and has in most years since the end of World War II imported in excess of 40 percent of its annual increases in teaching personnel. Should the rate of immigration diminish, a vastly higher burden would be placed on the state's colleges and universities. Also, should the colleges assume greater responsibility for preparing teachers of occupational programs, the demands on existing facilities could be significantly increased. Thus the colleges' ability to meet the challenge should be carefully weighed and alternatives identified, to be put into effect on an emergency basis if the need arises.

One complicating factor is whether at the State Colleges which will reach their maximum growth during the next five years or so—conspicuously San Francisco and San Jose State Colleges—industrial arts will be permitted to expand at the expense of other disciplines when enrollment ceilings are attained. Certainly the facts that the industrial arts facility at San Jose State College has the capacity for several hundred additional majors and that the field is one of short supply are considerations the administration should take into account as criteria for differential admissions are established.

A review of facilities now existing or projected as part of the master building plans of several campuses over the next few years reveals that there is room for a good deal of expansion within existing facilities or within additions to or complete new facilities planned in the immediate future at the nine State Colleges which currently offer industrial arts programs. Further, these colleges cover the main geographical areas of the state (see map on inside back cover). There appears, then, to be no immediate need to mount additional programs in other State Colleges.

As a general principle, existing industrial arts education programs should be utilized close to maximum capacity before proposals for additional programs are considered for implementation in the System. Inasmuch as there already exists an option in teacher education under the technical degree at Cal Poly, San Luis Obispo, that college should be permitted to establish a separate baccalaureate degree program with the industrial arts designation. Cal Poly is a likely prospect to offer a master's degree when an upswing in the number of master's degrees awarded annually in the System becomes evident.

If or when capacity degree production is reached elsewhere in the System, consideration might be given to establishing a tenth program, preferably in Southern California. Cal Poly, K-V (Pomona), has indicated an interest in developing a curriculum in either industrial arts or industrial technology some time in the future, and might be encouraged to develop a program in industrial arts when CSC-Los Angeles and CSC-Long Beach approach capacity enrollments in their programs. The geographical location of the new State Colleges at San Bernardino and Bakersfield offer some advantages, however.

Otherwise it is to be doubted that conditions will change substantially in the next several years to justify the introduction of industrial arts programs in any other State College, or to justify a master's degree program at Humboldt State College. Rather, all effort should be concentrated on securing for existing programs that level of support which will ensure the highest quality education possible.

Problems of Recruitment and Retention

Each year Dr. Woodward conducts a survey of industrial arts supervisors and teacher educators to determine the need for and supply of teachers for the coming academic year. The survey identifies the number of students graduating with teaching credentials and the number of positions available in junior and senior high schools in the field of industrial arts. Over the past few years these surveys have revealed that California colleges are consistently producing only about 50 percent (in former years as low as 40 percent) of the new and replacement teachers needed annually. The difference has been made up by employing teachers trained in other states, a source of supply which is uncertain.

The ability of the State's higher educational institutions to meet the demand is not in question. Careful planning has marked the evolution of industrial arts teacher training in California. Not only is the geographical distribution of the nine State Colleges and two private colleges excellent, but all the contributory elements are favorable: generally, the facilities are adequate and modern, the curricula are strong, and the facilities are competent and dedicated. Existing facilities are ample to accommodate many more students immediately, or they can be expanded to do so easily.

However, although undergraduate enrollments in industrial arts over the last few years have shown a steady, if moderate, increase, the rate of growth has been too small to make much headway in meeting the demand for teachers. The problem, then, is one of recruitment: How to attract students in appreciably larger numbers. What are some of the reasons for this condition? What improvements can be effected?

Changeover to a five-year credential program in 1962 compounded recruitment difficulties. The new requirements precipitated an immediate and substantial drop in enrollments in teacher education programs generally. The effect on industrial arts was particularly debilitating, both because the most popular route to teaching had been via the old special secondary credential and because there is very little incentive for a student who can be employed in industry after only four years, and at higher salary initially, to continue for a fifth year.[1] In order to compete favorably with industry, some educators are suggesting that graduates be permitted to start teaching after four years and to complete the fifth year over a specified period of time during which they could be earning a full salary. In 1968 both enrollments and graduates have caught up with, and exceeded, those existing in 1962, but the cumulative imbalance will not be righted for many years to come.

Further, designating industrial arts as "non-academic" for credentialing purposes and requiring an "academic" minor has had a negative effect. This somewhat artificial distinction has relegated industrial arts, and other occupationally-oriented curricula as well, to an inferior position in the educational hierarchy, and its teachers to second-class citizenship. Recent decisions by the State Board of Education affecting the status of certain disciplines have tended to so blur the distinction that prospects for abolishing it altogether are bright.[2]

Another handicap is the often disillusioning experience of the high school industrial arts teacher. Into his classes harried administrators have thrust the lower echelon of students: the unmotivated and disciplinary cases. The resurgence of vocational trade-technical education in high schools will lessen this practice. At the same time the profession must recognize the vocational needs of the non-college-bound majority and accept responsibility for providing appropriate class experiences/activities for them.

More than the question of status is involved, however. Engineering and physics, for example, have not been attracting students in growing numbers either. Undoubtedly these disciplines suffer from the anti-technology attitude among students today. The concept of producing engineers and physicists to meet the needs of the "establishment" is unacceptable to many students. This phenomenon is only temporary, experts agree.

[1] The Placement Office of one of the largest State Colleges reported in July 1967 that 28 graduates with four years of college and nonteaching industrial arts majors were employed by industry at a median starting salary of $8,050, whereas 13 industrial arts teaching majors with five years of college completed started teaching at a median salary of $6,500.

[2] Through recent Board action, industrial arts at San Jose State College has acquired "academic" status.

Industrial arts educators themselves have contributed to the difficulties. First, identifying as its province the study of our industrial society, industrial arts has branched out dramatically in the last two decades. In addition to the long-recognized, traditional mission of preparing teachers for the public schools, offering service courses for other departments, and sometimes participating in the general education program, the typical industrial arts department of a large college has taken on a comprehensive cast, so that it is not unusual to find encompassed in a single department, besides teacher education, such related but diverse curricula as photography, printing, industrial technology, industrial design, industrial safety and supervision, driver education, and occupational therapy, to mention the most common areas.

It must be understood that this expansion has been more dictated by external pragmatic considerations than motivated by "empire-building" proclivities of industrial arts faculties. The configuration makes good administrative sense, as being more economical, efficient, and realizable of full potential. Moreover, in developing such related curricula industrial arts departments were responding to certain needs of business and industry which had not been attended to by other disciplines; they were also meeting requests from other areas of the college for course work involving information that brings into play technical understandings in the broad sense (architectural drawing, upholstery, painting and finishing for majors in interior decorating, for example).

However, certain dangers are inherent in this administrative arrangement. The existence of other programs can detract from teacher education in subtle ways. Faculty, having diverse interests and concerns, and therefore lacking cohesiveness, can lose sight of primary goals and obligations. Questions of priority and emphasis can become blurred, especially when enrollments in programs that were originally conceived as peripheral grow so large as to overshadow the central one, as has happened in some State Colleges, even to the extent that at least one institution has given serious consideration to dropping the teacher education curriculum entirely in favor of the industrial.

The benefits accruing from the co-existence of these multiple curricula in a single department—for example, acquainting prospective teachers with the latest developments in technology, challenging the educator to keep his knowledge and experience cogent and up-to-date, and exposing the student to several points of view—far outweigh these possible dangers, of course. This evolutionary modernization is entirely justifiable, and there is no intent here to suggest alteration of the administrative structure itself or the varied but essentially heterogeneous curricula it may subsume. The caution to industrial arts educators is that constant vigilance be exercised to keep the programs complemental, rather than competitive, and to ensure that all faculty, no matter what their interests or assignments, regard the teacher education function as essential and feel a personal responsibility to direct able students into it in recognition of the fact that our educational system is dependent to a large degree on the accumulated skills and knowledge that industrial arts teachers transmit to students in the public schools.

A second way in which industrial arts educators themselves must be faulted is their failure in the past, and sometimes in the present, to provide an environment that is challenging, a curriculum that is up-to-date and relevant, and methods and techniques that are exciting. Dr. Bohn alerted his colleagues to the fact that the profession's

> . . . real problems deal directly with the curriculum and methods . . . and, most important, the vitalizing and updating of our programs so that we do not continue to find ourselves in the position of providing shallow and outdated programs of instruction.

Both Schmidt and Pelley nationwide and Lathrop and Farr for California assert that the industrial arts instructional program is "too narrow in scope." The latter educators would include "more instructional content in areas such as graphic arts, electricity/electronics, power mechanisms/transportation, industrial plastics and materials, and photography, " and call for

> . . . greater emphasis on mass production, machine production, technical and scientific theories and concepts, and student assignments that involve the solution to industrial problems through research, planning, creating and inventing.

Too often the "project" remains the single most important element in industrial arts pedagogy. Manual and machine shop skills continue to be stressed in an era of numerically controlled machine tools. Wood technology is emphasized when more knowledge about emerging technologies, such as plastics, and experience with quality control/reliability methods are needed.

While it is possible for educators in many fields to confine themselves to the classroom and to the traditional methods and techniques successfully, industrial arts teachers cannot. Since their subject-matter is industry, and industry is a dynamic and complex entity, they must keep in close contact with the industrial world and be knowledgeable about the latest advances in it. This contact can be maintained through a variety of activities—by visiting industrial firms and interviewing industrialists, by taking summer employment in industry, by engaging in consultative work, and by supervising students involved in internship and/or cooperative work-study programs jointly sponsored by the colleges and industry.

As Lathrop and Farr show, there is much exciting research and experimentation taking place nationally in the teaching of industrial arts,[1] though not as much as there needs to be.

Educators must keep abreast of the results and adapt innovative practices and techniques both to the curriculum and the classroom, and encourage students to utilize them in their own teaching later. They must also call them to the attention of experienced teachers by conducting conferences, short courses, and institutes, as, for example, the Division of Industry and Technology at Chico State College does by means of its annual Industrial Arts Teachers' Conference, to which high school teachers from sixteen northeastern counties are invited. Through these means teachers are influenced to effect the necessary reshaping and modernizing of the high school curriculum.

Much in-service training is being provided in the State Colleges,[2] but more is needed. All Federal and State funds to which industrial arts is entitled must be investigated and exploited to the limit to accomplish the improvements needed. Industrial arts educators certainly can meet the challenge, since as a group they have been noticeably more concerned about the advancement of their field and active participants in professional societies, conferences, and symposia than many of their colleagues in other fields.

Well aware of the gravity of the recruitment problem, industrial arts educators have been making extroardinary efforts to attract more students generally and more able students particularly. Retired military personnel, for example, have been induced to enter teaching as a second career, and intensified training programs provided to get them into the classroom as quickly as possible. Many devices are being used in the recruiting campaign. The following are the most promising approaches, grouped for convenience into four general categories.

I. Career Guidance

Recognizing that high school and junior college counselors exert considerable influence on the career choices of

[1] Among significant experimental programs under way in high schools across the country the study describes: the American Industry Project, a conceptual approach to teaching about American industry which was developed by Dr. Wesley Face of Stout State University, Wisconsin; the "cluster concept" evolved by Donald Maley of the University of Maryland; Industriology, or teaching about the main areas of industry rather than specific occupations which originated at Wisconsin State University, Platteville; the Industrial Arts Curriculum Project, funded by USOE and administered jointly by Ohio State University and the University of Illinois, which elaborated a rationale for the systematic structuring of a body of knowledge for the organized study of industry; and VICOED, a curriculum engineered by Dr. Ray Schwalm of Western Washington State College, with visual communication as the organizing agent. In addition, the work of the Center for Technological Education at San Francisco State College should be mentioned. Established in 1965 through a Ford Foundation grant, the Center was funded for 1968-69 by the State of California. It grew out of experience with the "Richmond Plan," an interdisciplinary approach to education which began in 1961 as an experiment in two Richmond schools. The Center staff works with high schools and junior colleges to develop innovative pre-technological projects and curricula, and conducts in-service and pre-service programs for teachers involved in them. Thus far the Center has helped develop forty programs in the San Francisco Bay area.

[2] Lathrop and Farr point out that in the last three years the State Colleges conducted thirty-five workshops and seminars and five NDEA institutes in carrying out their in-service responsibilities.

students, industrial arts educators have begun to include course work in career guidance and occupational information in the curriculum and are encouraging experienced teachers to pursue graduate work in the area of counseling leading to the Pupil Personnel Credential. Attractive brochures are prepared and sent to counselors in all schools in the service area. Generally these identify and explore the field, delineate the college program, recommend appropriate pre-entry preparation, and enumerate career opportunities. CSC-Long Beach and San Jose State College have developed colored, sound motion pictures which describe the respective programs and the career opportunities. Also, various recruitment materials are prepared by, and available from the American Industrial Arts Association and other national agencies, and from the offices of the State Superintendent of Public Instruction and the Bureau of Industrial Education. Several colleges offer an introductory course which students searching for a suitable major may elect for credit. The counseling center or service and advisors in other departments are provided with information which will be helpful to students who are considering a change of major.

Every member of the profession must feel a personal responsibility for identifying promising high school students and encouraging them to consider careers in industrial arts teaching. In "Teaching: The Challenge and the Glory," Dr. Bohn provides the following exemplary statement for use in recruiting:

> Industrial arts has many advantages over the teaching of other subjects. You will be teaching a subject which most students enjoy. You can view the results of your teaching by seeing the knowledge and the skills developed by your students ... If you are interested in an area of industrial arts, teaching provides you with an opportunity to turn your interests into a career. You'll find that industrial arts is often the most popular area during school open house, and the one which makes a direct contribution to the future career of the student—whether he becomes a teacher, engineer, scientist, technician, or mechanic.

2. Public Relations

College industrial arts programs are better-articulated with those of high schools and particularly community colleges than ever before.* Many community colleges are providing counseling and courses that lead to teacher preparation at the State Colleges and others are being encouraged to do so. Industrial art departments are extremely cooperative in transferring units and keeping loss of previous credits to a minimum consistent with maintaining a quality program. Faculty members take advantage of every opportunity to foster the concept of industrial arts. They give talks to high school and junior college students, and to various civic, PTA, and club groups; they act as judges for competitions; they solicit scholarship and loan funds from business and industry and private sources; they serve as counselors to students. Although dedicated industrial arts educators assume these responsibilities as a matter of course, prolonged recruitment activity should receive professional recognition. Administrators should explore the possibility of assigning released time for coordination of recruitment activities in this shortage field.

3. Student Organizations

At least one strong, active industrial arts student organization exists on every campus which offers a program. These clubs and societies promote the field by sponsoring visitation programs whereby high school seniors are brought to the campus, guided through the facilities, and observe classes; by setting up and manning exhibits at open houses held on campus or at fairs or other events where high school students are likely to congregate; and by providing scholarships.

4. Follow-up

Besides having the advantage of keeping the curriculum viable and relevant, continuous follow-up on graduates can be a significant recruitment device. For example, twice each year the Industrial Arts Department at CSC-Long Beach publishes the "State Slate," a newsletter which is sent out to all former students and graduates. It contains information about the status of the program, the activities of faculty, and forthcoming events. In this way former graduates are made to feel a sense of identity and a responsibility to help recruit new students. Also, graduates employed in business and industry may be influenced to turn to careers in teaching.

*In 1969 through NDEA funds, the State Department of Education sponsored work sessions on the "Articulation of Industrial Arts Teacher Preparation" with Central Valley State Colleges and Community Colleges. Similar sessions are planned in the North Coast and Southern California regions during 1970.

Every effort is made to retain the teacher candidate, once recruited, to keep him interested and on course. Student organizations are important in this respect, as is the counsel given and personal interest shown by faculty members. But a high-level program is the *sine qua non*. Qualified students who are known to be planning to seek employment in industry upon graduation should still be required to meet the full undergraduate teacher education curriculum because in later years they may be redirected into teaching.

The foregoing enumeration of recruitment and retention activities used by industrial arts departments is by no means exhaustive. It is apparent, however, that the type of aggressive recruitment program that is needed to meet the challenge of today and tomorrow should include a high degree of attention to all of these approaches.

Bachelor of Vocational Education Degree

The Bachelor of Vocational Education degree, granted by (or at least on the books of) eight State Colleges, came into being upon passage of Senate Bill 752 in 1943. The "Swan Act," as the legislation is more commonly known, after the name of the senator who introduced it, makes it possible for a qualified vocational education teacher to secure a baccalaureate degree through any participating State College. On the basis of certain evaluative criteria, including the passing of comprehensive written and performance examinations, a Board of Examiners fixes the semester hours of credit for work experience that the admitting college should grant the applicant towards the B.V.Ed. The maximum credit that can be allowed is 40 units; over the 20-odd year period since the law went into effect, the average number of units granted has been about 28.

The law does not require the State Colleges to participate in the program. They need not offer the B.V.Ed., and if they do offer it, need not admit all applicants nor accept the number of units recommended by the Board of Examiners. The Board's examinations have proved so rigorous, however, that the participating colleges do, in fact, generally allow the credit recommended.

At the time the Swan Bill was implemented, the nature of trade and industrial education was almost entirely that of the traditional trades, and consequently most of the classes were of the "shop" variety. Thus, while the legislation did not stipulate a particular department in which the work was to be done, most of the teachers chose to do their work in the industrial arts department, both because of the natural affinity which exists between industrial arts and vocational arts and because the earliest applicants were experts in the area where industry then most needed workers: auto mechanics, machinists, and electricians.

Industrial arts departments thus came to be assigned administrative and counseling responsibility for the B.V.Ed. students, and continue in this role today, even though in recent years the trade and industry education program has taken on a very different cast, expanding beyond shop classes to include health services, public services, and other areas of activity. Indeed, the B.V.Ed. degree encompasses several hundred different occupational categories, for most of which corresponding baccalaureate-level programs or options do not exist. Generally, the State Colleges encourage only applicants with backgrounds in industrial education.

The high school and community college trade and industry vocational education teacher coming directly from industry finds himself in a rather unusual position *vis-a-vis* a college degree. Appropriate collegiate preparation is available for teachers of agriculture, business, and home-making; indeed a baccalaureate is generally required for initial certification in these fields. There is no similar program or requirement for the trade and industry teacher. Such a multitude of special areas exists that it is not feasible or desirable for colleges to fashion programs to prepare teachers in them all. Under the B.V.Ed. the teacher's work experience established his subject-matter competence and essentially constitutes the *major* (that is, vocational arts); his college program consists mainly of gaining general education breadth and further cultural development.

While the practice of placing the technically competent but professionally unfinished person in the classroom first, and having him secure the bulk of methodology later and a college degree still later, is obviously not the most desirable sequence, it is a necessary expedient as long as certain conditions obtain. By design the vocational education program in the public schools prepares individuals directly for gainful employment. For teachers of such a program, subject-matter competence is indispensable. Under present conditions, this competence can for the most part be acquired only through recent, sustained, related work experience in industry. Colleges cannot cover the whole spectrum of specialties, nor do they at present require either that the student have gained related work experience in industry prior to graduation or enter into internship arrangements with industry to ensure that he will receive the requisite work experience. Moreover, even if colleges were able to do these things, the schools would still find it necessary to supplement regularly credentialled teachers with persons drawn directly from industry, since the present demand for vocational educators far exceeds the supply. Until the supply of fully certificated vocational education teachers holding baccalaureate degrees in related fields equals or exceeds the demand, the B.V.Ed. must be continued and expanded.

From the point of view of some industrial arts educators, the B.V.Ed. poses certain difficulties. For one thing, it is hard to identify with a program which is not of their own making nor entirely controlled by them. Although B.V.Ed.

graduates carry the recommendation of the department and the college, they usually take only a limited number of courses in the department and thus do not become well-known to the faculty. To improve this situation, industrial arts educators in some colleges are considering requiring a sequence of professional courses which will contribute to the student's knowledge as well as provide the faculty with an opportunity to evaluate his abilities in accordance with departmental and college standards.

Moreover, the industrial arts educator does not feel qualified to counsel applicants with backgrounds other than industrial education—in cosmotology, for example, where no baccalaureate program exists nor is likely to in the future. In connection with the counseling function itself, B.V.Ed. students—though they are small in number compared to overall enrollments in the college and even in the department—bring with them a host of problems which require many hours of administrative consideration. There is no provision for the extra time that must be devoted to counseling these special students, who take an average of nine years to complete the degree. There is also a question of possible duplication between the Swan Act and community college units for students who first take an associate degree, work in industry for a number of years, and then turn to teaching. The seriousness of this issue could accelerate as a result of the Licensing Certificated Personnel Law of 1961, which increased the minimum attainment level of the vocational education teacher from the holding of a high school diploma to earning an associate degree or completing 60 semester units of college work. However, the committee that recommends unit credit for candidates who apply for Swan Act evaluation is aware of the problem, and will be taking measures to prevent duplication.

On the other hand, as pointed out previously, the value of and necessity for the B.V.Ed. route is so compelling as to outweigh any apparent problems and inconveniences. It makes a career in teaching possible and attractive to persons at the mid-point in life and thus lessens the recruiting problem. It may play an increasing role in the complex of programs developed to meet the needs of special types of students admitted to the State Colleges. For example, recently the "exceptional admissions" category was broadened, so as to provide for the admission of a larger number of students who do not meet the regular criteria but are deemed capable of profiting from college work. Special programs for the disadvantaged and for minority groups have been introduced. Several larger colleges offer what is termed a "special major," by means of which a student with uncommon career objectives can, through special advisement procedures, work out a program consisting of relevant courses from several different departments. San Francisco State College, which also participated in the B.V.Ed., offers another unique program for students interested in professional careers in which a comprehensive knowledge of design integrated with other selected disciplines is needed. Depending on the particular industrial inclination of the student, advisers in the Department of Design and Industry organize a logical course of study incorporating one or many programs of the college. The program accommodates students with training in such diverse fields as electronics, hotel and restaurant management, merchandising, technical illustration, shop practices, art and international business, to mention a few.

Under present arrangements applicants for the B.V.Ed. are fully qualified academically and pursue rigorous college programs. In addition, they are highly motivated to succeed. Dr. Lee D. Bodkin, currently regional supervisor of trade and technical education, Bureau of Industrial Education, in his 1966 dissertation points out that the provision for allowing recognition of work background to count toward a baccalaureate degree has had a very positive influence on the educational aspirations of trade and technical teachers. In a survey which covered 80 percent of the 590 applicants for evaluation up to 1963, he learned that 54 percent of them actually acquired the B.V.Ed. and 26 percent were actively working towards it. Further, 20 percent of these received the master's degree and 5 percent were actively pursuing it. An impressive number have achieved positions of leadership in education, including the presidency of a junior college. As Bodkin concludes:

> It would seem that persons coming into teaching as a second career at the average age of 39 years have a social and cultural maturity which is based upon experience in the community and is a natural basis for further participation in the educational world of which they have become a part.

Granting credit for work experience, a practice inherent in the B.V.Ed., is not uncommon in colleges and universities. Moreover, through the efforts of the College Examination Board, the concept of accepting credit by examination towards a degree, whatever the means of acquiring the particular knowledge and competence, is gaining momentum. This program, known as the College-Level Examination Program (CLEP), aims:

> . . . to provide a national program of examinations that can be used to evaluate nontraditional college-level education, specifically including independent study and correspondence work; to stimulate colleges and universities to become more aware of the need for and the possibilities and problems of credit by examination; . . . to assist adults who wish to continue their education in order to meet licensing requirements or qualify for higher positions.

Tests involving vocational subjects are not included at this time, but they could be developed and standardized by the Board or another agency if sufficient demand existed. At any rate, as the practice itself becomes adopted more widely, as it surely will in the future, there will be no reason to continue a separate degree for vocational education teachers. Using the regular Bachelor of Science degree would, as Bodkin points out:

> . . . tend to lead to better acceptance and recognition within the state colleges. The general education requirements for the Bachelor of Vocational Education follow the same pattern as for other baccalaureate degrees. The practice in institutions across the nation responding to this study is almost totally that of designating the degree involving recognition of work experience a Bachelor of Science degree. Such a change in designation would reduce the implication that a degree which allows for subject-matter development in a manner other than through formal course work is different and less desirable or valuable.

Impediments to changing to the B.S. degree are that the number of units of credit by examination that can be applied to a B.S. degree from the State Colleges is fewer than the number of units commonly recommended by the Board of Examiners, and the units required for the major larger. However, these and other apparent obstacles are not insuperable, and the State Colleges should give serious consideration to effecting a changeover. Regardless of the outcome, the B.V.Ed. can become a more serviceable degree if it is opened up to occupational categories other than industrial education. This will necessitate some change in the attitude of the faculty in certain departments. They must come to a better understanding of the unique position and needs of vocational education teachers and realize that for these people flexibility and innovation need not dilute academic standards in any way. Administering such a broadened program need not be the exclusive responsibility of industrial arts faculty; administrative responsibility might be vested in a college-wide coordinator of special programs. However, since it is likely that the bulk of applicants will continue to be in the industrial education category, relief in the form of released time for program advising should certainly be given to industrial arts departments.

The applicable credentials are the Standard Designated Subjects Teaching Credential with Specialization in Vocational Trade and Technical Teaching and the Standard Designated Subjects Teaching Credential–Industrial Arts and Occupational Subjects, commonly known as the 8.0 and 8.1 credentials respectively, from the articles of the Education Code which pertain to them. The 8.0 credential authorizes the holder to teach in grades nine through fourteen and in classes for adults in the general and specific subject or subjects named. The holder of this credential must normally have seven years of specific occupational experience. The 8.1 credential was adopted to meet the pressing need for teachers in the high school trade and technical programs that accelerated as a result of the Vocational Education Act of 1963. It permits holders to teach both industrial arts and industrial occupations classes in grades 9 through 12, including but not limited to courses reimbursed from vocational education funds. Industrial arts teachers qualify for this credential if they have two years of work experience in industry.

Responsibility both for recommending certification and for providing the teacher training courses for persons who qualify for the 8.0 and 8.1 credentials is now vested in the Supervisors of Trade and Technical Education, Division of Vocational Education, University of California at Berkeley and Los Angeles. The faculty members of the Division are provided through a contractual arrangement with the Bureau of Industrial Education. Since the original agreement between the Bureau and the University was negotiated, the functions of both the University and the State Colleges have changed considerably and it therefore seems appropriate to deal with the question of responsibility anew.

Lathrop and Farr point out:

> There are members on state college faculties qualified for teaching the core courses for the Standard Designated Subjects Credential–Industrial Arts and Occupational Subjects. If these

courses were taught by state college faculty members on state college campuses, college credit could be given which would be applicable to degree programs. It would also make the courses available at several centers throughout the state.

Consequently, they recommend that "the six units of course work required for the industrial arts teacher for the 8.1 credential be offered by selected state colleges . . ." On October 14, 1967, the California Council on Industrial Arts Teacher Education passed a resolution recommending that "the vocational trade-teacher education courses . . . be offered in all of the California State Colleges having industrial arts education programs."

Because of the considerable benefit to students and teachers, and for other compelling reasons which will be enumerated later, this report goes a step further and recommends that the administration of both the 8.0 and 8.1 credentials be transferred from the University to the State Colleges. It does not make either administrative or pedagogic sense that the University, which has otherwise divested itself of curricula in industrial and vocational arts as part of its regular offerings, should continue to administer these two credentials and give courses in support of them through the Extension Division. It would be more logical, efficient, and economical to concentrate all responsibility for preparation of industrial education teachers in that segment which now does about 90 percent of the job.

When the University phased out industrial arts education a few years ago, the State Colleges proved themselves well qualified to take over. Nearly 40 percent of the permanent faculty hold earned doctorates, and a large number of the faculty have been engaged in research, have contributed to the literature of the field through books and articles, and are active in professional societies. Lathrop and Farr, in citing the publication of over fifty articles, five books, and several manuals over the last two years, comment that "probably in no other place in the country is there as great a concentration of authors in the field of industrial education" as in the California State Colleges. In addition, at least twenty-five research projects, exclusive of smaller projects associated with classes and doctors' dissertations, were carried out in the same period.

Many state college industrial arts faculty members have the background and experience necessary to teach the professional courses for credentials. At present, trade and technical teachers must take the core courses offered by the University, namely "The Instructional Process in Vocational Education" and "Principles and Practices in Vocational Education," for a total of 12 units. They may—and often do—complete the additional 10 units required for full certification at one of the State Colleges, as authorized by the Division of Vocational Education staff. Further, the State Colleges offer the B.V.Ed., which is the follow-up degree for holders of the 8.0 credential. As of June 30, 1967, State College industrial arts faculty became responsible for developing and standardizing the competency examinations for the 8.1 credential jointly with personnel in the Division of Vocational Education at the University. Finally, as Lathrop and Farr note, school "administrators are requesting industrial occupations teachers directly from the state colleges."

Transfer of authority, faculty, research activities, etc., would require a great deal of good will on the part of all parties concerned. The difficulties of negotiation were revealed when representatives of the University, the State Colleges, the Bureau of Industrial Education, and the Coordinating Council for Higher Education met in the fall of 1967 to consider the merits of transferring responsibility to the State Colleges. Although the University wished to be relieved of the program, agreements could not be reached and the *status quo* was maintained. Discussions should be initiated again between appropriate personnel in the State Department of Education and members of the Chancellor's Office of the California State Colleges in an effort to effect a transfer of responsibility. The difficulties do not appear to be insurmountable.

Assumption of responsibility by the State Colleges will entail some adjustments and accommodations—for example, some relaxation of criteria for admission, a more positive attitude toward vocational education itself, clarification of the degree of control and decision-making exercised by the State Board of Education, the development of new administrative arrangements, and reexamination of the curriculum. Bohn pointed the way in his 1965 paper when he showed how the attempt "to keep industrial arts within the framework of general education while the needs of pupils in high school often included much broader and extensive things than general education" resulted in "a philosophy squeezed to the point that practice is much broader than stated objectives." In evaluating the "present and future contributions of industrial arts to the total school program," Bohn would add to the two areas of traditional instruction—pre-collegiate and pre-professional and general education—a third, namely occupational education, to which only "brief acceptance" has been given in the objectives of industrial arts. He urges industrial arts educators to meet "National interest in the education of the 60-80 percent of the student population unable to profit from college instruction . . . with both enthusiasm for the recognition of the need and respect for the magnitude of the educational problems identified."

The distinction between industrial arts and occupational education has never been very clear. After studying programs of both types in about a hundred schools across the country, no less an authority than Dr. James Conant concluded: "The line between the industrial arts program and the vocational shop program for boys is not an easy one to draw." The Lathrop and Farr study ostensibly aims to discover what the relationship between industrial arts and vocational-trade technical education in California is and "should be." They found a positive relationship to exist at all levels, but most apparently at the high school level, between industrial arts and what is termed "industrial occupations" classes. These latter differ from the regular vocational trade classes in that they involve the family of the occupations (e.g. general metals) rather than training for a specific trade (e.g. welding). Since industrial occupations programs were generally started in schools where industrial arts already existed, "in some cases classes are conducted in the same room with the same equipment by the same teachers." This arrangement is advantageous for industrial arts because a portion of the money allocated from Federal funds can be used to purchase equipment which benefits the industrial arts student as well as the occupations student.

The usual pattern, Lathrop and Farr note, is for a student to complete a year or so of an industrial arts program before enrolling in one of the industrial occupations programs. In this way the industrial occupations classes can be conducted at a more advanced level, since the student will come with a basic knowledge of tools, procedures, measurements, attitudes, and the like. Abstracting from the way things are in practice—with industrial arts classes used as a prerequisite and as a means of selecting students for the occupations classes—Lathrop and Farr recommend that "Most industrial occupations classes should be preceded by one or more industrial arts classes." This recommendation reinforces the traditional distinction drawn between industrial arts and vocational-trade technical education and supports the majority opinion of the people Lathrop and Farr interviewed during the course of the study:

> . . . the term industrial education should be used in defining these programs but each segment, industrial arts education and vocational trade and technical education, should maintain its own identity within this usage.

This recommendation conflicts with the Little report, which was prepared for the State Board of Education. It poses as one of the critical questions for the Board:

> How to integrate the now disintegrated trio of academic education, industrial arts (and similar programs), and vocational education. The first requirement is a new philosophy and definition of vocational education that decouples it from training leading directly to gainful employment and from the admission requirement that the student shall have preselected his occupational objectives. Then vocational education would include the exploration and development of occupational *commitment*—a function now reserved to industrial arts. It would extend the focus of industrial arts beyond the trades, industry, and technology to include the social sciences, the arts, business and commerce. It would call for the fusing of basic academic studies and vocational training into a new philosophy and practice of occupational education.

And:

> The fundamental philosophical issue for the Board, then, is to end the separatism of Vocational Education in California. Occupational education must be an integral part of education at all levels.

How influential the Little report may turn out to be there is at present no way of knowing. Thus far only Part I has been published, and the State Board of Education will not be taking it up formally until Part II, which will consist of a "strategy for implementing the objectives emerging," is completed late in 1969. At any rate, the implications for higher education in general and industrial arts in particular are far-reaching. One benefit integration has for industrial arts is belated access to Federal funds, which are likely to continue to be munificent in the future in recognition of the fact that the nation's economic and sociological well-being lies in what education can do for the "neglected" student, the high school dropout and the non-college bound. Clearly higher education has a stake in providing theoretical and professional direction to vocational education.

Industrial Experience

Lathrop and Farr describe the industrial education teacher needed today as:

> . . . one who has a good formal collegiate education in technical knowledge and skill plus a sound background in general education; has industrial experience; and keeps his industrial experience current by taking an active part in in-service education and summer employment.

The industrial experience requirement is followed through with a recommendation that "An internship program in industry should be established in state colleges to afford an opportunity for teachers to secure supervised industrial experience." This recommendation reiterates one made earlier by Dr. Wirt McLoney, professor of industrial arts at San Diego State College, in his doctoral dissertation, *Current Practices and Trends in Industrial Arts Education in the Comprehensive High Schools of San Diego County* (1965). He urged that industrial arts teachers

> . . . learn at first hand the dynamic requirements of industry and . . . teacher training institutions consider providing actual experience in industry as part of their offerings.

It is surprising that pilot internship programs between industrial arts departments and industry have not been developed long before now. Lack of such internship arrangements may be the most serious weakness in existing programs. If one important objective of the industrial arts program in high school is to provide the student with proper understanding and interpretation of industry, the teacher can hardly impart it realistically if he himself has not had work experience in industry. There is ample evidence (see Part II) that industry is ready and willing to cooperate with the colleges in organizing internships of various types. In recognition of the value of such programs, Congress has made provision in the Higher Education Amendments of 1968 for a new program whereby grants will become available to facilitate cooperative work-study arrangements between schools and public and private agencies.

Fortunately, a large number of industrial arts students have gained some experience on their own through part-time and summer employment in industry. However, such work may not be of the appropriate type or level, is not supervised, and has never been required as a condition of graduation. One reason internships have not been tried is the cost factor; another, the lack of faculty time and know-how to supervise them. But even if the internship does increase the overall cost of preparing the teacher, the expense and effort would be slight in comparison to the benefits to be derived. Effective learning is more apt to change attitudes and create growth than texts and vicarious experiences. The teacher would not only speak with greater authority and be able to give the student better career guidance, but he would also make his subject more relevant to students. An incidental benefit for the industrial arts teacher is qualifying for the 8.1 credential and thus broadening his career potential.

PART II: INDUSTRIAL TECHNOLOGY

PART II

Industrial technology constitutes the third sector of the industrial education triad with which this report is concerned. Although not all institutions which offer some version of industrial technology employ this particular title, it is the most common one, and appears to be gaining even wider acceptance. Five State Colleges use this title for their programs, and a sixth will switch to it soon. As would be expected of a program still in the development stage (although one progenitor, a curriculum at Bradley University, dates back to the 1920's, only in the last dozen years or so has the movement gained momentum so that today upward of seventy-five colleges and universities offer it), a certain amount of tentativeness attaches to it. Unlike engineering and engineering technology curricula, industrial technology has not been endowed with distinctive title, philosophy, and objectives by a national agency. Sympathetic studies, such as Weber's and Barnhart's, have noted as much the diversity as the commonality among existing programs. It is within this context of relative novelty and formlessness that the past action of the Board of Trustees to restrict the number of such programs must be understood and reviewed.

The formation of the National Association of Industrial Technology in 1967, as an entity separate from the American Industrial Arts Association, is a sign that industrial technology is coming of age. The expectation is that this body will give much-needed direction by elaborating a distinctive philosophy, identifying appropriate objectives, developing criteria for accreditation, serving as an accrediting agency, providing data, and encouraging research – and thus help these programs to realize their full potential.

A comprehensive national study has been urgently needed, but efforts to get such a study under way with Federal (HEW) support have not been successful. While it would be preferable to define the State College role within a national context, the prospect of such a comprehensive study is remote at this time, and even if undertaken immediately, would take several years to complete. Since technologist programs in the California State Colleges should not continue to be stymied at the very time that industry's need is becoming more acute, action in developing appropriate guidelines cannot be delayed.

It is indeed feasible – by examining the literature of the field, by exploring the State College programs in depth, by comparing them with similar programs offered by institutions across the country, and by utilizing the findings of an extensive survey which was conducted expressly to ascertain California industry's viewpoint on the need for and use of technologists – to clarify the status of existing programs and to chart some paths for their future growth and development. The resulting policy guidelines are an attempt to place an area of instruction, which is still malleable and searching, into reasonable relation to similar programs offered or envisioned in the colleges, so that balance and economy will be effected. These guidelines should of course be reviewed and modified as appropriate in light of the findings of any subsequent national study. California's experience may, however, prove relevant to other states, and the findings of this study may have some influence on the future direction of technologist education nationally.

DEFINITION OF INDUSTRIAL TECHNOLOGY

The **Master Curricular Plan** of 1963 defines the industrial technologist as:

> . . . an individual who uses tools, instruments, and devices to design, fabricate, maintain, and operate objects, materials or equipment. . . . Typical duties include laboratory testing, data interpretation, preparation of specifications data, cost estimating, supervision and scheduling of construction and production, and applied research on various industrial mechanisms.

This definition, agreed to by the practitioners, is essentially that given in 1962 by Dobson, who attributed it to the U.S. Office of Education. It is valid insofar as it describes, at least partially, the entry-level and initial work assignment of the technologist in industry. A more exact and complete definition must take into account the marketing, distribution, sales and servicing of industrial products; must include positions in the educational training section of the industrial enterprise; and – most importantly – must emphasize the leadership role the technologist is expected to exercise on the job: middle management. The "Position Paper" of the California Council on Industrial Arts Teacher Education (1968) thus more accurately characterizes today's industrial technology program as:

> ...preparing students for such positions as those in planning, supply, product utilization and evaluation, production supervision, management, marketing research and technical sales. These graduates are capable of analyzing problems, as well as recommending, implementing and supervising appropriate solutions. They satisfy the emerging need for technical administrators in industry.

The objective of preparing technical administrators is not new to industrial technology. Weber in 1961 pointed out that "The chief purposes of industrial technology programs... are concerned with the preparation of students for positions of leadership in the manufacturing industries" (rather than "industry" in general). And:

> The main difference between industrial technology and the other types of programs [i.e., industrial arts teacher education and technical institute training] is the general area of preparing students for positions in management.

Yet at the beginning of the decade this objective was only implicit in the catalog statements of a few institutions, and besides rather unrealizable through the actual curricular provisions. Today it has become the most distinctive feature of the program, offering a compelling rationale for its being truly baccalaureate in level, and designed to meet one of the pressing needs of industry as perceived by industry itself. The chief objective may be seen to be the training of persons to enter the field of industrial operations. The graduate, though having knowledge of basic industrial skills, is oriented towards assisting and directing the development program, the flow of production, the distribution of the product, and other facets of general management. The technologist supervises operations involved in the development of a consumer product, or its movement to the distribution point, and even making it acceptable and popular on the open market. Some curricula offer variations in the business portion, permitting a sales emphasis, for example.

The distinction between the technologist and the technician on the basis of length of educational preparation – four years versus two – and by level of job assignment – higher versus lower, professional versus semiprofessional, supervisory versus assistant, for example – has become standard in educational and professional circles, since ECPD established criteria for accrediting four-year engineering technology curricula in 1966. The distinction and nomenclature make sense, and are used throughout this report. In California the clarification could be complete if some community colleges did not claim to be preparing "technologists" rather than "technicians."

THE 1967 DEAN REPORT

The most extensive delineation of the philosophy and objectives of industrial technology is provided by the 1967 Dean Report (from the name of the chairman of the committee of the American Vocational Association which drafted it), which attempts to discover the common denominator among existing programs, and describes the industrial milieu in which the graduate works. The Report incorporates large sections of a paper prepared by Cunningham, one of the committee members. A brief summary of this most recent, comprehensive discussion of the subject, with pertinent excerpts, will be helpful here. Cunningham's charts on (1) the divisions and functions of the construction and manufacturing industries and (2) the source of educational content for the curricula in industrial technology are included in Appendix E.

After briefly tracing the history of technological progress in America, which prior to World War II had been slow but sure, Cunningham observes:

> Innovations to improve the efficiency of operation of industrial enterprises now occur so rapidly that the present era (1950 -) is commonly referred to as the Scientific Revolution. Rising labor costs, which started during World War II, were an influential factor in causing these changes. Industrial enterprises soon became aware that these costs would eventually price their products out of existence unless steps were taken to produce commodities at a price acceptable to the consumer. To meet this challenge, changes were made continually by industrial enterprises.... For example, increased research activities in the field of science resulted in discovery of new scientific principles, new materials, and new procedures; the application of automation was made to many industrial processes; and the initiation of efficient management practices was instituted. As a result the number of skilled jobs in some industries steadily declined while a much larger number of new technical jobs was created.

As the simpler organizational and personnel structure of the past proved inadequate to meet the needs of an industrial enterprise becoming ever more complex and sophisticated, there evolved three interrelated operational divisions – administration, research and development, and applied sciences or technology – requiring a spectrum of employee categories from top management to the craftsman. In the technology component are the areas of design and refinement, production and manufacturing, field service and product utilization, distribution and sales, and education and training. The high-level technologist, who works in one of these areas, is described as:

> ... a college graduate who is associated with managerial and scientific activities in the industrial field as well as in the educational field. He has a solid background in mathematics, physical sciences, human relations, and extensive educational experience in technical theory and manipulative skills in a field of specialization and related areas. He is able to work with scientific personnel and contributes to their ideas; he supervises and manages people, coordinating their efforts in the utilization of materials and machines in producing and distributing industrial products.
>
> The industrial technologist has a specific job area and a definite career. He fills positions which are interrelated with the divisions of research and development and administration. He advances to positions of increased responsibility within the industrial technology division according to his abilities. However, it is possible for the industrial technologist to be promoted into management positions within the other two divisions.

As to the chief objective, the Report acknowledges that the curricula:

> ... are oriented more toward training for supervisory and middle management positions. It is presumed that graduates ... will be employed in positions requiring leadership qualities and a broad knowledge of those supervisory and administrative functions which result in the efficient operation of an industrial organization.

With regard to the appropriate curriculum to prepare the technologist, the Report states:

> The training includes a basic knowledge of some engineering and management principles, a broad knowledge of industrial processes and the operation of machines and equipment, in addition to applied technical and practice skills. The chief asset of the training is that the graduate of such a program is provided with a broad background ... which makes him flexible and adaptable to almost any kind of industrial organization with a reasonable amount of in-service or job orientation training.

Previous studies dealt only with what industrial technology *is*; the Dean Report attends to what industrial technology *should be*. Thus a strong curriculum would satisfy the following conditions:

1. Be directed toward a field of specialization with generous educational experiences in related fields of industrial technology.

2. Provide opportunity for development of a thorough understanding of mathematical and scientific principles and the practical application of these principles to a field of specialization and related technological areas.

3. Provide opportunity for development of a basic understanding of the humanities and social studies and a knowledge of how they can be utilized for achieving better human relations.

4. Provide opportunity for development of sound principles of management and supervision and an understanding of how these principles can be used to achieve the objectives of the industrial enterprise.

5. Be of college level and of a quality required for graduates to obtain employment in accordance with the objectives of the curriculum.

6. Be reviewed frequently and changed to meet existing and projected needs of industry and education.

The curriculum is broad enough to prepare students for the varied positions in industrial technology and flexible enough to permit election of courses that satisfy the needs and interests of the individual student. On the other hand, it contains a core of courses that are basic for efficient performance in all areas of industrial technology.

As to meeting these conditions, an earlier draft of the Report (1966) minced no words in admitting the "wide range of sophistication" that can be found among existing programs:

> . . . a large share border on the naive; several indicate an awareness that replacing one or two educational courses in the standard education program is not sufficient; and a relatively few recognize that a valid program should be designed around industry's needs.

These observations were based on an analysis of 43 programs and a survey of 140 graduates of one specific program. The Report categorized the programs according to whether they aim to produce the "technician with a degree," the "technically-oriented generalist," or the "management-oriented technologist." The curricula are characterized as being largely composed of various "mixes" of existing courses from existing disciplines. Indeed, the Report is critical of the fact that there "do not appear to be enough unique industrial technology courses," i.e., courses with an IT prefix expressly designed to meet the specific needs of graduates and justifying the distinctiveness of the discipline itself. This objection is in line with the stricture of Sommers, another member of the committee drafting the report, who warns:

> If we don't develop the best possible definition of the product line and the best possible curricula for producing it, we must expect other educational programs to expand to fill the need . . . industrial technology will only achieve academic respectibility and professional status if it is based on a rational set of objectives that are unique when compared to other professional areas.

SUMMARY OF PREVIOUS SURVEYS AND STUDIES

Some findings of other surveys and studies of technological education are relevant to this report.

Weber's dissertation (1961), entitled *A Comparative Study of Industrial Technology Programs in American Colleges and Universities*, was designed to determine what industrial technology programs are and how they differ from industrial arts teacher education and technical (engineering) institute programs. His conclusions are based on an analysis of questionnaires returned from 163 institutions, including 22 technical institutes, 52 institutions offering industrial arts teacher education solely, and 89 institutions offering both industrial arts and technology curricula. He discerns two general types of programs: those in larger colleges having strong supporting departments of industrial engineering, mechanical engineering, graphics, business and journalism, etc., and those in smaller colleges which, lacking these resources, are more oriented toward development of industrial skills. (Wheaton in his 1964 study also notes this distinction, suggesting that it partially explains the trend for larger institutions to concentrate on industrial technology while leaving to the smaller ones the training of industrial arts teachers.)

Weber finds that, although considerable overlap of purposes and some similarity of curricula exist, industrial technology programs are "quite" different from industrial arts education and engineering-oriented technical institute training. Industrial technology programs exhibit the following characteristics:

> (1) purposes are management oriented rather than engineering oriented; (2) curriculums are general in nature rather than specialized; (3) a variety of courses in shops and laboratories is required; (4) requirements for graduation are similar to those of other four-year college programs; and (5) qualifications of instructional staff are identical to those of other four-year college programs.

With regard to purposes, staff qualifications, and curricula, industrial arts education is not significantly different, whether or not industrial technology is offered at the same institution, nor is the percentage of graduates of industrial arts that enter the teaching profession apparently affected by the co-existence of industrial technology. Weber describes industrial technology as:

> . . . an educational program designed to give students an insight into how goods are produced (through shop courses), a knowledge of problems of management and distribution (through commerce courses), and the ethical foundations for making decisions (through general education courses).

* * * *

Barnhart's modest survey (1963) for the meeting of the American Vocational Association is based on analysis of 60 curricula of 29 institutions. He categorizes industrial technology programs as either "general" or "specialized"; the former are designed primarily for preparation of personnel for managerial and supervisory positions, requiring a broad technical background combined with a working knowledge of business and managerial techniques, whereas the latter place less emphasis upon the professional courses and require fairly specialized training in one technical field, often supported by a basic knowledge of all fields of technology. He classifies the specialized programs into eight groups which are broadly descriptive of the industries for which they provide training: aeronautics, automotives, building and construction, drafting and design, electricity-electronics, graphic arts, metals and manufacturing, and woodworking. Like Weber, he finds that specialized programs tend to be offered by smaller institutions and to be skill-oriented, whereas the general programs are offered by large institutions and provide students with a professional, academic preparation in the areas of "management, industrial supervision, production and safety." In comparing the curricula according to their content in the fields of communications, science and mathematics, professional (i.e., nontechnical courses which aid the technologist in performing managerial tasks), and technical specialty, he discovers that the specialized programs have less science and mathematics but more technical requirements than the general ones. For all curricula, the mean science and mathematics requirement is 21 semester hours, and the mean technical course requirement is 46 semester hours.

* * * *

Groneman briefly summarizes previous surveys and studies in an article in *Industrial Arts-Vocational Education* for June 1964. He distinguishes four practices in designating the type of technology degree offered: (1) B.S. in Industrial Technology (the most common designation); (2) B.S. in Industrial Education, with designation of a nonteaching option; (3) degree named for the special area of concentration or specified technology (as Civil Technology); and (4) B.S. in broad areas, such as Industrial Supervision, Education-for-Industry, Industrial Management, Engineering Technology, or Industrial Science. He alludes to a study of the management, industrial engineering, and business support type of program commonly found in larger institutions. The graduate of this type of program is well-versed in the humanities and social studies, because of the need to work closely with personnel in the industrial organization, as well as in mathematics and science, related engineering, industrial materials and processes, business and industrial services. The mean curriculum devotes 16% of the total requirements to mathematics and science, 13% to engineering science, 19% to industrial materials and processes, 15% to business and industrial services, 22% to humanities and social studies, and 15% to electives.

* * * *

All the surveys and studies summarized above were conducted by industrial arts-industrial technology educators. Defore's study, done from an engineer's point of view, purports to deal with baccalaureate engineering technology programs, but it makes the assumption that many industrial technology programs are closely enough "related to the engineering field" to qualify for inclusion among the 73 institutions in 33 states offering 189 curricula covered. This assumption was challenged by Foecke at the 1966 meeting of the Engineers Council for Professional Development:

> Of the more than 70 baccalaureate degree programs in technology which now exist, I would say that only a very small number could be said to have grown out of an *engineering* heritage. These are extensions to four years of former two-year (or slightly longer) programs for the preparation of engineering technicians. These institutions and their personnel have long been active in both ECPD and ASEE, their associate degree programs have been accredited by ECPD, and their terminologies have regularly used the word engineering

as an adjective for such nouns as technology, technician, and technologist. Of the other and larger group of four-year technology programs, many grew out of an industrial arts heritage, they have never been associated with either ECPD or ASEE (and in some cases most definitely don't want to be), and many have never had the term 'engineering' attached officially to their programs either as an adjective or a noun (for them a much more common term has been 'industrial technology'). To call these latter programs engineering technology (even when they themselves do not) may be justifiable, but my special concern and that of ECPD should, I think, be with the smaller group which has long been a part of our 'family' and heritage.

The confusion is confirmed by the inclusion of six programs from the California State Colleges, five of which evolved from, and are still closely associated with, industrial arts. At any rate, Defore's equating of engineering technology and industrial technology programs underscores apparent similarities in orientation and structuring. Defore assigns the curricula to ten categories: aeronautical, automotive, architectural, civil, drafting, electrical and/or electronics, graphic arts, mechanical, production and industrial (the most common), and others. It is significant that at least three of these have no counterparts among traditional engineering curricula. Analysis of the curricular contents of four-year engineering technology and professional engineering programs reveals that they are comparable in technical specialty subjects, communications, and humanities-social studies, but different in other parts of course patterns. For example, technology requires approximately 50% more time in related technical studies, mainly of a laboratory or shop nature; professional engineering requires nearly double the mathematics-science content.

In comparing four-year engineering technology with two-year associate degree programs, Defore finds that the mean numbers of semester hour credits required in engineering, science, mathematics, and communications are approximately the same in both baccalaureate and associate degree curricula, although the number of credits represent slightly smaller percentages of the total requirements in the baccalaureate curricula than in the associate programs. In the baccalaureate curricula, however, an appreciably larger proportion of the total requirement lies in humanities and social studies. Baccalaureate curricula have a mean requirement of 34 semester hours credit in technical specialty subjects, or 36% of the total; the associate, 22 for 32%. Although the total requirement for the baccalaureate degree is nearly twice that for the associate degree, the mean requirement in the technical specialty for the baccalaureate is only 55% more than for the associate. Defore thus concludes that:

> As compared to four-year engineering programs, baccalaureate technology programs tended to concentrate more on technological methodology, to be more flexible, to contain less science-related subject-matter, and to require fewer total credits for the degree. As compared to associate degree engineering technology programs, baccalaureate engineering technology programs appeared appreciably less intensive, required a smaller proportion of their total credits in the technical areas, and had a larger portion of the total requirements in the curricular area which included unrestricted electives.

In interpreting these data, it must be remembered that the baccalaureate engineering technology—industrial technology combination is being compared exclusively to two-year programs offered by technical (engineering) institutes. At any rate, Defore's conclusions appear to bear out what Gallington surmises about technology programs:

> What can be done in a four-year program that cannot be done in two? Perhaps nothing more in specialized skill type of preparation. The four-year curriculum *could* do more than merely provide opportunities for the student to develop skills to a higher degree. First, it could provide opportunities for a broader cultural education which should enhance the graduate's ability to understand the many facets of the total industrial society in America. Second, it could provide instruction in a wide variety of related technical knowledge and skills which are particularly important to his primary technical interest. And finally, it could have an interdisciplinary curricular provision whereby the student would be forced to view his own technology in relationship to industrial psychology and personnel problems.

The four-year industrial technology program does indeed undertake all these things – and more.

One important byproduct of Defore's study is industry's verification of his initial assumption that a technologist is distinct from a technician, both in his longer and more advanced educational preparation and in the higher level of duties performed. He points out that it is common to regard those engaged in the technological enterprise in the United States as belonging to an "engineering team." Such a team consists of five categories of manpower:

1. Professional scientists and engineers who do research, development, original design, and planning;

2. Professional engineers who have a role primarily in routine design and operation;

3. Engineering technologists who are responsible for construction, operation, maintenance, and technical management;

4. Semi-professional engineering technicians with specialized technical competencies used in support of engineering activities; and

5. Nonprofessional skilled workers or craftsmen.

Educational programs exist for the preparation of individuals for all positions on the team.

Defore's study also includes a survey of the manpower needs for technologists. The 122 employers sampled were asked to supply the numbers of professional engineers, engineering technologists, and engineering technicians which their respective companies employed in 1966, lacked, and projected to need in 1975. He extrapolated the reported shortage of 890 technicians in the sample to a national deficit of 10,500 and concluded:

> The data suggest that the greatest proportionate need for engineering manpower in the United States is for the individual trained at the technologist level. In fact, the proportion by which employers included in the sample surveyed anticipated increasing their staffs during the period 1966-75 was 27% for engineers, 182% for engineering technologists, and 35% for engineering technicians.

The electrical and mechanical fields needed technologists most.

* * * *

Jacobsen's study (1966), done under the auspices of HEW, is an ambitious attempt to survey and identify technological manpower needs of industry and to relate these needs to curriculum development in higher education. The conclusions are based on questionnaire returns from approximately 1,100 companies across the country, with the largest number of responses from California firms. The questionnaire unfortunately distinguishes only between the professional engineer and scientist and the technician. The latter performs "activities dealing with the implementation of the engineering function into industrial reality." His role is "either one of liaison between engineering and production, or one of evaluating the control function of production." Among the more significant findings of the survey are the following:

1. Nearly 20% of engineers in a typical company serve the functions of a technician. Industry shows little respect for the engineering title.

2. Industry indicates that the most satisfactory preparation for the technician is the four-year college with a technical training program. It is estimated that at least 20% of the additional technicians needed should possess the bachelor's degree or more. California leads all the states in obtaining technicians from college sources (25%). (The best source of technicians, however, is other firms, and Jacobsen is critical of the "cannibalism" practiced by industry.)

3. Industry prefers general technical training to other types. Significantly, those companies which prefer general technical training most frequently rank four-year colleges with technical trainee programs as the most satisfactory technician programs.

Jacobsen comments: "Clearly there are not enough technicians available to meet the demand of industry, and the industrial demand is growing." Interestingly, the conclusions of Jacobsen's nationwide study of industry's needs and preferences are reinforced by the comprehensive Survey of Industry in California which was conducted in connection with the present study. The conclusions of this Survey are referred to *et passim* and detailed fully in Appendix D.

HISTORY OF THE FOUR-YEAR TECHNOLOGY PROGRAM

Historically, four-year technology programs developed from two principal sources, namely, the technical (engineering) institutes and the industrial arts departments of colleges and universities. The technical institute was the original two-year post-high school institution engaged in preparing middle-level technical personnel for industry – that is, support personnel for the engineering function. In employing the concept of the "engineering team," with the skilled craftsman at the lower end of the spectrum and the professional engineer at the top, the institute was spelling out its role in training the middle member of the team, the technician who acted more or less as an assistant to the professional engineer and as a liaison person between him and the craftsman.

The engineering profession, accepting the "team" approach, proceeded through the professional organizations to fix duration and content of the educational preparation needed by the technician and to accredit the better programs. It is significant that the engineering profession relied almost exclusively on these specialized institutes rather than on regular colleges and universities to train its support personnel, and that prior to the 35th Annual Report of the ECPD (1967) the profession officially conceived the two-year program as sufficient attainment for the engineering technician.

In California, where the technical institute is a rarity, but where the junior (community) college movement is most advanced, the two-year community colleges have taken on the function of training lower-level or middle-level technical personnel of all types and for all industrial purposes. Some of these technical training programs are pre-baccalaureate, designed expressly to articulate with and permit transfer to engineering or other appropriate programs in the State Colleges, but most are occupation-centered and terminal.

Several developments stimulated some technical institutes to raise their programs to four years. Foecke cites three factors: a "nudging from below" by another part of the education system, vocational education, which was attempting to change the tone and level of its programs; "outflanking" by four-year industrial technology programs which were emerging out of industrial arts; and a "stretching from above," to fill the vacuum created as engineering education more and more tended to vacate the undergraduate level in favor of graduate level programs for the preparation of the professional engineer. The immediate threat lay in the multiplication of vocational programs for the preparation of technicians as a result of "seed money" provided by the National Defense Education Act (1958) and subsequent legislation. As Foecke explains:

> Some of these programs are still being conducted in secondary schools, but many are being conducted by institutions of higher education as two-year, 'less-than-college-grade' programs. The products of these programs are being called technicians. This understandably has caused some consternation among those who for years have been conducting programs for the preparation of engineering technicians – programs which in the minds of these educators are not to be confused with vocationally flavored programs.

The resultant four-year programs, which are essentially elongations of the training time of technicians, were for a long time ignored by ECPD. Indeed, institute faculties felt so estranged that they often attended conferences sponsored by industrial arts organizations, where mutual problems affecting four-year technology programs were discussed. However, these institutes account for a very small percentage of the institutions offering some form of four-year technology program. In the majority of institutions, four-year technology programs grew out of industrial arts departments, beginning as technical tracks distinct from teacher education. This development occurred partly in response to pressures from local industrialists, who were not having much success communicating their changing needs to engineering departments. For the view of what a professional engineer is and should be, and thus the perception of the educational preparation that is appropriate for him, had undergone significant change to meet expanding responsibilities and new functions in industry. In the early 50's the American Society for Engineering Education (ASEE) appointed a committee to evaluate the status of engineering education and to set some parameters for the future. The 1955 "Grinter" Report recommended that greater emphasis be placed on engineers as theoreticians rather than as applied scientists and on the requisite of research. New courses in so-called "engineering sciences" were proposed to support this emphasis. Most colleges and universities revamped their curricula to conform to the new criteria established by ECPD for accreditation. As engineering became in consequence a highly mathematical and scientific field of study, it turned further away from a concern with specific applications that created the need for technicians in the first place. Industry's need became even more acute as societal, parental, and peer pressures placed a premium on the baccalaureate degree, thus discouraging students from enrolling in two-year technician programs.

Industrial arts departments were ready to fill the gap. Having experienced the siphoning off of some prospective industrial arts teachers into industry, and thus perceiving industry's need, many industrial arts educators were receptive to industry's overtures. Moreover, such development appeared to be consistent with the discipline's emerging objective of teaching about industry and technology and the pressures being exerted on it from other departments to offer certain technologically-oriented service courses. Speaking for the vanguard technical institute and industrial arts educators, Wheaton observed "that the well-educated top technician group should not consist of those who failed to complete engineering or science college curricula," but there should be a separate four-year program designed expressly to meet industry's needs. Engineering educators did not inhibit, but, in fact, often tacitly encouraged, the development of four-year technology programs out of industrial arts, recognizing that they filled a useful function which the engineering profession itself was not disposed to assume. Then, in the mid-sixties – when industrial technology had spread to over 70 institutions across the country – the profession was suddenly alerted to the "threat" posed by this number of programs completely outside the ken of engineering. Foecke (formerly engineering specialist with U.S.O.E., now Dean of Engineering at Gonzaga University) provided a well-conceived rationale and urged ECPD to recognize and accept four-year engineering technology as a legitimate addition to the engineering education spectrum and the technologist as a full-fledged member of the engineering team. As a result, a committee was formed to study the issue and make recommendations. On the basis of the McCallick Report (1965), which recognized the "crisis" aspect and was generally favorably disposed toward four-year engineering technology, and in spite of some serious problems in reconciling it with professional engineering, the ECPD adopted the recommended criteria for accrediting the stronger programs. The curricula of at least two institutions have been accredited to date, and a spurt of activity in this newly accreditable area can be expected.

EVOLUTION OF INDUSTRIAL TECHNOLOGY

In the evolution of the typical industrial technology program, a pattern is discernible. Starting as a technical track or option within the established industrial arts curriculum, industrial technology was naturally heavily weighted with the only resource that was abundant: industrial arts courses. At this stage of development, the criticism that industrial technology is merely industrial arts packaged in slightly different form, as preparing for employment in industry rather than in education, has some legitimacy. Sometimes the only difference between the two tracks lies in the greater depth of concentration in one of the traditional industrial arts specialties that is substituted for the professional education sequence required for the teaching credential.

However, only programs in very small colleges tend to remain long in this transitional stage. As industrialists are consulted about their needs and drawn into active curriculum development, and as faculty who possess recent industrial experience and enthusiastic commitment to the program are hired, separate courses with the IT prefix are introduced and their content tends to approximate the objectives more closely. Particularly if the program is located in a large, comprehensive institution, producing the technologist with managerial capability becomes the chief objective; the means consists of "mixing" appropriate courses from several professional areas – preeminently industrial arts and business, but also engineering, mathematics, science, art, psychology, English, speech, journalism, and humanistic and social studies. The ratio of these ingredients in the total program varies from institution to institution, depending upon the job category being trained for, the needs and preferences of local industries, the specialties and interests of the faculty, the size of the institution, and the range of offerings available in the various professional areas that make up the "mix." Some lightening here and highlighting there are also necessary to meet the constraints of a four-year program. Not everything that is desirable can be fitted into a total of 124 units or thereabouts.

Courses from other professional disciplines complement the more distinctly technological portion of the curriculum. This portion generally consists of (1) a technical "core" comprising knowledge that is basic to efficient performance in all functions of technology, and (2) a technical specialty. Gradually, the technical specialty, which originally consisted of one or more of the traditional industrial arts fields, yields to a focus on a "cluster" of industries, such as manufacturing, construction, and electricity/electronics, or sometimes on a job category, such as sales. The general program, characterized by great flexibility and adaptability, has passed into its most sophisticated form when the content is well-suited to the objective of preparing the technical administrator. By this time it is usually a separate curriculum leading to its own degree. At most the industrial arts portion of the curriculum consists of providing the basic skills and knowledge and contributing to the technological specialty as appropriate.

The programs of institutions across the country may be viewed as being at various stages in this evolutionary spiral. The State College programs have reached the most advanced stage of development, so that they may be said to be in the forefront of technological education in the country. Yet, because industrial technology is still experimental and malleable, it may be expected to upgrade and refine even further in the future.

INDUSTRIAL TECHNOLOGY AS A COLLEGE-LEVEL PROGRAM

To have a rightful place in the offerings of a college or university, a discipline/program must show itself to be unequivocally college-level in both content and quality. Industrial technology appears to stand up well when standard measures of quality are applied. Close scrutiny of programs in the State Colleges, and at selected colleges and universities across the country to which they were compared, proves that, for the most part, they are substantive areas of learning that recognize academic standards and principles of professional responsibility which separate professional education from trade training. In fact, the State College programs appear on the whole to be superior to others in several respects.

One assumption which underlies the *Master Curricular Plan* adopted "in principle" by the Board of Trustees in July 1962, applies notably to industrial technology, namely:

> Professional programs seek to provide a broad general preparation which will give the graduate maximum opportunity for service and leadership in the ever-changing vocational patterns of business, industrial and social-governmental agencies.

The breadth of preparation which is characteristic of industrial technology stems from awareness on the part of educators that they would be doing a disservice to graduates if, since technology changes at such a breathtaking pace, they trained them too specifically for skills that will be obsolete quickly. What *Time* has observed of the engineer applies as well to the technologist:

> It has been estimated that one-half of what he studies in college will be superseded ten years after he graduates. Thus, it is more plausible to provide a student with broad concepts into which he can fit the necessary details later.

And Haider further affirms:

> Actually no educational system has ever been able to teach a man all he needs to know for his entire career. It can merely provide him with a foundation on which to build, train him in learning habits, and instill in him a curiosity or desire to acquire new knowledge.

Industry itself supports the broader type of program. By a two-to-one margin respondents to the Survey of Industry prefer technologists to have an educational background which is broad and flexible rather than overly specialized. The margin turns out to be even greater when the responses of the one-third indicating a need for technologists with more specialized training are analyzed. Three out of four of those firms which distinguish between engineering and industrial technologists and employ both types prefer that the industrial technologists be more broadly trained. Specialized training can be provided on the job or in the firms' own educational systems, which are often substantial. Experience shows that the broadly trained technologist can, on the basis of adequate in-service training, perform very specialized tasks. Not the least advantage of broad training, of course, is the wide range of job opportunities open to the graduate.

SOME PROBLEM AREAS

The oft-repeated criticism that industrial technology programs are too skill-oriented is not applicable to the State Colleges. Admittedly, earlier types did devote too much time to developing shop skills, and this aspect is still overemphasized in some institutions. The programs of many smaller institutions do appear to be merely drawn-out technical and shop-practice formats, and even in some larger institutions, despite a stated managerial objective, the curriculum leans toward the technical side. In the California State Colleges, however, manipulative skills and techniques are taught only to the extent that acquaintance and proficiency are desirable – for example, to understand practical construction and manufacturing principles and the related techniques in order to solve production problems. This is in accord with the Dean Report, which explains:

> Manipulative skills enable the technologist to make prototypes, to diagnose malfunction problems, and to adjust mechanical products so that they will perform properly. In addition, these skills help the student to operate and service instruments, tools, and machines as well as to gain a knowledge of the capacities and operating conditions of equipment. Thus, the industrial technologist has a better understanding of the problems encountered by the worker.

It has been acknowledged earlier that the uniqueness of industrial technology lies essentially in its flexibility in combining appropriate elements from many professional areas. Inability to discover any courses or a core that could be said to be uniquely industrial technology led the Dean Report to pose the question:

> Should there be deliberate national effort to develop unique industrial technology courses, or will Industrial Technology always owe its uniqueness in filling industry's needs to its flexibility in mixing courses of other professional programs?

No answer to this question is discernible. Suffice it to say, a review of programs selected from across the country and in California fails to reveal a common core. Indeed, the most variable portion of the curriculum is the industrial technology content, that is, those courses carrying the IT prefix. Whether unique courses and a common core can or will be identified, developed, and successfully promulgated by the National Association of Industrial Technology is at this time a moot point. The uniqueness of industrial technology must at present be said to reside in its interdisciplinary nature, and its effectiveness in how adroitly the courses from other professional areas – especially business – are amalgamated into a pattern which meets the needs of industry.

For a program which is necessarily interdisciplinary, the State College versions are weak in one respect: they offer no opportunity for cross-fertilization with engineering. Though Gallington and other industrial technology educators have stressed the desirability of providing industrial technology with some engineering support, and the better programs across the country include a number of courses carrying the engineering prefix, the State College programs are almost conspicuously devoid of them. Though there are reasons for this condition, and though industrial technology educators cannot be faulted alone, the result is a tendency for industrial technology to proliferate. The contents of many industrial technology courses (and engineering technology, too, where it is offered) appear to be too close to the contents of existing industrial arts, engineering, and mathematics courses on the same campus. Doubtless, these courses are taught from a different perspective and stress different aspects of the subject matter, and can probably be defended on these grounds, but the arguments are not convincing. The interests of economy and efficiency dictate that better mechanisms be found for avoiding proliferation, while at the same time meeting the admittedly different needs of students.

It must be acknowledged, however, that most courses carrying the IT prefix are substantive, and in their totality apparently well-geared to the needs of industry. The Survey of Industry verifies this. In providing knowledge that is essential to efficient performance in all functions of the technology division, some courses may be said to make up a sort of "core"; but the composition of the core varies too much from institution to institution to identify it as a standard feature of industrial technology.

One purpose of the Survey of Industry was to discover what industrialists consider desirable content for an industrial technology program. The following pattern emerges from the respondents' distribution of unit-time according to the six general subject areas which comprise industrial technology:

Subject Area	Percentage of Total Program	Indicated Equivalents in Semester Units
General Education	20%	25
Communication Skills	12%	15
Mathematics	12%	15
Science	13%	16
Technical Subjects	26%	32
Business Administration	17%	21
Totals	100%	124

This pattern is not being proposed as an "ideal" one; it is subject to biases and errors and assumes that industrialists know more about curriculum planning and development than professional educators. Yet, in spite of its limitations, it can serve as a consensus field reference with which to compare the State College industrial technology programs. The most obvious discrepancies pertain to the areas of mathematics and business. The findings of nationwide studies confirm that the mathematics requirements in industrial technology programs are very low – according to Defore, frequently lower than the amount required in two-year technical institute programs. The reasons for the low mathematics requirements are difficult to ascertain. Graduates responding to follow-up questionnaires cite exposure to higher mathematics, at least through introductory calculus, most frequently as the key deficiency in their preparation. It is not, of course, a question of fearing that industrial technology students cannot master higher mathematics. Wheaton reports that at Texas A & M, where requirements in mathematics and other reputably "hard" courses were introduced, alarmists predicted that the industrial technology program would soon be without students. On the contrary, these features made the program more attractive to students and enhanced its reputation as one of the best in the country. Lesser mathematics requirements may be more a matter of the logistics of adjusting an already crowded content, and also the result of a feeling that the mathematics taught is too abstract and theoretical to meet the needs of applications specialists. The solution seems not to lie in having industrial technology departments offer their own "technical math" courses, as recommended by some observers, but in the faculties of the mathematics departments becoming more conscious of the needs of some of the areas they serve – in the case of industrial technology, providing more problems and activities of the applied type. One legitimate alternative for industrial technology departments is to provide for more experiences in their own courses whereby mathematical theory is applied to solving practical problems. This would assume that faculty members themselves be more conversant with higher mathematics.

The science content of industrial technology curricula appears to be adequate in amount, appropriate in nature and rigorous in quality. For certain options – construction, for example – the science requirement is very high. With regard to humanistic-social studies, the industrial technologist is often more broadly educated in these areas than the average college student. As the most distinctive feature of the industiral technology program, the business content could be more extensive. The Survey reveals a considerable difference of opinion regarding how much liberal arts or technical specialization needs to be part of the technologist's preparation, but does not equivocate on the matter of business content. Of course, he need not acquire all possible knowledge before he graduates; he will have opportunity to pursue additional work as needed in a graduate or a continuing education program.

CHARACTERISTICS OF A QUALITY PROGRAM

It is necessary to reiterate first the difficulty of getting everything desirable into a four-year program before presenting the following composite of an effective program. Distilled from what the available literature indicates *should be*, and the result of careful analysis and synthesis of salient features found in existing programs across the country, the following elements can be said to characterize a quality program in industrial technology.

1. It leads to the Bachelor of Science degree.

2. Students can complete it in four years without crowding (or in five years if a cooperative work-study program is included).

3. It profits from continual study to determine the educational requirements of industry and to keep abreast of rapidly changing technology, so that critical time lags are reduced.

4. An advisory council composed of interested members of business and industry is maintained.

5. In order to fulfill industry's needs, it is flexible in mixing courses from other professional disciplines. Accordingly, it is offered only by large, comprehensive institutions, capable of diversity and specialization.

6. It prepares primarily for supervisorial-managerial positions in industry. Thus, the human relations aspect of industrial employment is stressed.

7. It is broad rather than specialized. (The chief value is that the graduate is provided with a background which makes him adaptable to various types of industrial organizations and duties with a reasonable amount of in-service training and to the changing needs of a dynamic industrial society.)

8. Only those specializations are offered for which there is large demand in industry, for which there are adequate facilities and equipment, and for which specialists are available to instruct.

9. It is truly interdisciplinary. A liaison committee with membership drawn from all participating departments/disciplines as well as industrial technology has responsibility for curriculum design and revision. Generally, a high degree of cooperation among participating schools/departments/facilities is sustained, and the facilities and courses of departments and disciplines other than industrial technology are utilized whenever possible.

10. Integrative, problem-solving experiences are provided.

11. It requires as a minimum:

    a. Mathematics through analytical geometry and calculus;
    b. One full year of college-level physics;
    c. A semester of English Composition;
    d. A speech course, preferably in group discussion (because the technologist must be prepared to meet and talk intelligently with others who hold positions on his level and above);
    e. A course in technical writing;
    f. A block of 18 semester units in business, selected from the following areas: accounting, finance, personnel and industrial relations, marketing, management, law, etc.;
    g. A course in computer science;
    h. A course in industrial psychology offered by the Psychology Department (possibly team-taught with an industrial technology specialist);
    i. Ability to read blueprints;
    j. Courses of the following nature, according to the specialty pursued: quality control/reliability, statistics, organic chemistry, production evaluation (customer complaints, etc.), psychology, and independent study/projects.

12. Where no separate Industrial Technology Department exists, responsibility is vested in a coordinator with released time.

13. It is well-articulated with pre-baccalaureate programs offered by the Community Colleges.

14. Student transfer is expedited, not only between colleges but within the college itself when students desire to change majors.

15. Cooperative work-study and/or internship arrangements with industry are provided, or students are otherwise required to have pertinent industrial experience for an extended period of time prior to graduation.

16. The faculty, in addition to having requisite academic background and teaching competence, possesses previous work experience in industry and continues to keep abreast of current developments through close contact with, and summer employment in, industry.

17. Follow-up studies of graduates are conducted as a means of evaluating the relevance of the curriculum.

THE NEED FOR TECHNOLOGISTS

Industry's present and accelerating future need for high-level technical personnel is well documented. The national surveys of industry conducted by Jacobsen and Defore, described in an earlier section, confirm it. Jacobsen, for example, estimates that for every two technicians employed in 1967, three will be needed by 1972 and at least one-fifth of them will be required to have a baccalaureate or higher degree. This represents at least a doubling of the need for technicians with the bachelor's degree from 1967 to 1972. The Survey of California Industry, conducted in connection with the present report, substantiates that the demand for the technical administrator type is real and growing. A review of the records of the Placement Bureaus of the State Colleges offering industrial technology reveals that no graduate goes a-begging; often he has a choice among several attractive offers and commands an entry salary which on the average is only slightly below that received by the professional engineering graduate (see Appendix G).

Publications of the U.S. Department of Labor, Bureau of Labor Statistics, and the California Department of Employment are the only sources of information regarding future needs. For predictions of need on the national level, two documents, *Occupational Employment Patterns for 1960 and 1975* (1967) and *Tomorrow's Manpower Needs: National Manpower Projections and a Guide to Their Use as a Tool in Developing State and Area Projections* (1969), are valuable resources. Unfortunately, neither of these general documents recognizes "technologists" or "technical administrators" as job categories; but while no data are broken out that are specifically applicable, the broad classification "Professional and Technical" includes natural scientists, engineers, and *related technical occupations* and gives some insight into the extent of the need. The fastest growing occupational grouping, "Professional and Technical" workers are expected to increase their share of the total employment picture in 1975 (91.4 million) to 14.6%, considerably up from 11.3% in 1965. Requirements are thus projected to reach 13 million in 1975, up 45% from 9 million in 1965 and 73% from 1960. In the manufacturing industries, where about half the technicians are employed, and also in mining and construction, technological changes which increase output per worker tend to reduce the requirements for blue-collar production workers and increase the proportionate employment of technicians. Future job employment opportunities for technicians will be in the areas of design and installation of production equipment, supervision of output, technical sales, and field maintenance of equipment.

The only source of information for California is the recently published *California Manpower Needs to 1975*, first in what is hoped to be a series of systematic studies which will relate manpower requirements to education. De Witt stresses the "desperate need" for "synchronization of occupational requirements and occupational education training objectives" at all levels if the State is to forestall a serious manpower shortage in the future.

The document predicts nearly 2.7 million more job opportunities for 1975 than existed in 1968. Over one-half million or 18% of these will be in the "Professional, Technical, and Kindred" category and another 293,000 in the "Managers, Officials, and Proprietors" category, where career preparation usually involves several years of college training. Employment of technicians in California increased from about 58,000 in 1960 to about 96,000 in 1968, and will increase to 132,000 in 1975, creating more than 45,000 new job opportunities. The aerospace group of manufacturing industries, particularly electrical machinery and aircraft manufacturing, are cited as the major source of job opportunities, followed closely by construction, miscellaneous business services, government, and other industries, in lesser numbers.

While the category of "technologist" is not used as such, the job titles making up the classification "Engineers, Other Technical", requiring four or more years of college preparation, indicate that the data are pertinent. About 13,000 more employees in this classification will be required in 1975 than in 1968. Large numbers will find jobs in the manufacturing sector, especially in aerospace firms. Elsewhere, the need for 56,000 additional managers in construction and manufacturing industries is predicted by 1975.

Institutions of higher education in California, the most highly industrialized state and expected to employ well over 10% of the nation's total work force by 1975, cannot ignore the implications of these predictions. In any optimum solution to the manpower shortage, graduates at the two-year level should be more numerous than the four-year technologists, and the latter more numerous than the professional engineers. Existing technology programs in the State Colleges, which are practically the only institutions in California offering them, have shown dramatic enrollment increases over the past few years (see Appendix C). About 1,600 majors are estimated for 1969-70, up 100% over 1963-64, the period when Wheaton could recommend with equanimity, "The present limited enrollments and the current experimental nature of these programs lead one to the belief that the Calfiornia State College system should not place them in many schools, but should experiment seriouslv with them in a few colleges only." Even if the increases in enrollments were to continue at the same rate, i.e., nearly doubling again by 1975, the supply would not begin to approximate the demand. Existing programs simply could not accommodate this increase; additional ones will be needed. That there is sufficient student interest to justify additional programs is revealed by the enrollment statistics given in Appendix C. During a period when enrollments in professional engineering programs were nearly static, enrollments in technology programs doubled.

FURTHER CONSIDERATIONS OF TERMINOLOGY AND FORMAT

While "industrial technology" may appear to be a rather generic and imprecise title for the type of program delineated in this report, there is at present no viable alternative. "Industrial management" and "industrial administration" are ruled out, the former title preempted by Schools of Business and the latter now commonly used to designate somewhat competitive programs offered by Schools of Engineering and Business. "Industrial operations," a title still inexact but more descriptive of the work performed, is not used by any college at present, and to employ it would be to set California apart from the mainstream. "Industrial studies," while it seems an apt title for an industrial arts-industrial technology department, is as broad as, if not broader than, "industrial technology."

"Industrial technology" is the curricular and degree title generally used across the country and is coming more and more, through persistent usage, to have a meaningful identity for industry. It is consistent with the National Association of Industrial Technology, an organization created expressly "to foster the improvement of baccalaureate degree-level curricula of industrial technology within institutions of higher education," and perhaps to serve eventually as an accrediting agency as it gains recognition. Moreover, its use avoids unnecessary disruption. It is the title employed at Fresno, Long Beach and Cal Poly, and San Jose will adopt it within a year. It is the title favored by the practitioners, if the California Council of Industrial Education Teachers' "position paper" on "industrial technology" can be taken as representative.

Although no State College industrial technology program can be viewed as merely extending the training time for the technician to four years, this objective has seemed valid for engineering technology. Foecke and McCallick, among others, have presented solid cases in support of this objective, and their rationale has been accepted by ECPD. The McCallick Report cites as precedents the practice in other fields – the paramedical (medical technology), for instance, a particularly apt example because it underscores both the appropriateness of the term "technology" itself and the necessity for a four-year program.

The objective of preparing the high-level technician cannot be considered necessarily incompatible with preparing the technical manager type. The fact is that the entry-level job for the technologist may be indistinguishable from that of the technician. The difference is that the technologist has been prepared to move upward as rapidly as conditions and his own abilities and ambitions allow into supervisory and managerial positions. Industry does, at least initially, not differentiate levels and duties as carefully as educators might like. As is true of most areas of human endeavor, the technologist has to serve some sort of apprenticeship. The dividend of four-year preparation over two-year lies not in making the draftsman, for example, a defter draftsman, but preparing him for upward mobility on the job.

Thus, continued usage of the title "industrial technology" for the programs described in this report is recommended – at least until NAIT or some other national agency comes up with a taxonomy that all sectors will agree to abide by. Further, inasmuch as the industrial technology curriculum is an occupational one, the student should be awarded the Bachelor of Science degree. As indicated by the Survey, industry prefers the B.S.

In comparison to the total number of units required by institutions across the country for similar programs, 132 units would appear to be high. At any rate, a program which can be completed in four years of formal study is desirable.

ADMINISTRATION

As is the case with industrial arts, the administrative location of industrial technology programs varies form campus to campus. At Cal Poly, San Luis Obispo, the industrial technology program is administered in the School of Engineering and Technology; at Long Beach, in the School of Applied Arts and Sciences; and at Fresno, in the School of Professional Studies. While industrial arts and industrial technology are administered together in the Department of Industrial Arts *and* Technology at Fresno, they are separated at Long Beach into a Department of Industrial Arts and a Department of Industrial Technology.

Experts disagree over the question of whether joint or separate administration, classes, and instructors are better. In the June 1964 issue of *Industrial Arts/Vocational Education*, Dean and Kleintjes of Long Beach State College comment:

> There are two schools of thought regarding facilities and faculty for the technology program. First, there are those who believe the curriculum can and should be housed in the industrial arts laboratories and taught by the industrial arts faculty. The second group feels that separate facilities should be provided and the faculty should be entirely separate from those teaching industrial arts . . . .
>
> The industrial technology program at Long Beach State College was started by the industrial arts department but the need for a separate administrative department with some special facilities and a different faculty soon became apparent. The program has to be much more than merely a nonteaching industrial arts major. It has to have depth greater than the industrial arts curriculum and a much different philosophical approach. Steps were taken to facilitate this organization so that the area became departmentalized and had its own laboratories and faculty. *Only in special cases are the industrial arts students and the industrial technology students combined within a course.*

In the same issue, Spence and Nelson debate the pros and cons of maintaining separate faculties. Spence argues that "the graduate of most of the undergraduate industrial arts teacher education programs is technically incompetent to teach in college industrial education departments where the same staff serves both [industrial arts and industrial technology]." Nelson counters: "The generalized broad-field background of the industrial arts teacher educator provided many of the qualifications requisite for teaching industrial technology. If the industrial arts educator also possesses comprehensive technical skills in the field, there is every reason to believe he should teach technical courses for technology." The Dean Report concludes:

> In the final analysis, the organization of the four-year technology program will depend on the objectives and policies of the school as well as the school's ability to finance the technology program, the availability of faculty and staff to administer the program, and the needs of business and industry who will employ these technology graduates.

RELATIONSHIP TO INDUSTRIAL ARTS

The tendency across the country, at least in the larger colleges, is for industrial technology, although it originated in and was nurtured by industrial arts, to break away and become independent at maturity. In spite of Dobson's recommendation that the two be administered separately, this has not been the case in California, except at CSC-Long Beach. Wheaton's study revealed a trend among larger institutions to phase out of industrial arts teacher education altogether in favor of industrially-oriented programs, leaving to smaller institutions responsibility for preparing teachers. Such a trend is not discernible in the State Colleges. Here the programs are considered, to a greater or lesser degree, to be complementary, and there is strong opposition, both on philosophical and economical grounds, to the development of industrial technology in a college which does not already offer an industrial arts teacher education program.

The issue of joint as opposed to separate administration, facilities, faculties, etc., can thus be considered academic *as long as a high degree of interaction between industrial arts and industrial technology continues in the State Colleges.* Whether or not it is administered separately, industrial technology requires two or three specialized laboratories, one of them designed to give the student an overview of manufacturing processes and to demonstrate the elements of total production. Moreover, the industrial technology instructor must have extensive industrial experience and must maintain close and continual contacts with the evolving technology in industry. The industrial arts teacher who meets this qualification should have the capability of offering many industrial technology classes.

The presence of industrial technology helps keep the industrial arts curriculum relevant and the faculty and students abreast of the latest developments in industry. Industrial technology students can gain their basic skills and knowledge of industrial tools, machines, materials, processes, and procedures through industrial arts laboratories and classes, thus avoiding duplication, and industrial arts students can profit from working in industrial technology laboratories, which will, of necessity, contain the latest equipment. Integration has the advantage of keeping the costs of operating an industrial technology curriculum to a minimum.

The Industrial Technology program at CSC-Long Beach must be considered a special case. Instruction there is exclusively upper division, the program depending on input from community colleges with which it is closely articulated. Since the student enters with a high degree of technical competence, the laboratory program in the last two years can stress the application of skills and techniques to industrial processes, production, and construction. For this reason, there is less interaction with industrial arts than would be desirable at other colleges.

Disillusioned with industrial arts, which has seemed resistant to and neglectful of the needs of vocational education, some statewide administrators tend to regard industrial technology as the more ideal curriculum for preparing teachers for the occupational classes and programs in the high schools and community colleges. A program which keeps attuned to the latest advances in the industrial world is attractive, of course; but the answer to the needs of vocational education lies not in fragmenting the teacher education function, any more than the needs of industrial technology demand the phasing out of industrial arts, which spawned it. Superimposing a teacher education function on a program that originally justified its existence – indeed, continues to do so – on its industrial orientation smacks of proliferation and is therefore unwarranted. Rather, the answer lies in industrial arts educators recognizing their responsibilities in the occupational fields and utilizing the expertise industrial technology has to offer in developing suitable curricula for vocational teachers. To the extent industrial technology cooperates in offering appropriate courses for a curriculum so designed, it would assume a *service* function that has not been a characteristic of it up to now. Under such conditions, neither area need be hurt at the expense of the other; both can benefit from cooperative effort.

Distinction of programs by their primary function – industrial arts preparing teachers and industrial technology preparing industrial workers – must be preserved. However, a broadened conception of industrial arts is called for, as preparing teachers not only for industrial arts classes, but for occupational classes and in-plant training programs of industry as well, in conjunction with industrial technology. On the undergraduate level, it is as indefensible for industrial technology to take on a teacher education function as for industrial arts to continue a technical track when the institution also offers industrial technology. The industrial arts faculty cannot control what the prospective teacher does with his degree after graduation, but they should not aid and abet indecision and confusion by offering a competing technical track. The industry-oriented student, if identified prior to graduation, should be counseled into the industrial technology program. The issue is likely to become academic in the future as industry recognizes the unique contribution the four-year technologist can make and engages in more selective hiring.

Under existing conditions, the tie-in of industrial technology with industrial arts at the graduate level is absolutely necessary if industrial technology is to get involved in graduate work, since no master's degree is authorized. According to the latest official version of the Academic Master Plan, three State Colleges which presently offer baccalaureate programs in industrial technology have aspirations for master's degrees: Fresno, Long Beach, and Cal Poly, San Luis Obispo. In addition, Chico State College, which is looking forward to introducing a bachelor's degree pending outcome of this study, is interested in mounting a master's program. The rationale for the master's degree is both to give students who possess the bachelor's degree an opportunity to pursue advanced work and to prepare teachers for the related technical programs offered by the Community Colleges and some other colleges and universities, including the State Colleges themselves. One college conceives the master's program as a two-year course of study designed for students who do not possess a baccalaureate major in industrial technology; during the first year the student would make up the background needed to pursue advanced work in the field in the second year, culminating in the master's degree.

THE MASTER'S DEGREE

A master's degree in industrial technology is not recommended at the present time. The Survey does not support the need for it. If the technologist pursues graduate work, industrialists would prefer it to be in business, leading to the Master of Business Administration. It is doubtful, too, if the baccalaureate program, being of recent origin, is seasoned or solidified enough to support a capstone degree or even whether a substantive body of advanced technical subject-matter exists to constitute a full master's program in industrial technology. Energy should be directed at strengthening the undergraduate program.

Just as societal pressures and industrial needs spurred the development of four-year technology programs, when only a short time ago two years seemed quite sufficient, these influences, and others, will probably lead in time to demand for technologists possessing a master's degree in the field. There is also the function of preparing instructors for industrial technology and related programs in the Community Colleges to be considered. Industrial technology faculties should therefore be encouraged to introduce a few select graduate courses to meet the continuing education needs of technologists working full-time in firms located in the colleges' service areas. These courses could be organized into a technical concentration within the existing M.A. in Industrial Arts, which appears to be flexible enough to accommodate it, as at CSC—Los Angeles. Perhaps the national organizations will devise and recommend a title which reflects the inclusion of a concentration in industrial technology within the master's degree in industrial arts. Until this occurs, however, the points supporting retention of the title "industrial arts," enumerated on page 6, should apply. Another possibility that should be explored is cooperating with Schools of Business to provide a technical concentration which interested M.B.A. candidates might pursue. Much of the graduate course work would of necessity be in the human relations field anyway. By means of these arrangements genuinely graduate-level subject-matter in the technological field could be delineated gradually, and experience with enrollments in the courses and concentrations could well provide the justification needed for selected colleges to move eventually into separate Master's of Science degrees in Industrial Technology.

RELATIONSHIP TO INDUSTRY

Jacobsen calls for a "new level of industrial-education dialogue," so that "problems of the work world [will] find their translation in educational programs." That the present level of communication leaves much to be desired is revealed by the following comment Donald P. Krotz, President of the Northern California Education Council and Vice President of Chevron Research Company, made at the Council's 1969 annual meeting:

> . . . whether we like to admit it or not, many educators have had a distrust of those in the world of work, and business people, in turn, have lacked the necessary respect for educators. Effective cooperation results only from mutual trust and mutual respect.

The potential for cooperation and reciprocity exits, however. Dr. Lawrence E. Vredevoe, Professor of Education at U.C.L.A., reports after meeting with 25 business and industrial groups throughout the country, that the business and industrial world is more interested in higher education than at any time in history. "Support will come" he insists, "if education can articulate, evaluate, and communicate its needs." But communication is a two-way street. As Fred D. Merrill, Chairman of the Advisory Board of the Northern Industrial Education Council, points out, in summarizing the activities of that body during 1968-1969:

...industry must communicate its needs, provide technical assistance, and exchange experience and know-how in scientific discovery and job training techniques.

Directly or indirectly, California industry *is* making several important contributions to industrial education in general and to the State College industrial technology programs in particular. Interdependence is acknowledged; the State Colleges cannot maintain quality technology programs in a vacuum, and industry has to rely on them to provide the high-level manpower it needs. Thus leaders from business and industry are serving on advisory boards and councils to industrial technology programs. Such liaison has the advantage of insuring that the curricula are, and continue to be, responsive to the ever-changing needs of industry and that there is a ready-made market for graduates; but it has also had one serious disadvantage: localization has militated against evolving a national philosophy and objectives. In view of this local orientation, it is not surprising that many of the firms contacted through the Survey were unaware that the State Colleges were involved in preparing "technologists."

At this stage of development in California, what is needed is a state-wide advisory board consisting not only of faculty representatives from State Colleges with technology programs and leaders from business and industry, but also of representatives from the Community Colleges which offer technical programs and from state governmental agencies concerned with the advancement of technical education. Such a board would help keep technological education in the state practical, relevant, and geared to actual and anticipated manpower needs. It would serve to articulate State College and Community College programs and to facilitate integration of similar programs so as to avoid proliferation and duplication of effort. It would provide information about and publicity for existing programs. It would sponsor research studies concerned with future manpower needs and the like. It would seek avenues for increasing the financial support of these programs.

Another of industry's contributions is offering courses and seminars, generally through a college for credit but sometimes in the educational training division of the company itself, which acquaint teachers with the latest technical advances, processes and machinery. For example, the San Mateo County Industry–Education Council sponsors each year, in cooperation with the College of Notre Dame, Belmont, a Summer Work Experience Program for Teachers. Teachers employed by local industry on jobs related to their teaching subject attend evening seminars at the college twice a week. The program's purpose is to narrow the gap between what is taught in the classroom and what is happening in industry. Though designed expressly for secondary teachers, a similar program could be developed for college teachers of industrial technology as well as industrial arts. This is only one of several imaginative programs spearheaded by industry. Not only should the number and nature of these programs be expanded, but the scope of activity should be extended to higher educational institutions.

Still another contribution industry has made is allowing its high-caliber personnel to teach courses at nearby state colleges and universities. Because there is a shortage of full-time faculty, or lack of a full load for certain types of specialists, the health of many a college technology program depends on the availability and willingness of qualified industrial specialists to offer certain highly technical courses. One obvious advantage lies in exposing students to persons whose knowledge of the industrial enterprise is first-hand and current.

One contribution which industry would be willing to make but which the State Colleges have yet to take advantage of is the work-study or internship-type arrangement. The Survey of Industry revealed that almost all firms would be willing to participate in such arrangements with the colleges, and doubtless would defray administrative expenses connected with them, too. Though it would seem a truism that any effective technology program would include concomitant, related work experience, few college programs make provision for such work activity. Those which do require only that the student secure experience on his own prior to graduation. That experience may or may not be directly related to the instructional program. To be really valuable, work experience must be integrated with the educational program, and carefully supervised.

Nationally, there is a resurgence of interest in work-study programs. A recent issue of *Time* disclosed that "Already 136 colleges and universities have instituted work-studies programs that provide undergraduates with a taste of a career ahead of time." Shoben ascribes their popularity in part to "the dullness and lack of cogency in study in relation to the authenticity of the work experience." Under terms of an omnibus bill, extending and changing the

Higher Education Facilities Act, the Higher Education Act of 1965, and the National Defense Education Act until mid-1970, several million dollars are provided for a new program of grants to colleges "to develop, carry out, or expand cooperative education programs that alternate periods of study with full-time employment." One significant advantage to the college in this day of the overcrowded campus and limited physical facilities is the ability to handle more students at a given time because a portion will always be away working. Although the student's stay in college may be increased by as much as a year, the extra time is compensated for by his increased salability at graduation (usually he will be hired permanently by the firm for which he has worked) and the opportunity of earning while learning. Another advantage: in using industry as its laboratory, the college need not invest in a variety of expensive machinery and equipment.

The work-study arrangement is most favored by industry because it is a sustained, full-time experience. Industry is not geared to providing much part-time work experience. Although it makes a practice of hiring students and teachers during the summer months, this opportunity is a limited one.

The primary reason work-study arrangements are not more widespread is that the problems posed by these relatively new, rapidly-growing, under-financed programs have absorbed so much faculty attention and energy that there has simply not been time to negotiate with industry, let alone supervise students, should such arrangements be consummated. Now that stability is being achieved, however, there seems little justification for further delay. A survey conducted by Boaz for the 1965 Industrial Technology Conference revealed that graduates were most critical of the lack of practical experience, which contributed to feelings of frustration and anxiety over the first job. Failure to utilize industry as a classroom may be the most serious deficiency in the State College industrial technology program. After all, no campus laboratory can duplicate the industrial environment.

Further, business and industrial firms might be encouraged to provide, directly or through associations, scholarships and equipment, for it is shortsighted to think that public institutions, which are supplying the bulk of high-level employees now and will do so to a greater degree in the future, can offer quality programs without these kinds of supplemental support.

Finally, there needs to be closer coordination between college programs and the educational training centers operated by industry, many of which are very extensive and impressive. While in the beginning in-house training developed more as a protective device, to meet some conspicuous "ability gaps" in the educational process or to counteract education's indifference to or inability to handle special personnel needs, it has evolved into a means of *supplementing* the employee's formal educational preparation in ways the colleges cannot (and should not) – orienting to a specific job or task, meeting needs which are peculiar to a single industry, indoctrinating, or upgrading knowledge and skills, to mention a few of the common purposes. It is time that industry and higher education became full-fledged partners in the educational process, supplementing and complementing each other in agreed-upon ways. Such articulation and integration will not only enable both sectors to avoid costly duplication, but will greatly aid the student in his transition to employee status and his effort to upgrade and advance himself on the job.

RELATIONSHIP TO COMMUNITY COLLEGES

The following comments by Knoell and Medsker aptly preface an examination of the relationship, both as it is and as it should be, between the Community and State Colleges in general and the technical programs offered by each segment in particular. They are concerned lest:

> The advantage gained by expanding opportunity in the junior colleges . . . be negated by failure to provide new types of opportunity and additional spaces in existing upper division programs to accommodate the growing numbers of transfer students. It may be desirable to develop entirely new types of programs, in some cases by building on junior college occupational curricula as technology expands and in others by designing different levels of programs in such fields as engineering and business administration. As a two-year college program is rapidly becoming a requirement for many types of employment today, it is possible that within a matter of years a baccalaureate degree – perhaps in a two-plus-two program – will be a requirement in many new fields.

With regard to students in the non-transfer tracks, they plead:

> The door should be kept open to allow capable junior college students who are attracted into terminal occupational programs to transfer. One easy but undesirable solution to crowding in the four-year colleges is to exclude arbitrarily the junior college students who have enrolled in occupational programs designed to be terminal. Techniques for classifying students as 'terminal' and 'transfer' and for counseling them into appropriate programs are no better than existing techniques for matching student and college at the freshman level. Closing the door of the four-year college to good students in all nontransfer programs would result both in discouraging many capable students from enrolling in such programs and in denying opportunity to others who should go on to work for baccalaureate degrees.

Pertinent, also, is the admonition of the McCallick Report:

> In any society such as ours where technological changes are taking place at an unprecedented rate, the very idea of 'terminal' education is not only unrealistic but unthinkable.

Certainly there are deficiences in the present transfer system; but articulation between the State Colleges and the Community Colleges in California is the closest and transfer of students between them the smoothest in the nation. Articulation in the industrial technology area is good and amenable to improvement. Mutually beneficial arrangements have been effected, whereby the Community Colleges offer pre-baccalaureate programs expressly designed to permit the student to transfer into an industrial technology program at a particular State College without loss of time or credit. These programs are concentrated in Community Colleges located within the service areas of the State Colleges offering industrial technology, but there is nothing to preclude Community Colleges in other areas from participating, too, whether or not additional State Colleges inaugurate industrial technology programs. Fullerton Community College's program, for example, is tied in with CSC-Long Beach's, which is exclusively upper division, dependent for input of students on the graduates of those Community College programs with which it is articulated. This arrangement has distinct advantages for the State Colleges. An industrial technology program can be operated more economically when the Community Colleges can be relied on to provide some of the specialized training, thus making duplication of certain types of laboratories and equipment unnecessary. This is not meant to suggest that all State College programs ought to be exclusively upper division as at CSC-Long Beach. Something valuable could be lost in a structure whereby the State Colleges became strictly upper division and graduate institutions. Reasonable diversity is desirable, and some State Colleges should continue to provide four-year programs for entering freshmen as well as upper division sequences for transfers. When the laboratories and courses of industrial arts and engineering are utilized, the cost of operating a lower division industrial technology program is minimal.

However, looking more to the Community Colleges to offer basic technical preparation and a larger share of the specialty portion of the industrial technology curriculum is in keeping with the Trustees' insistence that the State College programs should be "broadly-based" and "nonproliferative." Industrial technology is in many ways the "natural" advanced program for Community College technical graduates to enter. By design, the upper division part of the broadly conceived program concentrates on "rounding out" the student, and thus could yield readily to the two-plus-two approach. Picking up the student whose lower division training has been relatively specialized, preparing him for middle-level technical jobs in industry, industrial technology at the upper division can provide him with the means to qualify for higher-level positions through courses in management, communications, psychology, and humanistic/social studies, among others, and through advanced and integrative technology courses which give an overview of technology and the industrial enterprise. In states where the junior college system is not entrenched, some colleges – Purdue, for example - offer technical programs in a "block" configuration, thus permitting the student to seek employment after one, two or three years and to return later part-time or full-time to complete additional steps leading to the baccalaureate degree.

It should be noted that, although there must and will be widening of the limited vocational and trade-technical fields now covered in the State Colleges, it may never be possible to offer advanced work in all of them. At least 60 different trade-technical fields in which the Community Colleges offer curricula can be identified; undoubtedly new ones will come to the fore in the future. There is no unanimity of opinion as to whether these fields require baccalaureate-level preparation now or in the future. Further, no change in the notion that undergraduate education in the State Colleges should be other than broad and non-specialized, or at least not overly specialized, is foreseen. There is also the difficulty of locating faculty with requisite degrees and competencies to instruct in the varied specialties.

Most important of all, programs in these areas will have to be much improved before liberalization of the transfer policy can take place. The contents of the vocational programs, dubiously collegiate-level in many instances, need to be upgraded. Many technical programs are too narrowly focused and excessively skill-oriented rather than concept-oriented. A majority require no college mathematics at all, and practically no science, or at least not to any depth. Since there are few electives, the student has no opportunity to secure breadth either in general education areas or in general technology. Though students are, of course, encouraged to combine the occupational curricula with the requirements for the associate degree, there is not enough insistence on it and a woeful lack of counselors with understanding to identify the better students and to channel them into transfer tracks. The State Colleges cannot be expected to compensate for inadequate counseling procedures or for the student's failure, in spite of counseling, to settle on specific goals earlier and thus avoid prolonging the time it takes after transfer to obtain a degree. In general, much needs to be done in the area of guidance both in high schools and Community Colleges to channel students earlier into pre-engineering, technology, industrial arts, or business programs. Research is needed to identify factors which will predict student success in these fields, and also to synchronize the number of students flowing into these areas with the job slots existing and projected by business, industry, and education.

On the State Colleges' part, there needs to be a more liberal acceptance by transfer of technical courses, and more diversity of opportunity at the junior and senior levels. The trend toward upward educational mobility makes it imperative to the welfare of the Community Colleges that they be able to use State College programs as a motivating goal for their students. This is in itself a good argument for the State Colleges offering industrial technological programs. For Community College students who do not major in pre-engineering programs they represent the only currently available route to a college degree. San Francisco State College's innovative, interdisciplinary program in Design and Industry, described more fully on page 14, is organized to permit optimum transferability from many diverse technology programs offered by the Community Colleges. This flexible approach could well be emulated by other colleges.

The resources for working out a coordinated plan for technical higher education in California are available. What is needed is more cooperation, first, between the two segments principally engaged in technical education, and, second, between the segments and industry, the chief beneficiary. In concert they must identify the types of technical employees needed and the level of activity engaged in, agree on the nature and duration of curricula to train each type, and differentiate the role each participant is expected to play in the training process. An ideal integration appears to shape up this way: the Community Colleges provide more specialized training in two-year pre-baccalaureate programs for technicians at one entry level; the State Colleges in broad, advanced programs produce the technologist, who operates at a higher level; and industry, through an enlarged in-plant training system, both orients the graduates to the requirements of a specific work situation and provides subsequent upgrading in position as a result to formal education. If all three segments – industry, the Community Colleges and the State Colleges – shared responsibility for furnishing appropriate continuing education experiences, maximum benefit at lowest possible cost for all could be achieved. The Articulation Conference's recent formation of an Ad Hoc Committee in Industrial Technology is a significant step in this direction.

RELATIONSHIP TO ENGINEERING

In all the literature on industrial technology and the descriptions of programs, reference to producing semi-professional engineers is studiously avoided. Although the ability of the industrial technologist to function as an indispensable teammate with the engineer and technician is stressed, only Hauer, after analyzing a number of industrial technology programs, comments, "The pattern seems to be focused more on a sort of semi-professional industrial engineering type program, or a semi-professional production engineering type program." There is little tangible evidence to support the contention of some engineering educators that industrial technology instructors lead students to believe they are being prepared for semi-or quasi-*engineering* positions in industry. Of course, many graduates will actually be hired for positions that are engineering-related and will be given titles in which the term "engineer" figures prominently (see Appendix G). Industrial technology educators can hardly be faulted for industry's tendency to ignore some academic subtleties and to use the term "engineer" loosely, especially as a means of upgrading in position. Nevertheless, the fact that the majority of industrialists surveyed would use graduates of industrial technology and engineering technology programs interchangeably confuses the relationship of industrial technology to engineering and intensifies the question of whether or not the differences between industrial technology and engineering technology are really substantial enough for the same campus to operate both programs.

No satisfactory answer to the question can be given at this time. In an effort to provide one internal source for the kind of information needed, special authorization has been granted to Cal Poly, San Luis Obispo to offer both programs, beginning in the fall of 1969. Two or three other institutions across the country offer both programs, but they do not submit easily to the kind of close analysis that is needed. Of course, the fact that an institution offers both programs cannot be taken as *a priori* proof that they are inherently different. It may be more a matter of an institution's failure to face up to and resolve some sensitive philosophical or personnel issues than a *real* difference in terms of degree majors.

In approving the dual approach at Cal Poly on an experimental basis (see Appendix H), it was thought that the system would have a "working model" to observe. The results of a formal evaluation after a reasonable period of time could be used to make some long-term decisions affecting technologist education in the system. The fact that both programs happen to be administered in the School of Engineering (changed subsequently to the School of Engineering *and Technology*) – a highly unusual practice – lessens the possibility of duplicating laboratories, courses, and options/specialty areas, and of competing for students. Since the particular college has always assumed an applied stance toward educational objectives, and consequently assembled a faculty committed to this approach, it is perhaps an ideal choice for the experiment.

A preliminary look at the differences in objectives and patterns between the two programs as Cal Poly administrators and faculty perceive them should be helpful. The objective of engineering technology is "to prepare graduates for that part of the technical field which requires the application of scientific and engineering knowledge and methods combined with technical skills in support of engineering activities." This statement accords with that which appears in the 35th Annual Report of the ECPD:

> Engineering technology is that part of the technological field which requires the application of established scientific and engineering knowledge and methods, combined with technical skills, in support of engineering activities; it lies in the occupational spectrum between the craftsman and the engineer at the end of the spectrum closest to the engineer.

The key phrase is *in support of the engineering effort of industry*. The engineering technologist is sometimes said to be like the pre-1955 professional engineer who was more concerned with the techniques of engineering art. With regard to the nature of the preparation required, the 1969-70 Cal Poly catalog states:

> The engineering technician is somewhat more specialized than the engineer, focusing on a narrower range of subject matter and skills. In general, he seeks less depth in basic and engineering sciences but develops more specific capability and education in technical skills and in the more essential aspects of design and production.

The student may select from options in air conditioning-refrigeration technology, electronic technology, manufacturing process technology, mechanical technology, and welding technology. In this respect the program differs from others across the country which, in preparing high-level personnel to act as assistants to professional engineers, employ such titles as civil engineering technology, electrical engineering technology and so forth, or in preparing for a variety of positions in the manufacturing industries, offer a single, broad program with few or no options.

On the other hand, the industrial technology faculty at Cal Poly, San Luis Obispo describes its program as:

> . . . that part of higher education which prepares students for professional-level (baccalaureate degree) technical occupations in industry, excluding professional engineering. This field, forming the mid-ground between engineering and business administration, emphasizes the applied aspects of industrial processes and

personnel leadership. It is based upon a foundation of understanding and working knowledge of industrial materials, tools, processes, procedures, and human relations. Industrial technology includes the industrial areas of electricity, electronics, drafting, graphic arts, metal-working, wood-working, plastics and power technology. This specialty requires high levels of ability in: (1) working effectively with people, (2) mechanical aptitude, (3) communication-motivation skills, and (4) planning.

The key phrases here are *occupying the mid-ground between engineering and business administration* and *emphasizing the applied aspects of industrial processes and personnel leadership.* The industrial technologist plays a "middle-man" role between scientists and engineers, management, and craftsmen. In giving the student a choice between only two general curricular options, industrial sales and technology or industrial education, the program fits into the mainstream of industrial technology programs across the country, which characteristically permit very few options. The industrial sales and technology option emphasizes:

> ... preparation for professional positions in the manufacturing and marketing of industrial products. Students selecting management and production aspects of this option obtain positions as plant supervisor, production-control analyst, systems coordinator, materials expediter, plant and product designer, technical writer, department head, executive trainee, personnel manager, product consultant, manufacturing specialist and training director. Management and production are concerned with effective manufacturing operations as they relate to people as well as materials and equipment. Students specializing in the marketing phase of the option are preparing for positions as manufacturers' sales representative, distributors' representative, liaison engineer, sales analyst, and sales manager. (1969-70 catalog)

To insure that the technologist is "people-oriented," the curriculum seeks to import an understanding of human relations as well as a thorough knowledge of the operating principles of the technological area.

The technical sales curriculum is unique among industrial technology offerings in California institutions As a matter of fact, there is both a blend of the usual and the unique in the State College programs and a distribution of emphases, objectives, and approaches within an overall framework of similarity and consistency.

Some of the sub-fields of industrial technology enumerated by the Cal Poly faculty – electricity, electronics, drafting, graphic arts, metal-working, plastics, and power – which are commonly industrial arts specialities, overlap with engineering. This should not be surprising, since in the secondary schools industrial arts is to some extent pre-engineering in its focus, serving as the discipline which introduces students to basic concepts and skills involving tools, machines, materials, processes, and procedures as applicable to engineering as to industrial arts. Still, many of the areas in the listing are clearly non-engineering in nature and scope. To the extent that industrial arts-industrial technology trains students in these areas, which may be vital to certain industries, it is providing the *only* training available. Thus a few types of technologists could not be trained by engineering alone; and even if engineering had introduced four-year technology programs *first*, industrial arts would still have evolved programs more or less similar to industrial technology, though of course on a far more limited scale.

Engineering technology at Cal Poly does not appear to encroach on the business content that is the most distinguishing mark of industrial technology, intended to provide the technologist with managerial capability. While there are some business courses in the curriculum, the titles suggest that they are meant to help the technologist function as a co-worker and communicator. Engineering education is sensitive to the criticism that it produces mechanists who have little interpersonal capability; the uniqueness of the technologist lies precisely in his complementing technical competence with ability to mobilize human resources.

But in some other institutions this distinction tends to break down. Foecke, in advocating engineering technology, clearly conceives of it as an extension of the two-year engineering technician program, preparing high-level assistants to professional engineers; the technologist is "concerned primarily with operation, installation, maintenance, and supervision - where he is involved with design his involvement is limited to technical problems only." The McCallick Report adds another dimension:

It is for the educational preparation of the engineering technician – the technician who must discharge the duties of yesterday's applications and design oriented engineer and who must be prepared for *eventual managerial positions* as well as positions of great technical responsibility -- that the four-year programs in engineering technology have been developed.

In a way this is only stating the obvious, for no matter where the college graduate goes today, he will eventually be seeking a management position. The only viable advancement opportunity for the technologist is some kind of managerial position. However, in predicating this as an objective for engineering technology, and in actually including a block of business courses in the curriculum to meet it, the engineering profession is entering territory preempted by industrial technology and thus blurring the most visible line of distinction.

The definition of industrial technology given early in this report* is put in question by such descriptions of engineering technology and the engineering technologist as the following:

> The program would provide training for careers as applications engineering technologists, sales engineering technologists, production engineering technologists, and plant engineering technologists. (*Journal of Engineering Education*, June. 1964 as quoted in the McCallick Report).

And:

> [The Engineering technologist is] the much sought-after 'middle-man' in the industry, part business-man, part technician, part supervisor and part diplomat . . . a broadly prepared, techno-scientifically oriented graduate with preparation for manufacturing management in industry. (*Electro-Technology*, February, 1968 describing the graduate of a program offered by the University of Wisconsin).

And:

> The technologist is an organizer of men, materials, and equipment for the effective planning, construction, and maintenance of technical facilities and operations. He may be responsible for work requiring considerable theoretical and practical knowledge. He can apply his ability in using technical equipment, selling technical products, serving as a manufacturer's technical representative, or supervising varied construction projects and manufacturing processes. The technologist works alongside the engineer in the routine aspects of project developing, planning production, and final testing of industrial, military, or consumer products. (From brochure describing a Brigham Young University curriculum accredited by ECPD).

Or, to bring in another dimension, what is the relation of engineering technology to a curriculum generally designated by the title "industrial administration," which is offered by several engineering schools, including three State Colleges? The objective of San Jose State College's program is described as follows:

> . . . to prepare graduates for managerial and administrative positions in industry, business, and government requiring appreciation of both disciplines. Graduates usually find their first employment in manufacturing, marketing, or related areas. The broad training received enhances the opportunity for advancement into positions of major management and administrative responsibility.

What, for that matter, is the relationship of this program to industrial engineering itself since at San Jose State College industrial engineering includes an option designated "engineering management," which aims to:

> prepare the engineer for executive management, staff support, or consulting services in engineering design and development, industrial organization, manufacturing operations, systems and technical sales.

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* See page 20.

It is clear, then, that programs with aims markedly similar to those of industrial technology are emanating from two other sources in the California State Colleges, namely from Schools of Engineering, through programs labeled "industrial administration" and the like, and from Schools of Business, through options similarly titled. The chart in Appendix B lists the range and number of technology and technology-related programs in the State Colleges, both as they exist today and as they are projected in the official academic master plans of the individual colleges. It reveals that two of the State Colleges which offer industrial technology likewise offer a curriculum in "industrial administration" under the aegis of engineering. Further, in a reverse of the usual arrangement, whereby schools of business cooperate with industrial arts and engineering in making appropriate courses available to technical students, the School of Business at Cal Poly, Pomona, sponsors an option which depends on engineering to provide appropriate technical knowledge and skills.

Inasmuch as the administration of similar programs varies from institution to institution across the country, no one area can be said to be the "natural" administrative unit. Yet to avoid proliferation of degrees and degree terminologies in accordance with the mandate of the Board of Trustees, appropriate policy guidelines must be formulated and reasonable measures of control exercised.

POSSIBLE SOLUTIONS

As early as 1962, Vivian, writing from an engineer's viewpoint, noted that "Industrial Technology programs in the State Colleges are now a 'gray area' between Engineering and Industrial Arts and need to be controlled." He recommends that "Future programs should be interdisciplinary between these divisions and the Business Division and administered by the faculty with the highest level of technical knowledge of industry, the Engineering Division." In the seven years which have passed only one State College – Cal Poly, San Luis Obispo, which is especially noted for the applied orientation of its curriculum – has followed this dictum to the extent of transferring the Industrial Technology Department (including the teacher education option) from the School of Applied Arts to the School of Engineering (now called School of Engineering and Technology), a move that was not accomplished without some serious reservation on the part of the faculties concerned, and on the promise of some measure of continued autonomy. With respect to Vivian's insistence that the program should be "interdisciplinary," a joint effort of engineering, business, and industrial arts, there has been no compliance. Cal Poly is currently offering separate programs in industrial technology *and* engineering technology. While a high degree of cooperation with business is absolutely necessary if the objectives of industrial technology are to be realized, except for Cal Poly, San Luis Obispo, there is a singular lack of communication between industrial technology and engineering – a situation which is somewhat peculiar to the State Colleges. Vivian's recommendation had merit, but he misjudged both the attitude of the engineering faculty toward technology and the readiness of the various schools and departments to cooperate to the extent a joint program would require.

Even with official recognition by ECPD, the profession remains divided over the question of four-year engineering technology programs. Peters, spokesman for the opposition at the ECPD meeting in October 1966, where the question of whether or not ECPD should extend accreditation to four-year engineering technology programs was debated and decided, warned of an impending identity crisis. He argues that "The Bachelor or Baccalaureate of Engineering Technology . . . is an inappropriate designation and should not be permitted to develop in close relationship with engineering." He contends that a two-year technology program is sufficient training, but that:

> . . . if the decision is made that a four-year training program in technology is needed, then this should not be associated in any way with engineering and the word 'engineering' should not be used in the title because the product is not an engineer.

He continues:

> We are diluting our overall engineering education capabilities of the country by encouraging the BET [Bachelor's in Engineering Technology] approach and we are simultaneously causing serious damage to the future of engineering by losing much of our chance for the development of a high-status, two-year Technical Institute approach.

And:

We are making a serious error in accepting the BET approach as anything different than a watered-down and diluted four-year engineering program.... By separating the technician and technology program from engineering education, we make it completely clear to the public that engineering education is something special.

The McCallick Report, in spite and because of nagging doubts, recommends acceptance and accreditation of these programs by the following reasoning:

...unless criteria for accreditation of those programs are promptly adopted, considerable chaos could result. Engineering technology education, as ECPD has known it, is in jeopardy. It is being squeezed from below by two-year associate degree programs growing out of a vocational education background and is being outflanked at the four-year level by degree programs in technology evolving from an industrial arts heritage. Failure to act will neither reverse these threatening trends nor, therefore, the growth in numbers of four-year technology programs.

While the foregoing statement is a realistic assessment of what has been occurring in technological education, as an *educational* justification for entry into the four-year technology field it leaves much to be desired. Condescension toward four-year engineering technology programs permeates the literature. Foecke, for example, in justifying four-year engineering technology, argues that "some tenured faculty members are really technology-oriented at heart, and some who are second-class citizens in the modern engineering program could find new purpose and challenge in a technology program." Recommendations of the ASEE and the ECPD committees charged with formulating accrediting criteria also reflect this attitude: "College of Technology" should be used as "the generic term to designate the institution or unit awarding the baccalaureate degree"; the transcript and diploma should "indicate clearly" that the program is one in engineering technology; the degree designation should include the term "engineering technology"; and "No curriculum will be approved for accreditation unless the word technology is used as the final noun in the title."

It must be remembered that, consistent with the recommendations of the Grinter Report and the subsequent accrediting criteria established by ECPD, engineering education today is theoretically oriented; the major emphasis is on the functions of design, development, and research, especially on the first, rather than on production and manufacture. Institutions have exerted tremendous effort over the last dozen years in securing ECPD accreditation, and most engineering faculties do not seem persuaded at this time that the hard-won gains should be jeopardized through diversification into engineering technology programs. The McCallick Report asserts that:

...a number [of industrial technology programs] are sufficiently similar that they could readily be converted to engineering technology programs with only minor changes in curricula and objectives.

Yet in making this assumption, the committee implies that the engineering profession can absorb industrial technology, and is willing to do so. The direction engineering education will take in the future is simply not clear enough for such a commitment to be made. The Engineering Goals Report (1968) recommends, in view of the manifest trend for engineers to pursue advanced work, that the master's degree should become the entry level into the profession. If this recommendation should indeed become the accepted guideline for the engineering profession, then the place of the emerging four-year technologist in the engineering continuum might become clearer.

There are other obstacles to easy absorption and accommodation of industrial technology by engineering. Even if State College industrial technology faculty were amenable, and could be sufficiently distinguished from industrial arts faculty, the transfer of 70 or so faculty, 1500 or more majors, numerous laboratories, equipment, and the like would present difficult logistical problems if attempted over a short period of time. Moreover, the rather liberal practices of industrial technology departments with regard to transfer credits, which has done much to ameliorate articulation conflicts with the Community Colleges, might be jeopardized by the less flexible provisions of schools of engineering. (It can be said that the interest some Community Colleges exhibit in extending technical programs to three years or more seems to stem as much from the obstacles their students encounter in locating suitable programs into which to transfer as from aspirations to become four-year colleges themselves.) Finally it is the view of some industrialists, as confirmed by the Survey, that the goals and patterns of industrial technology are better suited to their needs than those of engineering, at least as presently constituted. As an immediate or short-term solution, then, wholesale movement of industrial technology into engineering appears neither feasible nor desirable.

Nevertheless, Vivian's recommendation with regard to the development of a single, interdisciplinary technologist program, participated in jointly by engineering, business, and industrial arts, is a promising prospect. The Survey of Industry reveals that many industrialists would favor such an approach, since they tend to use graduates interchangeably whether trained as engineering or industrial technologists. Several institutions across the country operate such cooperative programs successfully. The benefits of subsuming *all* programs with a technological-managerial cast should be obvious. Besides cost and efficiency advantages, such an arrangement would permit better utilization of technology faculty members, who are in short supply, and greater flexibility and ease of transfer at all levels within and without the college.

At any rate, while new or additional technology programs are patently needed, actual and potential differences between industrial technology and engineering technology are not significant enough at this time to support the concurrent development of these programs on a given campus. The experiment underway at Cal Poly, San Luis Obispo may or may not provide more conclusive evidence, or NAIT, ECPD and other agencies may articulate more distinctive objectives and curricula for the two programs. The fact that the present and future levels of economic activity practically insure employment of graduates from any program designed to fulfill industry's needs must not obscure the need for rational evolution and careful evaluation of curricular requirements, nor the obligation to avoid proliferation.

ELEMENTS OF A PROPOSED POLICY

A viable policy governing the present status and future development of industrial technology and technology-related programs in the California State Colleges must embody such principles and seek to achieve such accommodations as the following:

1. Pending the outcome of the experience of Cal Poly, San Luis Obispo in offering both industrial technology and engineering technology on an experimental basis, no other college should be permitted to offer dual programs.

2. Subject to provisions detailed throughout the report, development of industrial technology programs *or* engineering technology programs at other State Colleges would be encouraged. Industry's need for high-level technical personnel is so great that implementation of technology programs at several State Colleges would not overextend curricular provisions within the System. Nor would this development be expensive since the colleges concerned already operate strong programs in professional engineering or industrial arts or both.

3. Engineering technology programs must be developed only in colleges where the engineering program is strong and where the faculty is fully supportive. Otherwise the technology program will risk being relegated to inferior status from the start, as a "dumping ground" for students who cannot succeed in regular engineering curricula, and with the stigma of second-class citizenship applied to students and faculty involved in it.

4. Educators responsible for planning and supervising technology curricula should draw upon appropriate existing courses of related areas rather than duplicate them. Steps should be taken to increase cooperation and reciprocity between engineering and industrial arts-technology areas, through inclusion of representatives on advisory committees, through joint use of engineering laboratories, and through designing multi-purpose laboratories to serve the needs of both disciplines.

   The argument that each discipline needs to offer courses in certain shared areas – namely that particular needs cannot be met otherwise – is weak when applied to technology education, because whether originating in industrial arts-technology or engineering, courses will stress the *applications* of established principles over theoretical derivations. There are strategies for making a single course fit seemingly diverse functions and student needs.

5. Colleges which presently offer multiple programs designed to prepare technical administrators for employment in industry should review them carefully and consolidate them, or reorient one or more of them.

RECOMMENDATIONS

RECOMMENDATIONS

1. The paramount function of Industrial Arts Departments in the California State Colleges shall continue to be preparation of teachers for the public secondary schools of the State. In view of the urgent need, departmental faculty should do all within their power to interest promising high school students in pursuing a teaching career and to encourage continuance in the teacher preparation program.

2. "Industrial Arts" shall continue to be the appropriate title for the teacher education degree, and the Bachelor of Arts the appropriate type of degree awarded. Departmental designations shall be the prerogative of the individual college.

3. Industrial Arts Departments shall continue to perform a significant service role for other areas and to participate in the General Education Program of those colleges in which the general faculty is receptive to inclusion of selected industrial arts courses.

4. Industrial Arts Departments in certain State Colleges shall continue to administer such additional curricula as are officially assigned to them—namely industrial design, photography, and safety and driver education—provided that programs which are interdisciplinary in nature remain so. Conversely, Industrial Arts Departments shall participate to the extent deemed appropriate in all technology or technology-related curricula which could profit from the expertise of industrial arts educators.

5. Industrial Arts Departments shall enter into internship or work-study arrangements with industry, to insure that the prospective teacher is fully conversant with the latest developments and practices in industry.

6. No other State College shall establish an industrial arts curriculum until existing programs that are reasonably accessible approach maximum enrollment capacity. When it is determined that such capacity has been reached, the first additional program shall be established in a college located in the southern part of the State. California State Polytechnic College, San Luis Obispo shall, however, be permitted to raise the existing option in industrial arts teacher education to full degree status and inaugurate a master's degree in industrial arts when the need for it can be demonstrated. During 1975-76, the Chancellor's Office shall review the status of industrial arts teacher education programs in the State Colleges to determine if additional colleges should inaugurate appropriate programs, beginning in 1976.

7. Industrial Arts Departments shall administer *all* programs designed to prepare teachers, whether for industrial arts or occupational classes in high schools or for industrial arts, vocational trade-technical, or pre-industrial technology classes in the Community Colleges. Industrial technology educators shall participate in this preparation to the extent appropriate.

8. Industrial arts educators shall reevaluate the relationship with vocational education and accommodate its needs along lines emerging nationally and in California. Just as industrial arts shall take greater responsibility for preparing and upgrading the trade-technical teacher, other appropriate subject areas in the California State Colleges shall strive to serve the needs of vocational teachers under provisions of the B.V.Ed. degree.

9. The Office of the Chancellor shall negotiate with other concerned agencies to arrange transfer from the University to the State Colleges of complete responsibility for administering the Standard Designated Subjects Teaching Credential with Specialization in Vocational Trade and Technical Teaching and the Standard Designated Subjects Teaching Credential—Industrial Arts and Occupational Subjects.

10. Programs leading directly to employment in industry shall be a recognized secondary objective of Industrial Arts Departments, but they should take the form of industrial technology or specialized technology programs. Definite advantages accrue to industrial arts when an industrial technology program exists on the same campus. The Industrial Arts Department shall not offer a technical track or option leading to employment in industry rather than in education when a formal industrial technology program is operative.

11. "Industrial Technology" is the appropriate designation for the industrially-oriented program growing out of an industrial arts heritage, and the Bachelor of Science the appropriate type of degree awarded.

12. No particular administrative structure is presumed to be more satisfactory than another; but where industrial technology is administered separately from industrial arts, the relation shall continue to be a complementary one, with each area providing the maximum appropriate service for the other and thus avoiding duplication.

13. Industrial technology shall be developed only in colleges which are already operating a strong industrial arts curriculum. Insofar as industrial arts and industrial technology programs serve distinct purposes, no State College shall phase out the existing industrial arts curriculum in favor of industrial technology or any other industrially-oriented curriculum.

14. Existing industrial technology and related programs affiliated with Industrial Arts Departments shall be continued and shall be supported in a manner that will insure high quality. Enrollment growth shall not be limited, except when a college reaches its enrollment ceiling or is maintaining a planned balance among its offerings. Existing technology programs which are unique and specialized–namely in Aeronautics at San Jose State College and in Printing Management at California State Polytechnic College, San Luis Obispo and California State College, Los Angeles–shall be continued but shall not be duplicated at other State Colleges.

15. During the next five-year period, 1970-75, only California State Polytechnic College, San Luis Obispo shall be authorized, on an experimental basis, to offer both industrial technology *and* engineering technology programs. Review and evaluation of this experiment in 1974 by the Chancellor's Staff shall help to determine whether dual programs are warranted at San Luis Obispo and other campuses, beginning not earlier than 1976.

16. Colleges with strong professional engineering programs but without industrial technology may, in the context of academic master planning, consider developing an accredited engineering technology program if all conditions, especially a fully supportive engineering faculty, are conducive to doing so. Specialized technology programs, such as Surveying and Photogrammetric Technology projected at Fresno State College, shall be authorized if both need and feasibility are fully demonstrated.

17. Colleges which are not projecting an engineering technology program may, in the context of academic master planning, project industrial technology, and the programs already projected at San Diego State College and California State College, Los Angeles shall be authorized for implementation at the times indicated in the respective master plans. Approval of an industrial technology program at Chico State College shall be dependent on the phasing out of the Applied Science program in the Division of Engineering. Within the context of academic master planning, California State Polytechnic College, Pomona shall determine whether to implement an engineering technology program *or* industrial arts-industrial technology programs; commitment to the latter course shall be in accordance with Recommendations 6 and 13 above. Humboldt State College shall not be authorized to introduce an industrial technology program prior to 1976.

18. No master's degree in industrial technology shall be authorized in the System before 1976, but an option within the existing master's in industrial arts may be approved at colleges which demonstate the need for it.

19. Faculty and administrators responsible for industrial technology programs shall endeavor to incorporate as many of the characteristics of excellence specified on pages 31-32 of this report as is reasonable within the confines of a four-year program. If a national accrediting agency for industrial technology is created, the State Colleges shall meet the criteria and apply for such accreditation at the earliest possible time.

20. Faculty and administrators responsible for technology programs shall develop and maintain close cooperation with business and industry to their mutual benefit, as delineated in the report; and with the

Community Colleges, in facilitating transfer of students between segments. Methods shall be devised to make access easier for capable, terminal students who belatedly aspire to continue their education in State College technical programs consistent with the maintenance of standards.

21. Steps shall be taken to increase cooperation among the engineering, business, and industrial arts--industrial technology areas on the campuses. In line with the principle that any program shall draw upon appropriate offerings of related disciplines in preference to duplicating them, all colleges with industrial technology programs are requested to review areas of possible proliferation of offerings and to consider incorporating appropriate *engineering* courses in the curriculum. Colleges offering two or more technically-oriented programs which appear to be duplicatory shall study them carefully and explore alternatives, including consolidation of such programs or reorientation of them.

22. During 1975-76, the Chancellor's Office shall review the status of technology education in the State Colleges to determine (1) whether all the guidelines recommended in this report still have applicability, and, if not, to formulate new guidelines and/or employ whatever corrective measures are necessary; (2) whether additional programs are needed, of what type they should be, and in which colleges they should be placed; (3) whether a separate master's degree in technology is warranted, and, if so, how many and in which colleges the degrees should be introduced, so as to preserve a reasonable balance of offerings in the System; and (4) whether there is need for separate (as distinct from joint) doctoral programs in any of the areas of industrial education.

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APPENDIX A

A Master Curricular Plan for the California State Colleges
Trustees of the California State Colleges, March 8, 1963, pp. 27-29

INDUSTRIAL ARTS

Programs in industrial arts in the state colleges are primarily designed to prepare teachers of industrial arts for the public schools of the state. Since this is the primary objective, the nature and scope of industrial arts programs are largely governed by requirements for the appropriate teaching credentials. Currently, the areas which must be covered in the major are automobile mechanics, design and drafting, electronics, graphic arts, metalwork, and woodwork.

In college programs in industrial arts the emphasis is not upon the acquisition of skills, but rather upon the knowledge and understanding, as well as the skills, needed by the teacher of industrial arts. The aim is not, therefore, to train automobile mechanics or metalworkers, or television repairmen, but to prepare teachers who can be employed in the junior and senior high schools and the junior colleges so as to help young people at those educational levels to acquire and use the skills of these trades and occupations. While the teacher must have enough skill to give sound demonstration and instruction to the classes he teaches, he does not concentrate his training on learning to operate a wood lathe or to use an acetylene torch. Much of his time is spent studying mathematics, physics, properties of materials, and other content so that as a teacher he can bring to the classroom real comprehension of why and how materials and objects must be manipulated in order to achieve the desired goals of production and repair.

The need for teachers of industrial arts is annually surveyed by the State Bureau of Industrial Education. Over the last several years, its findings indicate an average annual need of about 300 industrial arts teachers per year. Approximately 180 of these are filled by graduates of California institutions, 120 by persons from other states.

Programs in industrial arts are currently offered at Cal Poly-SLO, Chico, Fresno, Humboldt, Long Beach, Los Angeles, San Diego, San Francisco, and San Jose. From these programs, 318 graduates received the bachelor's degree, 110 the master's degree, and 27 the Bachelor of Vocational Education degree during 1961-62. Many of these graduates find employment in industry in preference to entering the teaching field. This fact accounts for most of the discrepancy between the annual number of graduates and the annual number of California graduates employed by the public schools. It is also related to the development of programs in industrial technology, discussed later in this report. As the proposed study of industrial technology is undertaken, attention will also be given to ways and means by which the teacher education function of industrial arts is kept paramount by both the faculty who plan the industrial arts programs and the students who choose industrial arts as a field of study.

Enrollments at Humboldt State College are relatively low, but are increasing. This program has been in operation for over 40 years, and the public schools in the region look to the college for their supply of industrial arts teachers. With some remodeling, facilities are available for all areas of instruction except automobile mechanics. Plans are being developed for a minimum facility in this area.

Recommendation:

It is recommended that:

Industrial Arts programs currently operative in the state colleges be continued, with the understanding that:

1. majors in Industrial Arts in the state colleges be recognized as having only one purpose, namely; the preparation of teachers, provided that Industrial Arts programs currently in operation be continued at their present level, with Humboldt State College limited to minimal facilities and equipment until such time as larger enrollments justify augmentation;

2. in view of requests pending for the expansion of industrial arts education, it be the policy of the Trustees that the colleges, in conjunction with the Chancellor's Office, undertake a complete study of this field to be completed at the earliest feasible date.

INDUSTRIAL TECHNOLOGY

The industrial technologist is an individual who uses tools, instruments, and devices to design, fabricate, maintain, and operate objects, materials, or equipment. As modern technology has developed and become more complex, the demand for technologists has increased greatly. Typical duties include laboratory testing, data interpretation, preparation of specifications data, cost estimating, supervision and scheduling of construction and production, and applied research on various industrial mechanisms.

As is true in many other vocational field, requirements for employment in this field have increased and changed a great deal in recent years. In order to operate effectively the technologist needs greater understanding of the concepts, theories, and principles involved in the problems that he must solve; he needs instruction in science, mathematics, engineering, business, and art; and the ability to communicate ideas effectively. These greater demands have led to the development of baccalaureate degree programs in industrial technology, now offered at Cal Poly-SLO, Fresno, Long Beach, and San Jose. Closely related is the Printing Management program at Los Angeles State. Similar programs have been developed at other colleges and universities throughout the nation.

Despite these developments, several questions still arise concerning this program:

1. Is the content of the program appropriate to collegiate education at the baccalaureate level?

2. What are the appropriate elements of a curriculum in industrial technology? How much mathematics? How much science?

3. What is the relation of this program to both industrial arts and engineering?

Recommendation:

It is recommended that:

existing programs in industrial technology currently operative in the state colleges be continued for the time being, pending further study of this and the industrial arts areas.

APPENDIX B

Existing and Projected Industrial Arts, Industrial Technology, Engineering Technology, and Technology-Related Programs in the California State Colleges, 1969-70

INDUSTRIAL ARTS – TECHNOLOGY EDUCATION IN CALIFORNIA STATE COLLEGES, 1969-70

COLLEGE	ADMINISTERING UNIT		DEGREE FIELDS					OTHERS	
	DEPARTMENT	SCHOOL/DIVISION	IND. ARTS TCHR. ED.	INDUSTRIAL TECHNOLOGY		VOCATIONAL EDUCATION[1]	SPECIALIZED[4]	ENGINEERING–RELATED (Administered by School/Division of Engineering)	
			EXISTING	EXISTING	PROJECTED	EXISTING	EXISTING	EXISTING	PROJECTED
Cal Poly SLO	Industrial Technology	School of Engineering and Technology	Option in Industrial Education[2]	B.S. (132)	M.S.	B.V.Ed.	B.S. Printing Tech. & Mgt. (132) (Sch. of Sciences & Applied Arts)	B.S. Engr. Technology (132) B.S. Industrial Engr. (132)	B.S.;M.S. Construction Engr.
Chico	—	Division of Industrial Arts & Technology	B.A. (124); M.A.	Option	B.S.; M.S.	B.V.Ed.	—	B.S. Applied Science with options in General; Industrial Administration (128)	
Fresno	Ind. Arts & Technology	School of Professional Studies	B.A. (124); M.A.	B.S. (128)	M.S.	B.V.Ed.	—	B.S. Industrial Engr. (136)	B.S. Surveying and Photogrammetric Tech.
Humboldt	Ind. Arts	School of Science	B.A. (124)	—	—	—	—		
Long Beach	Ind. Arts Ind. Tech.	School of Applied Arts & Sciences	B.A. (124); M.A.	B.S. (128)	M.S.	B.V.Ed.	—	B.S. Engineering with option in Industrial Management (132)	
Los Angeles	Industrial Studies	School of Fine & Applied Arts	B.A. (124) M.A. Industrial Education	Option	B.S.	B.V.Ed.	B.S. Printing Management (128)		
San Diego	Ind. Arts	Division of Physical Sciences	B.A. (124); M.A.	—	B.S.	B.V.Ed.	—		
San Francisco	Design & Industry	School of Creative Arts	B.A. Option: Industrial Arts (124); M.A.	B.A. Option: Design & Industry (124)	—	B.V.Ed.	—		
San Jose	Industrial Studies	School of the Applied Sciences & Arts	B.A. (124); M.A.	B.S. Business & Industry (124)[3]	—	B.V.Ed.	B.S. Industrial Design (132)	B.S. Industrial Administration (131) B.S. Aeronautics B.S. Industrial Engr. with options in Production Systems; Management (128) M.S. Industrial Engineering	M.S. Aeronautics

[1] B.V.Ed. is also offered at Sacramento State College.

[2] Raising the option to full degree status as a B.S. in Industrial Arts and adding an M.S. in Industrial Arts are planned.

[3] Title of this program to be changed to Industrial Technology.

[4] Not shown, but related, is the B.S. in *Business Management with option in Industrial Management offered* by the School of Business at Cal Poly, K.V. Also, a B.S. in Industrial Design is projected by California State College, Long Beach.

[5] *Cal Poly, Pomona's Academic Master Plan also projects a B.S. in Industrial Technology*

APPENDIX C

Majors, Graduates, FTE, Industrial Arts and Industrial Technology, 1963-69

MAJORS IN INDUSTRIAL ARTS – UNDERGRADUATE

	Chico	Fresno	Humboldt	Long Beach	Los Angeles	San Diego	San Francisco	San Jose	San Luis Obispo	Total	% + or –
Fall 63 FT	133	100	38	124	137	119	87	148	40	926	
PT	10	25	8	122	137	39	53	43	4	441	
T	143	125	46	246	274	158	140	191	44	1,367	-
Fall 64 FT	136	82	39	151	164	115	130	125	41	983	
PT	12	19	4	118	146	34	47	51	5	436	
T	148	101	43	269	310	149	177	176	46	1,419	+ 3.8
Fall 65 FT	147	91	48	190	144	109	152	126	65	1,072	
PT	13	13	5	109	169	32	45	34	4	424	
T	160	104	53	299	313	141	197	160	69	1,496	+ 5.4
Fall 66 FT	147	104	45	212	155	123	175	135	75	1,171	
PT	22	16	7	97	124	31	63	54	7	421	
T	169	120	52	309	279	154	238	189	82	1,592	+ 6.4
Fall 67 FT	161	112	53	245	160	170	53	147	80	1,281	
PT	16	15	5	133	149	42	64	50	4	478	
T	177	127	58	378	309	212	217	197	84	1,759	+10.5
Fall 68 FT	194	143	55	294	151	178	164	175	87	1,441	
PT	16	18	9	130	121	44	73	53	6	470	
T	210	161	64	424	272	222	237	228	93	1,911	+ 8.6

MAJORS IN INDUSTRIAL ARTS – GRADUATE

	Chico	Fresno	Humboldt	Long Beach	Los Angeles	San Diego	San Francisco	San Jose	San Luis Obispo	Total	% + or –
Fall 63 FT	2	7	–	3	5	9	9	8	–	43	
PT	5	18	–	105	105	65	46	45	–	389	
T	7	25	–	108	110	74	55	53	–	432	–
Fall 64 FT	3	5	–	8	24	10	4	7	–	61	
PT	13	17	–	101	73	63	45	52	–	364	
T	16	22	–	109	97	73	49	59	–	425	- 1.6
Fall 65 FT	2	4	–	3	1	3	15	7	–	35	
PT	13	23	–	96	73	56	41	70	–	372	
T	15	27	–	99	74	59	56	77	–	407	- 4.2
Fall 66 FT	4	4	–	9	2	4	4	4	–	31	
PT	21	19	–	72	77	40	41	71	–	341	
T	25	23	–	81	79	44	45	75	–	372	- 8.6
Fall 67 FT	2	5	–	10	1	3	7	7	–	35	
PT	6	10	–	76	94	30	36	45	–	297	
T	8	15	–	86	95	33	43	52	–	332	- 10.8
Fall 68 FT	3	15	–	14	8	7	11	15	–	73	
PT	20	21	–	80	105	53	43	57	–	379	
T	23	36	–	94	113	60	54	72	–	450	+35.5

Explanatory Notes

1. Legend: FT = full-time; PT = part-time; T = total.

2. *All figures furnished by the* Division of Institutional Research, Chancellor's Office.

MAJORS IN INDUSTRIAL TECHNOLOGY – UNDERGRADUATE

	Fresno	Long Beach	Los Angeles	San Jose	San Luis Obispo	Total	% + or –
Fall 63 FT	65	126	23	111	204	529	
PT	10	123	14	54	16	217	
T	75	249	37	165	220	746	–
Fall 64 FT	107	169	29	143	204	652	
PT	16	148	14	58	18	254	
T	123	317	43	201	222	906	+21.4
Fall 65 FT	150	213	28	185	247	823	
PT	21	167	16	44	12	260	
T	171	380	44	229	259	1,083	+19.5
Fall 66 FT	221	274	28	210	267	1,000	
PT	21	194	18	60	20	313	
T	242	468	46	270	287	1,313	+21.2
Fall 67 FT	278	335	38	201	260	1,112	
PT	28	245	14	72	14	373	
T	306	580	52	273	274	1,485	+13.1
Fall 68 FT	318	395	39	208	288	1,248	
PT	27	282	16	87	28	440	
T	345	677	55	295	316	1,688	+13.7

MAJORS IN VOCATIONAL EDUCATION – UNDERGRADUATE

	Long Beach	Los Angeles	San Francisco	San Jose	Total	% + or –
Fall 63 FT	1	11	0	0	12	
PT	18	29	2	1	50	
T	19	40	2	1	62	–
Fall 64 FT	2	16	1	0	19	
PT	24	37	7	1	69	
T	26	53	8	1	88	+41.9
Fall 65 FT	2	20	2	0	24	
PT	17	28	5	2	52	
T	19	48	7	2	76	-13.6
Fall 66 FT	1	2	3	0	6	
PT	16	14	7	2	39	
T	17	16	10	2	45	-40.8
Fall 67 FT	6	4	3	0	13	
PT	24	15	10	2	51	
T	30	19	13	2	64	+42.2
Fall 68 FT	2	8	9	.	19	
PT	40	20	18	.	78	
T	42	28	7	.	72	+12.5

Explanatory Notes

1. Legend: FT = full-time; PT = part-time; T = total.
2. All figures furnished by the Division of Institutional Research, Chancellor's Office.
3. Industrial Technology includes curricula titled "Industrial Technology," "Business and Industry," "Printing Technology and Management," "Printing Management," and "Industrial Design."
4. The figures for Industrial Arts and Industrial Technology are not discrete. It has not been possible to cull out all Industrial Technology majors at those State Colleges which offer a technical track under Industrial Arts but not a separate degree program in Industrial Technology. The figures for Chico, Cal Poly, Lo Angeles, San Diego, and San Francisco are affected. Th systemwide the figures for Industrial Arts are somewhat inflate and those for Industrial Technology somewhat smaller than the actually are.

DEGREES GRANTED IN INDUSTRIAL ARTS AND INDUSTRIAL TECHNOLOGY PROGRAMS 1964-68

	Los Angeles	Long Beach	San Francisco	San Jose	San Diego	Fresno	Chico	Humboldt	San Luis Obispo	Total	% + or –
Undergraduate											
Industrial Arts											
63-64	58	54	43	42	59	38	16	8	10	328	-
64-65	82	53	57	54	49	39	58	8	11	411	+25.3
65-66	72	77	62	33	40	38	44	8	15	389	- 5.4
66-67	65	83	79	33	54	43	58	11	22	448	+15.2
67-68	71	119	97	53	65	58	55	14	24	566	+24.1
Industrial Technology											
63-64	5	24		22		9			34	94	
64-65	5	44		17		12			41	119	+26.6
65-66	7	45		26		22			45	145	+21.8
66-67	5	63		34		47			72	221	+52.4
67-68	7	76		55		71			70	279	+26.2
Vocational Education											
63-64	10	2	4	2	5	3			2	28	
64-65	13	9	2	2		3			1	30	+ 7.2
65-66	6	9	4	2		1			1	23	- 23.3
66-67	14	10	3	2						29	+26.0
67-68	4	17	3	1					1	26	- 11.1
Graduate											
Industrial Arts											
63-64	8	24	20	21	7	10	20			110	
64-65	6	31	29	23	5	13	19			126	+14.5
65-66	9	22	27	36	21	10	19			144	+14.3
66-67	16	24	11	33	22	15	21			142	- 1.4
67-68	6	26	17	34	20	16	19			138	- 2.8

UNDERGRADUATE FTE FOR INDUSTRIAL ARTS AND INDUSTRIAL TECHNOLOGY 1964-68

	Chico	Fresno	Humboldt	Long Beach	Los Angeles	San Diego	San Francisco	San Jose	San Luis Obispo	SYSTEMWIDE TOTALS
Industrial Arts										
1964	111.8	134.0	21.6	171.9	84.8	109.6	111.8	254.7		1,009.2
1965	126.0	174.3	30.8	197.4	140.0	118.8	110.8	258.9		1,157
1966	122.9	140.7	37.8	225.3	155.2	144.4	109.0	246.3		1,181.6
1967	121.2	235.0	40.6	260.4	145.5	172.6	94.0	279.7		1,349
1968	106.6	292.9	48.9	317.3	171.7	200.2	131.6	280.1		1,549.3
Industrial Technology*										
1964				80.8				18.9	50.4	150.1
1965				85.5				13.4	72.5	171.4
1966				111.0				12.4	117.5	240.9
1967				145.0				14.9	108.4	268.3
1968				175.7				13.9	138.3	327.9

GRADUATE FTE FOR INDUSTRIAL ARTS 1964-68

	Chico	Fresno	Humboldt	Long Beach	Los Angeles	San Diego	San Francisco	San Jose	
Industrial Arts									
1964	10.5	3.2	1.7	16.4	15.0	16.2	4.6	10.1	77.7
1965	12.0	4.4	0.7	14.4	20.1	24.6	9.6	14.3	100.1
1966	9.6	5.1	0.4	12.2	16.6	18.8	14.0	14.2	90.9
1967	10.7	5.5	0.5	16.2	19.4	22.6	9.0	13.2	97.1
1968	9.5	12.1	0.5	23.6	22.3	24.5	12.0	22.9	127.4

* Industrial technology FTE is broken out only at the three colleges which offer a *degree* program; at other institutions the FTE for industrial arts will include industrial technology. Conversely, at Cal Poly, San Luis Obispo, the industrial technology FTE includes industrial arts teacher education.

Figures supplied by the Division of Institutional Research.

APPENDIX D

Survey of Industry, 1968

SURVEY OF INDUSTRY

OVERVIEW

Soon after the industrial arts-industrial technology study began, it became clear that a survey of industry was needed. Whereas a good deal of information about industrial technology programs could be gleaned from existing literature, the same could not be said of industry's viewpoint toward the general concept of an industrial technology curriculum. Individual colleges had made surveys of those firms which employed their technology graduates, but these were generally regional and designed to elicit information related to their particular programs. No comprehensive survey of California industry's need for and use of technologists has ever been undertaken. The present survey was restricted to firms indigenous to California or national firms with major branches in California on the assumption, first, that the State Colleges primarily serve a local clientele, and, second, that students will seek employment and continue to reside in California following graduation.

A serviceable survey instrument was devised. As a test of reliability, the questionnaire was tried out on a sample of twenty carefully selected firms. On the basis of analysis of returns, minor changes were made to give better focus to certain questions and to prevent interpretational difficulties. The revised questionnaire was then sent out to the presidents or personnel directors of 290 firms representing a predetermined cross-section of industry in California--firms of various sizes, types and products, located in all areas of the state. Total returns exceeded 53 percent, but only 44 percent were usable, about 9 percent of the respondents indicating they did not employ technologists. The reasons 47 percent of the firms solicited did not respond, even though a follow-up reminder was sent, are not entirely clear. One explanation is that, proportionately, many more returns were received from the larger firms than from the smaller ones; the latter may have had no interest in employing technologists or lacked knowledgeable personnel to complete the questionnaire. At any rate, the return was substantial enough to permit valid conclusions.

A cover letter informed industrialists that the State Colleges were making a "formal assessment" of their technology programs and were thus interested in learning industry's viewpoint on such questions as: Do you need and desire baccalaureate-holding technologists? What types of positions do they fill? What kinds of training and competence are most satisfactory?

In order to maximize mutual understanding, the first page of the questionnaire itself contained a brief descriptive statement about industrial technology and a working definition of an "industrial technologist." Question 1 attempted to ascertain the kinds of positions industrial technologists actually hold. What positions are most common? What job titles are used? Questions 2 and 3 related to the specific educational background desired. What courses are most useful? How much technical background is required? Should the prospective technologist pursue a broad or a specialized type of program? Question 4 asked respondents to predict need and requirements for technologists over the next five years. Question 5 called for information about graduates of industrial technology programs offered by the State Colleges. Are they being employed? In what numbers? How are they rated on the job?

The last section of the questionnaire was composed of a series of attitudinal statements. These were designed to elicit preferences which would provide the basis for generalizations concerning the nature and content of industrial technology programs and their differences from engineering technology. Throughout the questionnaire respondents were repeatedly invited to comment, and open spaces were provided to permit this.

Detailed analysis of the responses, including many correlations and refinements, revealed both a definite pattern to the responses and a remarkable degree of internal consistency. Patently, industry has a need for technologists with baccalaureate degrees, and this need will accelerate in the future. For curriculum planning and development, the most important finding is that **industry is looking primarily for production–oriented persons who will eventually move into managerial and supervisory positions, and consequently technologists possessing a broad technical background combined with business and managerial techniques and communication skills are preferred.** Significantly, this is the rationale on which the State College programs have been largely operating.

The conclusions, given in order of questionnaire items, are as follows:

1. Positions in production management and quality control are the most likely job placements for industrial technology graduates. Other job openings are commonly found in purchasing, sales, and field service.

2. According to the title description, a large number of positions held by technologists are managerial. The terms "engineer" or "engineering" appear in many job titles, even though the holder may not be engaged in true engineering or engineering-support tasks.

3. Within the general subject areas identified, respondents evaluated individual courses as follows:

   a. **Mathematics** – The majority of respondents consider Arithmetic, Algebra, and Trigonometry necessary courses.

   b. **Technical** – Courses in Blueprint Reading, Time and Motion Study, and Quality Assurance or Control are considered necessary by a high portion of repondents. Few respondents rated such specialized courses as Fluid Flow, Plastics Technology, Power Technology, Graphic Arts, Photography, or Woodworking as necessary.

   c. **Business** – Respondents rated a relatively large block of business courses as necessary. These include Accounting Principles, Human Relations, Introductory Economics, Management Principles, and Production Supervision.

   Generally, the responses to specific course selections reinforce the preference for technologists having a breadth of technical background combined with strong business and human relations knowledge.

4. The following pattern emerges from the respondents' distribution of unit-time according to general subject area:

		Percentage of Total Program	Indicated Equivalents in Semester Units
General Education		20%	25
Communication Skills		12%	15
Mathematics		12%	15
Science		13%	16
Technical Subjects		26%	32
Business Administration		17%	21
	Total	100%	124

   If this pattern is thought of as providing the basis for a "model" program, there might be heavier requirements in mathematics and science than is now the case in most industrial technology programs in the State Colleges. However, respondents may have been influenced by the higher requirements in these two areas for engineering or engineering-related programs.

   On the surface it appears that respondents are deemphasizing the liberal arts portion of the curriculum, whereas the State Colleges require that fully one-third of the program consist of general education. In reality, if the percentages for liberal arts and most of communication skills are combined, as they should be, and a certain portion of the mathematics and science-percentages are added in, the result would then approximate or exceed one-third of the total.

5. Certain types of companies, notably electronics companies, appear to prefer students to have more technical training. However, the majority of aerospace, chemical, manufacturing and food companies do not expect high concentrations in the technical area but rather prefer students to have more general education and business courses.

6. Respondents by a two-to-one margin prefer technologists to have an educational background which is broad and flexible rather than overly specialized. Possible explanations for this preference include the following:

   a. California Community Colleges have been providing a large reservoir of two-year technicians of certain types.

   b. The largest portion of California companies are engaged in activities which are highly sophisticated and rapidly changing.

   c. Almost all companies offer some kind of on-the-job training.

   d. Many of the positions for which industrial technology graduates would be hired--production supervisors, for example--do not require the employee to work with intricate machinery and processes directly, but simply to possess broad technical knowledge and problem- solving abilities which can be applied to specific situations.

7. About one-third of the respondents indicate a need for technologists with more specialized training--persons who can move readily into jobs which require specific technical knowledge and expertise in a single area. However, closer analysis of the nature and preferences of this group reveals that:

   a. Three out of four of these firms prefer only engineering technologists or both engineering technologists and industrial technologists (whereas by a four-to-one margin the firms which prefer industrial technologists also prefer that they be broadly trained).

   b. The firms looking for technologists with very specialized preparation tend to be small and to offer little or no in-service training.

   It is clear, then, that while there is a need for the very specialized technologists, it is a limited one and appears to reflect more the training expected of an engineering technologist than of an industrial technologist.

8. Large companies tend to use industrial technologists and engineering technologists interchangeably; small and medium-sized companies tend to distinguish between graduates of four-year industrial technology and engineering technology curricula according to the duties performed.

9. Large companies recommend that engineering and industrial arts departments cooperate in developing a single curriculum for technologists.

10. Industry does not see a need for employing persons with a master's degree in industrial technology.

11. Respondents want graduates to have some prior industrial experience as gained through work-study, internship or some other arrangement and are willing to cooperate with the State Colleges in developing such reciprocal programs.

12. A sizeable number of respondents reported that they employ California State College graduates in technologist positions. Their responses reveal that:

   a. Many professional engineers are working in positions that could be filled by persons trained as technologists.

   b. Industry may not be pirating industrial arts majors from teaching careers in such large numbers as some observers have feared.

One unintended but beneficial by-product of the survey was to make industry more aware of the existence of technologist programs in the State Colleges. Many respondents who claimed ignorance of this fact indicated that they would actively seek to recruit technology graduates in the future. This at once suggests that not enough publicity has been given to these programs and that, if the recruitment activity of industry is indeed stepped up, technology graduates will be more sought after than ever before.

QUESTIONNAIRE DATA AND PROFILE OF INDUSTRIES SURVEYED

Number of companies receiving questionnaire: 290

Number of companies responding: 154

Number of companies not responding: 136

Number of companies completing questionnaire: 129

Number of companies returning questionnaires not completed: 25

Percentage of companies responding: 53%

Percentage of companies completing questionnaire: 44%

As shown below, the response to the questionnaire was slightly greater for companies of certain types and noticeably greater for companies of larger size. The latter distinction suggests that larger companies are more concerned about the educational background of their employees. Of course these companies undoubtedly have more sophisticated and better staffed personnel departments, which are geared to respond to requests for information. They also hire the majority of State College graduates;

QUESTIONNAIRE RESPONSE BY TYPE OR PRODUCT

Type or Product	Percentage of Companies Responding
Space	41%
Chemical, Wood	34%
Manufacturing	46%
Electronics	76%
Food	67%

QUESTIONNAIRE RESPONSE BY SIZE

Number of Employees	Percentage of Companies Responding
Under 1,000	37%
1,000 to 4,999	44%
5,000 and over	71%

PROFILE OF COMPANIES: DISTRIBUTION AND RETURN

Type or Primary Product	Sent Questionnaire	Returning Questionnaire
Space (includes aerospace, missiles, aircraft, rocketry, weapons, systems, nuclear products, explosives, scientific instruments)	63	26
Chemicals, Woods (includes paper, plastics, wood, glass, chemicals, insecticides)	35	12
Manufacturing (includes general manufacturing, steel fabricating, rubber, automobile, oil industry equipment, and tools)	83	38
Electronics (includes electronics and electronic equipment and data processing equipment)	66	50
Food (includes food processing, storing, canning, dairy products, consumer products)	12	14
Miscellaneous (includes various types of industries as well as utilities	31	14
Size (Number of Employees)		
Under 1,000	121	45
1,000 to 4,999	96	42
Over 5,000	49	35
Unknown	24	7
Location		
Los Angeles Metropolitan Area	190	80
San Francisco Metropolitan Area	70	35
Other Areas in California	30	14

ANALYSIS OF RESPONSES

Question 1a:

"Check which of the following positions industrial technology graduates most likely would fill in your firm."

		Responses
(1)	Production Management	104
(2)	Purchasing	43
(3)	Quality Control	81
(4)	Sales	42
(5)	Logistics	12
(6)	Field Service	40
(7)	Job Development and Training	16
(8)	Market Research	10
(9)	Other	42

Comment:

An industrial technology graduate is most likely to fill a position in "Production Management" or "Quality Control."

Question 1b

"Asterisk (*) the categories above for which hiring is especially difficult."

Response:

So few respondents completed this section that no conclusions can be drawn.

Question 1c:

"List below the job titles which are most commonly assigned."

Response:

The following job titles were identified:

Administrative Assistant
Administrative Service Engineer
Apparatus Sales Engineer
Area Manager
Arrangement Trainee
Assembly Supervisor
Assistant Engineer (1)
Associate Engineer (1)
Associate Field Maintenance Engineer
Associate Industrial Engineer
Associate Manufacturing Engineer (1)
Assistant Supervisor

Budget Analyst
Buyer

Chemical Production Technician
Computer Engineer
Contract Administrator
Contract Assistant
Controller Trainee
Cost Estimator
Customer Services Trainee

Department Analyst
Department Foreman
Department Manager
Detailing Supervisor
District Representative

Electrical Engineer
Engineer (1)

Engineer Administrative Assistant (1)
Engineer Estimator
Engineer Experimental Planner
Engineer Liaison
Engineer Planner (1)
Engineer Planning Assistant
Engineer Project Technician
Equipment Maintenance Engineer
Equipment Maintenance Foreman
Estimating Manager
Estimator (1)
Expeditor

Facilities Engineer
Field and Test Engineer
Field Crew Foreman
Field Engineer (2)
Field Installation Superintendent
Fieldman
Field Service Engineer (2)
Field Serviceman
Field Service Representative (3)
Foreman (13)
Foreman of Production
Functional Test Analyst

General Foreman (2)
Group Leader

Industrial Engineer (7)
Industrial Engineer Analyst
Industrial Engineering Technician
Industrial Power Engineer
Industrial Sales Representative
Industrial Specialist
Inspection Supervisor
Inspector (1)
Installation Engineer (3)
Integrated Logistics Analyst
Inventory Management Specialist

Job Foreman
Journeyman
Jr. Buyer
Jr. Engineer (1)
Jr. Industrial Engineer (2)
Jr. Manufacturing Engineer
Jr. Planner (2)
Jr. Process Engineer

Laboratory Development Technician
Laboratory Technician (1)
Leadman Supervisor

Liaison Engineer (2)
Lithographic Supervisor
Lumber Buyer

Mechanical Supervisor
Machine Shop Foreman
Machinist
Maintenance Engineer
Maintenance Supervisor
Management Opportunity Program
Management Trainee (1)
Manager
Manager of Planning
Manager of Purchases
Manufacturing Associate
Manufacturing Development Engineer
Manufacturing Engineer (9)
Manufacturing Planner (1)
Manufacturing Plant Superintendent
Manufacturing Supervisor
Marketing Research Trainee
Market Planning Manager
Material Control
Material Handling & Packaging Analyst
Material Identification Analyst
Material Planner
Materials Engineer
Metallurgist
Model Shop Supervisor

New Foreman Material Handling
New Foreman Production

Operations Analyst
Operations Foreman
Operations Supervisor
Operations Technician
Optical Engineer

PERT Analyst
Planner (1)
Planning Expeditor
Plant Equipment and Layout Engineer
Plant Layout Technician
Plant Manager
Plant Superintendent (1)
Plus Quality Control Engineer
Printing Supervisor
Process Control Engineer
Process Engineer (1)
Product Assurance Engineer
Product Design Engineer
Product Designer (1)

Product Development Technician
Product Director
Product Manager (1)
Product Specialist (2)
Production Assistant (1)
Production Control Analyst
Production Control Assistant
Production Controller
Production Control Planner (2)
Production Control Manager (1)
Production Control Supervisor (5)
Production Coordinator (1)
Production Engineer (2)
Production Engineer Manager
Production Foreman (4)
Production Manager (3)
Production Management Trainee
Production Planner (7)
Production Scheduler (2)
Production Supervisor (9)
Production Trainee (1)
Program Analyst
Program Manager (1)
Programmer
Programmer Analyst
Program Timing Coordinator
Project Control Appraiser
Project Control Planner
Project Engineer (2)
Purchasing Agent (2)
Purchasing Trainee

Quality Analyst
Quality and Test Engineer
Quality Assurance Engineer (1)
Quality Assurance Supervisor
Quality Control Analyst (7)
Quality Control Associate
Quality Control Engineer (15)
Quality Control Inspector (1)
Quality Control Manager (2)
Quality Control Supervisor (3)
Quality Control Technician (1)
Quality Engineer

Reliability Engineer
Research & Development Engineer
Research Technician

Safety Director
Sales Correspondent
Sales Engineer (9)
Salesman (1)
Sales Representative (1)
Sales Trainee (5)
Scheduler (1)
Section Head
Section Manager
Senior Foreman
Senior Planner
Service Center Foreman
Service Engineer (1)
Shift Superintendent
Shift Supervisor
Specifications Engineer
Staff Assistant (1)
Staff Industrial Engineer
Superintendent (3)
Systems Analyst

Technical Associate
Technical Coordinator
Technical Representative
Technical Sales Representative (1)
Technical Service Engineer
Technical Writer (1)
Technician
Test Engineer
Test Operations Assistant
Test Technician (1)
Time Study Evaluator
Tool Design Engineer
Tool Engineer
Trainee
Trainee Foreman

Value Engineer

Warehouse Superintendent
Work Standards Engineer

Comment:

Fifty-seven of the 211 titles have a supervisory description ("supervisor," "manager," "director," etc.).

Sixty of the titles utilize the description "engineer" or "engineering."

There is a definite correlation between responses to questions 1a and 1c.

NOTE: Numbers in parentheses indicate recurrent title designations.

Question 2:

"With regard to the specific preparation an industrial technologist should receive, please place the appropriate number in the blank preceding each field below."

1 - Necessary for adequate job performance
2 - Desirable for adequate job performance
3 - Unnecessary for adequate job performance

Courses by Subject Area	Responses:		
Mathematics	1	2	3
Arithmetic (College Math)	93	8	1
Algebra	73	27	2
Trigonometry	56	31	12
Descriptive Geometry	32	46	21
Analytic Geometry	21	46	29
Introductory Calculus	27	38	34
Applied Calculus	14	33	50
Differential Equations	14	29	54
Statistics	38	39	8
Computer Programing	24	50	24
Science			
Physics	55	35	12
Statics	27	43	28
Dynamics	23	45	30
Atomic Physics	2	15	51
Inorganic Chemistry	21	44	33
Organic Chemistry	15	32	49
Physical Chemistry	19	44	34
Thermodynamics	17	34	44
Introductory Biology	2	13	80
Introductory Geology	2	17	73
Technical			
Introductory Drafting	59	27	6
Blueprint Reading	77	18	6
Advanced Drafting	28	36	31
Basic Mfg. Processes	77	21	4
Machine Tool Skills	40	38	19
Tool Design	27	46	22
Understanding of Mechanical Systems	67	29	4
Design of Mechanical Systems	29	50	15
Design of Electrical Systems	26	51	21
Strength of Materials	29	52	16
Kinematics	15	43	34
Electrical Power	27	46	24
Electronic Power	18	42	32
Electronic Design	17	36	41
Numerical Control	18	41	35
Heat Transfer	12	48	33

Technical (continued)

	1	2	3
Fluid Flow	10	48	34
Plastics Technology	11	36	50
Graphic Arts (Printing)	7	24	61
Woodworking	2	19	73
Power Technology (Engines)	11	33	47
Mechanical Power Transmission	18	44	34
Photography	7	19	72
Product Evaluation	35	39	18
Time & Motion Study	50	39	10
Engineering Economy	46	40	9
Assurance or Control	50	39	8
Advanced Quality Assurance or Control	30	46	19
Industrial Design	19	50	27
Business Administration			
Accounting Principles	55	40	1
Marketing Principles	26	50	22
Human Relations	73	28	1
Introductory Economics	51	42	5
Advanced Economics	6	52	39
Business Law	11	56	27
Financial Management	25	53	18
Management Principles	64	36	3
Industrial Relations	45	48	5
Customer Relations	29	47	19
Industrial Marketing	18	44	33
Sales Management	13	43	40
Operations Research Introductory	17	56	23
Production Supervision	66	26	9
Industrial Purchasing	27	56	12
Communications			
Public Speaking	52	42	6
Technical Writing	55	39	4
Audio-Visual Methods	32	54	32
Psychology	21	67	8

Comment:

Although a large number of companies indicate elsewhere in the survey that there should be more emphasis on mathematics and science, the course-by-course breakdown does not reflect this same attitude. For instance, under **Mathematics** only three courses—Arithmetic, Algebra and Trigonometry—show a clear majority of "1" or "necessary" responses. Under **Science** only one course, Physics, received a majority of "1" responses. One possible explanation is that simply checking course titles did not give the respondent an opportunity to indicate the amount of unit time that should be alloted to the subject.

Under **Technical**, high "necessary" responses are given to courses in Blueprint Reading, Time and Motion Study, and Quality Assurance or Control, whereas relatively low responses are given to such specialized courses as Fluid Flow, Plastics Technology, Power Technology, Graphic Arts, Woodworking, or Photography. This response correlates with other sections of the survey, which reveal that industries–particularly manufacturing–prefer students with broad backgrounds over students with specialized technical preparation. The fact that companies provide appropriate in-service training helps account for low affirmative responses to certain technical courses.

It is noteworthy that under Business Administration five courses constituting 15 units of course-work are given majority responses of "1"; included are Accounting Principles, Human Relations, Introductory Economics, Management Principles and Production Supervision.

Two courses under the Communication category received a plurality of "1" responses but no majority.

Question 3:

"Based on four year preparation (which normally amounts to 124 units), what percentage of time ideally should be devoted to each of the following subject categories?"

a. General or Liberal Education
b. Communication skills
c. Mathematics
d. Science
e. Technical Subjects
f. Business Administration

Responses (by subject area) broken down into a range from 5% to 50%:

Percentage of Time/Subject	5%	10%	15%	20%	25%	30%	35%	40%	45%	50%
a. General or Liberal Education	13	25	15	33	14	15	1	6		7
b. Communication Skills	30	45	20	18	6	1		1		
c. Mathematics	12	58	27	19	7	1				
d. Science	18	40	23	22	10	4				
e. Technical Subjects		8	16	28	19	20	7	13		13
f. Business Administration	9	32	23	29	14	9	2	4		1

Comment:

The means and medians of the above categories are relevant if a "model" program is envisioned.*

	Mean	Median
a. General Education	20%	20%
b. Communication Skills	12%	10%
c. Mathematics	13%	10%
d. Science	14%	15%
e. Technical Subjects	25%	25%
f. Business Administration	18%	15%

*The totals do not add up exactly to 100% because some respondents used units rather than percentage values and others did not allocate evenly or completely.

Below is a further breakdown of responses according to the type or primary product.

	Type	5%	10%	15%	20%	25%	30%	35%	40%	45%	50%	Median %
General Education	Aero	4	3	5	4	2	4	1	2		2	20
	Chem	1	1	1	5	2	2					20
	Mfg	3	8	3	9	4	4		1		3	20
	Elec	5	12	5	3	2	3		1			10
	Food		1	1	11		1		1		2	20
	Misc				1	4	1		1			25
Total		13	25	15	33	14	15	1	6		7	
Communication Skills	Aero	7	14	6								10
	Chem	4	2	4	1							10
	Mfg	12	13	5	6	1						10
	Elec	6	15	3	7	1						10
	Food	1	1	2	3							15
	Misc				1	4	1		1			25
Total		30	45	20	18	6	1		1			
Mathematics	Aero	4	12	6	2	3						10
	Chem	1	8	1	1							10
	Mfg	2	19	8	4	3	1					10
	Elec	3	9	8	11	1						15
	Food		5	3								10
	Misc	2	5	1	1							10
Total		12	58	27	19	7	1					
Science	Aero	6	8	4	4	4						20
	Chem		4	3	3	1						15
	Mfg	3	16	5	7	3	1					10
	Elec	7	7	6	6	1	3					15
	Food		2	5	1							15
	Misc	2	3		1	1						10
Total		18	40	23	22	10	4					
Technical Subjects	Aero		3	4	5	4	4	2	2		3	25
	Chem		1		3	3	3	1			1	25
	Mfg		1	6	8	4	6	3	6		2	25
	Elec		1	2	9	6	5	1	3		5	25
	Food			3	1	1	1		1			20
	Misc		2	1	2	1	1		1		2	20
Total			8	16	28	19	20	7	13		13	
Business Administration	Aero	2	5	8	5	6	1					15
	Chem	2	1	2	3	1	2					20
	Mfg	4	9	8	11	2	3					15
	Elec		12	2	7	3	3	1	2			20
	Food	1	2	2	2	1						15
	Misc		3	1	1	1		1	2		1	20
Total		9	32	23	29	14	9	2	4		1	

Comments:

Corresponding to their higher scoring on the technical area, electronics companies are concentrated at the lower end of the scale on the general education classification. Manufacturing companies are somewhat spread out but tend toward the higher end. This correlates with responses in the attitudinal section of the survey, which shows manufacturing companies to have strong preference for broad background over more specialized training.

No significant pattern for communication skills is discernible. Manufacturing industries appear to be concentrated at a slightly lower level than other types.

In mathematics, electronics companies are concentrated higher than other types. The aerospace concentration was lower than would have been anticipated in light of its heavier engineering orientation.

Science showed a slightly higher allocation than mathematics for most classifications with the notable exception of electronics.

In technical subjects there is a noticeable spread for aerospace industries, suggesting the disparate needs of these companies.

Question 3 also invited respondents to comment on the amount of preparation in the five subject areas identified. The following are representative statements:

"The industrial technologist should not be as technically oriented as the engineer. However, he should have basic math and science."

* * * * *

"Industry can train specific skills but the employee needs a good background in fundamentals."

* * * * *

"The technology program should not attempt to make journeymen draftsmen out of students; shop skills can be acquired later in industry. Basic science, technical, and business administration subjects are hard to acquire outside college."

* * * * *

"The colleges should give a basic engineering core program and substitute business administration courses in lieu of advanced engineering courses."

* * * * *

"The industrial technologist must understand the problem to be solved, but of greater necessity are the tools that enable him to become the interface between engineering and production, company and customer, contractor and sub-contractors, and, finally, production and management. Emphasis should be placed on communication skills and ability to plan, organize, actuate and control."

* * * * *

"Obviously, if the individual desires to end up in administration, a larger percent of his preparation should be spent in business administration."

* * * * *

"We perform a great deal of in-house training as well as expect our people to go on for their master's degree. Thus, we look toward the bachelor's degree as being only the beginning of one's education and development."

"A new hire must come to us with better communication skills. 60 percent of our applicants cannot spell accurately and are slow readers."

* * * * *

"There is too much stress on physical education and liberal arts or humanities. These are important but can be acquired apart from the college curriculum. This now leaves inadequate time to acquire the technical subjects difficult to acquire after leaving college."

Question 4:

"What changes in needs and requirements for industrial technologists do you anticipate for the next five years?"

Response:

The following are representative statements:

"New advances by industry require corresponding changes in curriculum. The technologist will become more of a specialist in the automated world."

* * * * *

"We see the requirements for technical and administrative personnel to be increasing. Also human relation skills will be needed more than before."

* * * * *

"Many companies are just beginning to realize that there is an industrial technology major and will begin recruiting more IT graduates than ever before."

* * * * *

"We foresee a greater degree of specialization in the technical fields. The technologist will be required to have the ability to work with automated and computerized equipment."

* * * * *

"With current thinking in engineering education tending toward a five year first professional degree, there will be a tendency to consider the BS as a four-year technician degree."

* * * * *

"As manufacturing facilities become more highly mechanized, the need for people with broad technical background to run these operations becomes critical."

* * * * *

"There is a growing need within industry to fill the gap between the truly professional engineer and business administration trained graduate for a large range of positions that require comprehension of technical aspects of business as well as the business/financial aspects."

* * * * *

"We will need a practical yet sophisticated technologist who will be able to work and communicate with a more sophisticated management and scientist. We do not desire the industrial arts type of individual nor

Question 4 (cont'd)

one who found that he couldn't make the grade as an engineer or scientist. He is going to be working with complex systems and hardware. Yet he must be humanistic."

* * * * *

"None. They're already here, unrecognized. We're graduating engineers and misusing them. Probably we're cramming men into engineering molds without regard to fit. We need better evaluation and use of both requirements and resources."

* * * * *

"We consider this degree an important step in meeting the needs of a manufacturing operation. After design engineers this could be our strongest year-to-year need."

Question 5:

"Do any graduates of the California State Colleges now work as technologists for your firm?"

Response:

Seventy-two respondents, more than half of the companies completing the questionnaire, indicated a "yes" answer. Responses as to numbers of degree majors in different subject areas were often imcomplete, however. The following is summarized from data available.

Company Product	IA	IT	Engr.	Bus.	Other
Aero-Space	9	42	35		2
Chemical, Wood	4	6	8	3	
Manufacturing	5	14	27	54	2
Electronics	2	17	32	10	1
Food		5	5		
Miscellaneous	3	16	41	1	2
Total	23	100	148	69	7

Comment:

The conclusions to be drawn are:

1. A sizeable number of responding firms employ graduates of California State Colleges in technologist positions. However, not all persons so employed are industrial technology graduates.

2. Many engineers are presently working in positions that could be filled by persons trained as technologists.

3. Apparently industrial arts majors are not being pirated away from teaching in large numbers as some observers have speculated.

4. The fact that a substantial number of business graduates have been hired for technologist positions supports the inclusion of business courses in an industrial technology curriculum.

Question 6:

"Please check (✓) one or more applicable statements for each of the following items. The statements are not necessarily mutually exclusive."

For our purposes, we would recruit in terms of the following:

a. Hiring		Responses:
(1)	Prefer four-year **industrial** technology graduates.	86
(2)	Prefer four-year **engineering** technology graduates.	94
(3)	Prefer four-year **industrial** arts graduates.	8
(4)	Have no preference as to type of technology graduates.	13
(5)	See no need for technologists to receive more than two-year (junior college) preparation.	6
(6)	See a definite need for a person to hold a master's degree in industrial technology.	26
(7)	See little or no need for a person holding a master's degree in industrial technology.	65

b. Function

(1)	Distinguish between graduates of four-year industrial technology and engineering technology curriculums according to the duties performed.	63
(2)	Use graduates of four-year industrial technology and engineering technology curriculums interchangeably.	51

c. General Preparation

(1)	Recommend separate curriculums for industrial technologists and engineering technologists because the job duties of each are distinct.	63
(2)	Recommend that Engineering and Industrial Arts departments cooperate in developing a single curriculum for technologists.	50

d. Specific Preparation

(1)	Prefer technologists with a concentration in a specialized area, e.g. electronics, automotives, etc.	41
(2)	Prefer technologists with a broad background in two or more related areas of technology and business administration.	79

e. Degree Terminology

(1)	Prefer B.S. to B.A. degree-holders.	73
(2)	Have no preference between B.S. and B.A. degree-holders.	49

f. In-Service Training

(1)	Expect to provide appropriate in-service training.	111
(2)	Do not expect to provide in-service training.	13

g. Industrial Experience

(1)	Prefer technology graduates to receive industrial experience through cooperative work-study, internship or other type of arrangement.	72
(2)	Prefer technology graduates to have educational experience only, but including laboratory work.	22
(3)	Be willing to participate in cooperative work-study, internship or other type of educational arrangement with a nearby State College."	51

Comment:

Most of industry's preferences are clear-cut and decisive. The desire for broadly-trained technologists revealed in the responses to previous questions is reinforced here. Industry favors the B.S. over the B.A. degree. The need for employees with a master's degree in industrial technology is rejected. Companies want technology graduates to possess industrial experience as gained through cooperative work-study, internship, or other arrangement.

However, a few preferences are so evenly distributed as to require further interpretation. For example, while a slightly higher number of respondents differentiate industrial technologists from engineering technologists according to the duties performed on the job, a substantial number use the two types interchangeably; while a slightly higher number of respondents recommend separate curriculums for industrial technologists and engineering technologists, a sizeable number feel that a single, cooperative curriculum would meet their needs. In order to get a sharper focus on these relationships and on their implications, and, also, as a check on the degree of consistency maintained among the preferences expressed, the data were subjected to various refinements as follows.

REFINEMENT NUMBER 1: COMPARISON OF CERTAIN RESPONSES

Since a large number of respondents checked a preference for engineering technologists, either alone or in combination with industrial technologists, it is interesting to determine whether there is a relationship between the kind of educational background preferred and the specific kind of technologist preferred.

Listed below are six categories which show how the companies responded to questions (a 1) and (a 2) in conjunction with questions (d 1) and (d 2.)*

Question	Number of Responses:
a 1, a 2 and d 1 (IT & ET with specialized background)	20
a 1, a 2 and d 2 (IT & ET with broad background)	40
a 1 and d 1 (IT with specialized background)	4
a 1 and d 2 (IT with broad background)	17
a 2 and d 1 (ET with specialized background)	13
a 2 and d 2 (ET with broad background)	17

(Also 4 companies checked both (d1) and (d2), indicating need for both broad and specialized backgrounds).

*Note: a 1 – "Prefer four-year **industrial** technology graduates;" a 2 – "Prefer four-year **engineering** technology graduates;" d 1 – "Prefer technologists with a concentration in a specialized area, e.g. electronics, automotives, etc.;" d 2 – "Prefer technologists with broad background in two or more related areas of technology and business administration."

Comment:

Those companies which checked a preference for both industrial technologists and engineering technologists also showed a 2 to 1 preference for broad over specialized training. Significantly, however, those companies which checked a preference for industrial technologists only, showed more than a 4 to 1 preference for broad over specialized training. This contrasts with those companies which checked a preference for engineering technologists only; they showed little more than a 1 to 1 preference for broad over specialized training.

It would appear, then, that companies prefer industrial technologists who are broadly trained for certain positions and engineering technologists who have broad training and/or specialization for other positions. That is, when a company thinks of hiring an industrial technologist, it has in mind a person with enough breadth of background to move into managerial production-oriented positions; when it considers an engineering technologist, it expects a more skill-oriented person. However, companies still desire a certain breadth of background even from the more specialized types of employees.

REFINEMENT NUMBER 2: COMPARISON OF RESPONSES ACCORDING TO TYPE OF COMPANY

	Question		Aerospace	Chemicals, Wood, Glass	Manufacturing	Electronics	Food	Miscellaneous	Total
(Hiring)	a	1	16	7	28	22	7	6	86
		2	21	9	26	25	5	8	94
		3	2	0	1	1	1	3	8
		4	1	4	3	2	1	2	13
		5	0	1	1	2	1	1	6
		6	9	0	6	7	1	3	26
		7	12	8	24	13	5	3	65
(Function)	b	1	18	4	17	14	3	7	63
		2	6	9	15	15	4	2	51
(General Preparation)	c	1	14	4	22	13	3	7	63
		2	10	6	11	14	5	4	50
(Specific Preparation)	d	1	7	3	8	17	1	5	41
		2	18	7	27	16	7	4	79
(Degree Terminology)	e	1	10	6	26	20	5	6	73
		2	13	5	13	10	4	4	49
(In Service Training)	f	1	21	11	36	27	5	11	111
		2	3	1	2	4	3	0	13
(Industrial Experience)	g	1	14	6	22	16	6	8	72
		2	5	1	8	7	0	1	22
		3	12	6	19	10	1	3	51

Comment:

1. A relatively high number of respondents indicate preferences for both industrial technology and engineering technology graduates. Manufacturing and food processing companies show a slight preference for industrial technology graduates, whereas aerospace, chemicals-wood and electronics companies favor engineering technology graduates.

2. Responses to questions a (6) and (7) regarding the need for master's degrees in industrial technology show a general 2-1/2 to 1 rejection of the graduate degree.

3. Responses to questions b (1) and b (2) are designed to determine whether the respondent distinguishes between engineering technology and industrial technology backgrounds in placing an employee. Aerospace companies apparently do see a distinction which relates to the duties performed. However, a large number of other companies use industrial technology and engineering technology graduates interchangeably.

4. Responses to questions c (1) and c (2), regarding the merits of a separate or combined curriculum for industrial and engineering technologists, show that aerospace and manufacturing industries favor separate curricula. Manufacturing's two-to-one preference here is interesting in light of its almost even preference on the previous question.

5. Questions d (1) and d (2) asked respondents to indicate whether they preferred technologists with specialized concentrations or with broad backgrounds. Electronics industries show a slight preference for technologists with specialized concentrations. The other identifiable categories, however, show preferences for technologists with broad backgrounds: Aerospace, 2-1/2 to 1; Chemicals, over 2 to 1; Manufacturing, 3-1/2 to 1; Food, 7 to 1. These breakdowns are fairly consistent with responses to question 3 of the survey relating to allocation of time to different subject areas.

6. The results of question f (1) show that almost all companies expect to provide appropriate in-service training. A large number of companies also indicate they would be willing to participate in cooperative work-study, internship or other arrangements with the State Colleges.

REFINEMENT NUMBER THREE: COMPARISON OF RESPONSES ACCORDING TO SIZE OF COMPANY

	Question		Small	Medium	Large
(Hiring)	a	1	28	27	29
		2	34	34	26
		3	2	4	2
		4	1	5	7
		5	4	0	2
		6	8	8	8
		7	22	23	20
(Function)	b	1	28	22	15
		2	16	17	19
(General Preparation)	c	1	28	23	11
		2	17	11	21
(Specific Preparation)	d	1	18	16	10
		2	28	22	25
(Degree Terminology)	e	1	27	25	18
		2	19	12	16
(In Service Training)	f	1	39	32	33
		2	5	7	2
(Industrial Experience)	g	1	26	23	18
		2	9	7	6
		3	14	17	13

Comment:

The responses to questions (b 1) and (b 2) show that small and medium-sized companies tend to distinguish between graduates of four-year industrial technology and engineering technology curricula according to the duties performed. Large companies, however, tend to use graduates of four-year industrial technology and engineering technology curricula interchangeably.

Questions (c 1) and (c 2) reveal similar distinctions; small and medium-sized companies generally prefer separate curricula for industrial technologists and engineering technologists, whereas large companies show a preference for a single curriculum for both types of technologists. There is a significant difference in the responses to questions (c 1) and (c 2) according to the categories established. That is, small and medium-sized companies are almost 2 to 1 in favor of separate curricula, whereas large size companies are almost 2 to 1 in favor of a single, cooperatively developed curriculum.

This trend is reinforced by the responses to questions (d 1) and (d 2): 71 percent of the large companies preferred technologists with broad backgrounds compared to 58 percent for medium-sized companies and 60 percent for small companies. Also, in questions (e 1) and (e 2), large companies show an almost even distribution in having no preference between B.S. or B.A. degree holders. Small and medium-sized companies, on the other hand, show a marked preference for B.S. degree holders.

These results suggest that larger companies, because of their size and number of positions, and also perhaps because of more extensive and sophisticated in-service training programs, do not require an employee to have as specialized a background as do smaller companies.

Since the great majority of technology graduates are likely to be employed in large companies, their preferences should carry more import than their representation in the survey allows.

Question 6 also called on the respondent to modify or comment on any of the preferences he checked. The following statements are representative:

> "We have found Industrial technology to be a very flexible major. We need specialists and generalists."

* * * * *

> "Our answer to 6.d. (specialization desired) may seem to be in conflict with other answers indicating broad training. The reason 6.d. was answered that way was for "hiring in" an applicant needs a specific skill to get started. Industry needs to re-evaluate their hiring practices. We tend to philosophize one way and hire another."

* * * * *

> "We believe industrial technology should be in the Engineering Division rather than an Industrial Arts Department. The level of the science and engineering courses should be engineering oriented even though developed for industrial technology students."

Question 7:

Respondents were invited to make any general comment they wished to.

Response:

The following statements are representative.

"Some of the two-year institutions are offering excellent programs for industrial technicians, which are also a requirement of industry but on a lower level. The name 'industrial technologist' bears a connotation to the two-year program. Another name such as 'industrial administration' might be more descriptive of the resultant careers of these students."

* * * * *

"Inter-personal relationships are very important, but there is no substitute for technical competence."

* * * * *

"There are mixed reactions to the industrial technology programs in our company. One faction would say, 'Why settle for an industrial technologist if you can get an engineer?' The other faction accepts the fact that 'We can't get enough engineers and are willing to readjust work assignments to accommodate the less academic background of the industrial technologist'."

* * * * *

"It becomes increasingly difficult to evaluate prospective employees' educational background with so many degrees with great similarity. Rather than industrial technology, why not industrial engineering with a minor in business?"

* * * * *

"Our main need is engineers. If an industrial technology graduate has strong enough background in the technical subjects, we might be able to use him. He would be competing for advancement primarily with engineers, however."

* * * * *

"California schools do not graduate enough industrial technologists at either the associate or bachelor's degree levels. Our company recruits in neighboring states for both. Last year 4.8 percent of our employment offers went to industrial technology graduates–next year 10 percent."

ATTACHMENT A

Companies Surveyed

1.	Aerojet-General Corporation +	El Monte
2.	Aeroquip Corporation, Marman Division	Los Angeles
3.	Aerospace Corporation +	El Segundo
4.	Air Reduction Pacific Company	San Francisco
5.	Airesearch Manufacturing Company *	Los Angeles
6.	Aluminum Corporation of America *	Los Angeles
7.	Amax Aluminum-Mill Products	Riverside
8.	Amelco Semiconductor	Mountain View
9.	American Can Company *	Los Angeles
10.	American Cement Corporation *	Los Angeles
11.	American Crystal Sugar Company	San Mateo
12.	American Electric	Paramount
13.	American Electronics, Incorporated *	Fullerton
14.	American Machine & Foundry Company	Los Angeles
15.	American Pipe and Construction Company	Monterey Park
16.	American Potash & Chemical Corporation *	Los Angeles
17.	American Standard Industrial Division *	Los Angeles
18.	American Yearbook Company	Visalia
19.	Ampex Corporation *	Redwood City
20.	Applied Research Laboratories *	Sunland
21.	Armco Steel Corporation *	Long Beach
22.	Armstrong Rubber Company *	Hanford
23.	Arrowhead Products	Los Alamitos
24.	Astrodata, Incorporated	Anaheim
25.	Atlantic Research Corporation	Costa Mesa
26.	Atlantic Richfield Company	Los Angeles
27.	Atlas Coverall & Uniform Supply Company	Los Angeles
28.	Atomics International, Division of North American Aviation, Incorporated *	Canoga Park
29.	Babcock Electronics	Costa Mesa
30.	Baker Oil Tools, Incorporated *	Los Angeles
31.	Basalt Rock Company, Incorporated	Napa
32.	Bendix Corporation	North Hollywood
33.	Bermite Powder Company	Saugus
34.	Bertea Corporation	Irvine
35.	Bethlehem Steel *	San Francisco
36.	B. F. Goodrich *	Los Angeles
37.	Bio-Rad Laboratories *	Richmond
38.	Borg-Warner Corporation	Santa Ana
39.	Bourns, Incorporated	Riverside
40.	Braun CF & Company +	Alhambra
41.	Bunker-Ramo	Canoga Park
42.	Burroughs Corporation	Pasadena
43.	Byron Jackson, Incorporated	Long Beach
44.	Byron-Jackson Pumps *	Los Angeles
45.	Cadillac Gage Company *	Costa Mesa
46.	California Canners and Growers *	San Francisco
47.	California Computer Products, Incorporated	Anaheim
48.	California Packing Corporation	San Francisco
49.	Capitol Records, Incorporated *	Los Angeles
50.	Carlisle & Company *	Los Angeles
51.	Carnation Company *	Los Angeles

52.	Caterpillar Tractor Company *	San Leandro
53.	Challenge-Cook Brothers, Incorporated	La Mirada
54.	Chevron Chemical Company +	San Francisco
55.	Chicago Telephone of California *	South Pasadena
56.	Cinch-Graphic Division *	Los Angeles
57.	Clary Corporation	San Gabriel
58.	Clayton Manufacturing Company	El Monte
59.	Cohu Electronics, Incorporated	San Diego
60.	Collins Radio	Newport
61.	Conam Services +	Long Beach
62.	Consolidated Electrodynamics Corporation +	Pasadena
63.	Consolidated Film Industries	Los Angeles
64.	Consolidated Freightways	Menlo Park
65.	Container Corporation of America *	San Francisco
66.	Continental Can Company	San Francisco
67.	Continental Can Company, Incorporated	San Pedro
68.	Continental Device Corporation *	Hawthorne
69.	Cox L M Manufacturing Company	Santa Ana
70.	Crown Zellerbach Corporation	San Francisco
71.	Cubic Corporation *	San Diego
72.	Cutter Laboratories +	Berkeley
73.	Dalmo Victor Company +	Belmont
74.	Dana Laboratories *	Irvine
75.	Daniel Industries, Incorporated *	Los Angeles
76.	Deutsch Company, The	Los Angeles
77.	Dole Company *	San Jose
78.	Donaldson Company *	San Fernando
79.	Douglas Aircraft Company, Incorporated *	Huntington Beach
80.	Dow Chemical Company, The +	San Francisco
81.	Ducommun, Incorporated *	Los Angeles
82.	Dymo Industries, Incorporated	Emeryville
83.	Eimac	San Carlos
84.	Eldon Industries, Incorporated	Hawthorne
85.	Electra Motors	Anaheim
86.	Electronic Engineering Company *	Santa Ana
87.	Electronic Memories *	Hawthorne
88.	Electro-Optical Systems, Incorporated *	Pasadena
89.	Ets-Hokin Corporation +	San Francisco
90.	Factory Insurance Association	Los Angeles
91.	Factory Mutual Engineering Division *	Pasadena
92.	Federal Pacific Electric Company *	Burlingame
93.	Federal Sign and Signal Corporation *	Los Angeles
94.	Firestone Tire & Rubber Company	Los Angeles
95.	Folger Coffee Company	San Francisco
96.	Fluor Corporation, Limited *	Los Angeles
97.	Ford Motor Company *	Pico Rivera
98.	Ford Motor Company *	San Jose
99.	Foremost Foods Company *	San Francisco
100.	Friden, Incorporated	San Leandro

101.	Fruehauf Corporation	Fullerton
102.	Gaffers & Sattler	Los Angeles
103.	General Atomic	San Diego
104.	General Cable Corporation *	San Francisco
105.	General Dynamics *	Pomona
106.	General Electric Company *	San Francisco
107.	General Electric Company *	San Jose
108.	General Foods Corporation *	Modesto
109.	General Metals Corporation	Burbank
110.	General Mills, Incorporated *	Palo Alto
111.	General Motors *	Fremont
112.	General Motors *	South Gate
113.	General Precisions Systems, Incorporated	Sunnyvale
114.	General Telephone Company of California *	Santa Monica
115.	Giannini Controls Corporation	Duarte
116.	Goodyear Tire & Rubber Company *	Los Angeles
117.	Grove Valve and Regulator	Oakland
118.	Hardman Tool & Engineering *	Los Angeles
119.	Harvey Aluminum	Torrance
120.	Herald Publishing Company, The	Compton
121.	Hexcel Products, Incorporated +	Berkeley
122.	Hi-Shear Corporation +	Torrance
123.	Hoffman Electronics Corporation	El Monte
124.	Honeywell	Gardena
125.	Honeywell California Ordinance Center	West Covina
126.	Hopper Machine Works, Incorporated	Bakersfield
127.	Houston Fearless Corporation	Los Angeles
128.	H. S. Crocker Company, Incorporated	San Bruno
129.	Hughes Aircraft Company	Canoga Park
130.	Hughes Aircraft Company *	Fullerton
131.	Hughes Aircraft Company *	Los Angeles
132.	Hunt Wesson Foods, Incorporated *	Fullerton
133.	Hycon Manufacturing Company *	Monrovia
134.	Hydraulic Research & Manufacturing Company	Burbank
135.	Hydro-Aire	Burbank
136.	Hyland Labs	Los Angeles
137.	I B M Corporation	San Jose
138.	International Business Machines *	Los Angeles
139.	International Pipe and Ceramics Corporation	Los Angeles
140.	International Rectifier	El Segundo
141.	Interstate Electronics *	Anaheim
142.	Interstate Engineering Corporation +	Anaheim
143.	I-T-E Circuit Breaker Company	Los Angeles
144.	ITT Cannon Electric *	Los Angeles
145.	ITT Controls and Instruments Division	Glendale
146.	ITT Gilfillan *	Van Nuys
147.	ITT Jabsco, Incorporated	Costa Mesa
148.	ITT Jennings Radio Manufacturing Corporation *	San Jose
149.	Johns-Manville Sales Corporation	San Francisco
150.	Kaiser Aluminum & Chemical Corporation +	Oakland
151.	Kaiser Steel Corporation *	Oakland

152.	Kerr Glass Manufacturing Corporation	Los Angeles
153.	Kimberly-Clark Corporation	Orange
154.	Kirk Engineering Company	Los Angeles
155.	Kirkhill Rubber Company *+	Brea
156.	Kirk Morris P Son, Incorporated	Los Angeles
157.	Kobe, Incorporated *	Huntington Park
158.	Kwikset Division of Emhart Corporation	Anaheim
159.	Leach Corporation	San Marino
160.	Lear Siegler, Incorporated	Anaheim
161.	Lindberg Hevi-Duty	Downey
162.	Lindberg Steel Treating Company	Los Angeles
163.	Link-Belt Division FMC Corporation *	San Francisco
164.	Litton Industries, Incorporated +	Beverly Hills
165.	Litton Industries, Incorporated *	Culver City
166.	Livermore Radiation Laboratory	Livermore
167.	Lockheed Missiles & Space Company *	Sunnyvale
168.	Lockheed Propulsion Company *	Redlands
169.	Loud Company	Pomona
170.	LTV Ling Altec, Incorporated	Anaheim
171.	Lufkin Foundry and Machine Company	Los Angeles
172.	Lynch Communications	San Francisco
173.	McClellan Air Force Base *	Sacramento
174.	McCormick Selph A *	Hollister Airport
175.	McCulloch Corporation	Los Angeles
176.	McDonnell-Douglas Company *	Long Beach
177.	Marquardt Corporation	Pomona
178.	Matson Navigation Company	San Francisco
179.	Mattell, Incorporated *	Hawthorne
180.	M C S Corporation	Monrovia
181.	Menasco Manufacturing Company *	Burbank
182.	Metal-Craft Product Company *	Lynwood
183.	Microdot, Incorporated	South Pasadena
184.	Mobil Oil Company +	Los Angeles
185.	M. Tech. Corporation	Pomona
186.	National Cash Register *	Hawthorne
187.	National Seal Division *	Downey
188.	National Seal Division *	Redwood
189.	National Steel and Shipbuilding Company +	San Diego
190.	Nordskog Company, Incorporated	Van Nuys
191.	Norris Industries	Los Angeles
192.	North American Aviation, Incorporated *	Anaheim
193.	North American Aviation, Incorporated *	El Segundo
194.	Northrop Corporation *	Ventura
195.	Northwest Paper Company, The	Pomona
196.	O'Keefe & Merritt Company *	Los Angeles
197.	Ordinance Division	San Jose
198.	Owens-Corning Fiberglass Corporation	Santa Clara
199.	Owens-Illinois *	Los Angeles
200.	Owens-Illinois	San Jose
201.	Paceco	Alameda

202.	Pacific Gas & Electric Company *	Fresno
203.	Pacific Gas & Electric Company *	San Francisco
204	Pacific Pipe Line Construction Company	Montebello
205.	Pacific Press, Incorporated *	Los Angeles
206.	Pacific Scientific Company *	Anaheim
207.	Pacific Telephone & Telegraph Company	San Francisco
208.	Pacific Telephone Company	Sacramento
209.	Pacific Tube	Los Angeles
210.	Pacific Valves, Incorporated	Long Beach
211.	Pacific Vegetable Oil Corporation	San Francisco
212.	Packard-Bell Electronics Corporation *	Los Angeles
213	Packard-Bell Electronics, Space-Systems Division	Newbury Park
214.	Paper Mate Manufacturing Company	Santa Monica
215.	Parker Aircraft	Los Angeles
216.	Parker Hannifin Corporation	Montebello
217.	Peerless Pump Hydrodynamics *	Los Angeles
218.	Peterson Manufacturing Company, A E	Glendale
219.	Petrolane Gas Service, Incorporated	Long Beach
220.	Phelps Dodge Copper Products Corporation +	Los Angeles
221.	Philco-Ford, Aeronutronic Division	Newport Beach
222.	Philco-Ford Microelectronics *	Santa Clara
223.	Philco-Ford Space & Reventry Systems Division *	Newport Beach
224.	Pickering Lumber Corporation +	
225.	P P G Industries *	Fresno
226.	Precision Sheet Metal, Incorporated	Los Angeles
227.	Producers Cotton Oil Company +	Fresno
228.	Purex Corporation, Limited	Lakewood
229.	Rapid Blue Print Company +	Los Angeles
230.	Raychem Corporation *	Menlo Park
231.	Raytheon Company *	Oxnard
232.	Raytheon Computer *	Santa Ana
233.	Reuland Electric Company	City of Industry
234.	Revell, Incorporated	Venice
235.	Revere-Mincom Division *	Camarillo
236.	Robertshaw Controls Company	Long Beach
237.	Rocketdyne, Division of North American	Canoga Park
238.	Rohr Corporation	Chula Vista
239.	Royal Industries, Incorporated	Santa Ana
240.	St. Regis Paper Company *	Los Angeles
241.	San Fernando Electric Manufacturing Company	San Fernando
242.	San Francisco Bay Naval Shipyard	Vallejo
243.	San Jose Steel Company, Incorporated	San Jose
244.	Sargent-Fletcher Company	El Monte
245.	Sargent Industries	Hungtington Park
246.	Schlage Lock Company *	San Francisco
247.	S D S Data Systems	Pomona
248.	Sealright Company, Incorporated	Los Angeles
249.	Shell Companies	Los Angeles
250.	Signetics Corporation *	Sunnyvale
251.	Simpson Timber Company	Arcata
252.	Smith Industries International, Incorporated	Whittier

253.	Solar *	San Diego
254.	Soule Steel Company *	San Francisco
255.	Southern Pipe & Casing Company	Irwindale
256.	Space-General Corporation	El Monte
257.	Spectrol Electronics Corporation	City of Industry
258.	Speedspace Corporation *	Santa Rosa
259.	Square D Company	Los Angeles
260.	Stainless Steel Products, Incorporated *	Burbank
261.	Standard Register Company, The *	Oakland
262.	Statham Instrument, Incorporated	Los Angeles
263.	Stauffer Chemical Company	San Francisco
264.	Systron-Donner Corporation *	Concord
265.	Technicolor Corporation	Los Angeles
266.	Teledyne Telemetry Company *	Los Angeles
267.	The Nestle Company, Incorporated *	Salinas
268.	Todd Shipyards Corporation *	San Pedro
269.	Union Carbide	El Monte
270.	United Airlines *	San Francisco
271.	United States Geological Survey *	Menlo Park
272.	U. S. Naval Civil Engineering Laboratory *	Port Hueneme
273.	U. S. Naval Missile Center	Point Mugu
274.	U. S. Naval Weapons Center	China Lake
275.	U. S. Plywood Corporation	Tustin
276.	U. S. Steel Corporation *	San Francisco
277.	United Technology Center	Sunnyvale
278.	Universal Engineered Systems	Walnut Creek
279.	Varian Associates *	Palo Alto
280.	Veritron West, Incorporated *	Chatsworth
281.	Voi-Shan Manufacturing Company *	Culver City
282.	Voit W. J. Rubber Corporation *	Santa Ana
283.	Watkins-Johnson Company +	Palo Alto
284.	Weber Aircraft	Burbank
285.	Western Gear Corporation *	Lynwood
286.	Westinghouse Electric Corporation *	Los Angeles
287.	Westinghouse Electric Corporation *	Sunnyvale
288.	Whittaker Corporation *	Los Angeles
289.	Yuba Industries, Incorporated	San Francisco
290.	Zinsco Electrical Products	Los Angeles

* Questionnaire returned, completed

\+ Questionnaire returned, uncompleted ("do not employ industrial technologists")

ATTACHMENT B

The California State Colleges
5670 WILSHIRE BOULEVARD • LOS ANGELES, CALIFORNIA 90036

Office of The Chancellor

August 16, 1968

Mr. John Doe
Vice President for Industrial Relations
ABC Corporation
500 Van Ness Avenue
San Francisco, California 94105

Dear Mr. Doe:

One way in which the California State Colleges are trying to serve a dynamic industrial world–a world which you share and influence–is by preparing four-year technologists. Four State Colleges currently offer a degree major in Industrial Technology, namely those at Fresno, Long Beach, San Jose and San Luis Obispo, and at least three other Colleges have requested approval for new programs. Before expansion can be justified, however, a formal assessment must be made of the import and effectiveness of these programs. Do leading industries such as yours need and desire baccalaureate-holding technologists? What types of positions do they fill? What kind of training and competences are most satisfactory?

The Office of the Chancellor, with the aid of a faculty consultative committee, is undertaking a comprehensive study of Industrial Technology. We earnestly solicit your cooperation in providing information which will help us prepare students better to meet your needs. You can do this by completing the attached questionnaire in as much depth as possible and returning it promptly in the self-addressed, stamped envelope provided.

We would certainly be grateful to you for your assistance in this project.

Sincerely,

Gerhard Friedrich
Acting State College Dean
Academic Planning

GF:lin

Enclosure

ATTACHMENT C

QUESTIONNAIRE CONCERNING INDUSTRY'S NEED AND USE FOR INDUSTRIAL TECHNOLOGY GRADUATES

For their purposes, educators frequently make distinctions in curricular terminology and job classifications which may or may not have meaning for industry. Educators try to distinguish between technicians and technologists, and further between industrial technologists, engineering technologists, and engineers, and to develop separate programs for each type.

This questionnaire deals primarily with graduates of four-year industrial technology programs. In the State Colleges, industrial technology programs were created and nurtured by Industrial Arts Departments; although separate from programs designed to prepare teachers of industrial arts in the public schools, they are still administered by or allied to Industrial Arts Departments. They have no connection with Engineering Departments.

No universally accepted definition of the industrial technologist exists, but to assure that our understandings will be similar and the responses to the questionnaire thus more meaningful, the following descriptive definition will be used:

> The industrial technologist is a college graduate who is associated with managerial and scientific activities in the industrial field. He has a solid background in mathematics, physical sciences, human relations, and extensive educational experience in technical theory and manipulative skills in such fields of specialization as electricity, electronics, drafting, graphic arts, metal working, woodworking, plastics and power technology. He works in the mid-ground between engineering and business administration, focusing on the applied aspects of industrial processes and personnel leadership. He supervises and manages people, coordinating their efforts in the utilization of materials and machines in producing and distributing industrial products.

Because the relationship of industrial technology programs to those called engineering technology and administered by Engineering Departments is often uncertain, you will be asked to indicate some preferences aimed at clarifying the relationship between the two.

Please Check:

____ Do not employ technologists nor anticipate doing so in the future.

____ Would like a copy of The study.

____
Name, Title of Person Completing Questionnaire

____
Name of Firm

____
Address of Firm

________________ ________
Primary Activity or product — Number of Employees

1. a. Please check which of the following positions industrial technology graduates most likely would fill in your firm.

(1)____ Production Management
(2)____ Purchasing
(3)____ Quality Control
(4)____ Sales
(5)____ Logistics
(6)____ Field Service
(7)____ Job Development and Training
(8)____ Market Research
(9)____ Other (Specify)
____
____

b. Asterisk (*) the categories above for which hiring is especially difficult.

c. List below the job titles which are most commonly assigned.

2. With regard to the specific preparation an industrial technologist should receive, please place the appropriate number in the blank preceding each field below:

1 - Necessary for adequate job performance

2 - Desirable for adequate job performance

3 - Unnecessary for adequate job performance

Asterisk (*) all the "1" fields to which greater attention should be given in preparation than is now the case.

Mathematics

____ Arithmetic
____ Algebra
____ Trigonometry
____ Descriptive Geometry
____ Analytic Geometry
____ Introductory Calculus
____ Applied Calculus
____ Differential Equations
____ Statistics
____ Computer Programing
____ ________________
____ ________________

Science

____ Physics
____ Statics
____ Dynamics
____ Atomic Physics
____ Inorganic Chemistry
____ Organic Chemistry
____ Physical Chemistry
____ Thermodynamics
____ Introductory Biology
____ Introductory Geology
____ ________________
____ ________________

Technical

____ Introductory Drafting
____ Blueprint Reading

Business Administration

____ Accounting Principles
____ Marketing Principles

5. Do any graduates of the California State Colleges now work as technologists for your firm?

_____ YES   _____ NO

If YES, in which of the following areas do they hold their baccalaureate degrees, what is the total number employed in each category, and what is your rating of their overall training and performance?

Area	Number	Rating (Please Check) Adequate	Good	Excellent
Industrial Arts	_____	_____	_____	_____
Industrial Technology	_____	_____	_____	_____
Engineering	_____	_____	_____	_____
Business	_____	_____	_____	_____
Other (Specify)	_____	_____	_____	_____

If it is not possible for you to provide the detailed information requested above, please make appropriate general statements.

6. Please check ( ) one or more applicable statements for each of the following items. The statements are not necessarily mutually exclusive.

For our purposes, we would:

a. **Hiring:**

(1)_____ Prefer four-year industrial technology graduates.

(2)_____ Prefer four-year engineering technology graduates.

(3)_____ Prefer four year industrial arts graduates.

_____ Advanced Drafting
_____ Basic Mfg. Processes
_____ Machine Tool Skills
_____ Tool Design
_____ Understanding of Mechanical Systems
_____ Design of Mechanical Systems
_____ Design of Electrical Systems
_____ Strength of Materials
_____ Kinematics
_____ Electrical Power
_____ Electronic Power
_____ Electronic Design
_____ Numerical Control
_____ Heat Transfer
_____ Fluid Flow
_____ Plastics Technology
_____ Graphic Arts (Printing)
_____ Woodworking
_____ Power Technology (Engines)
_____ Mechanical Power Transmission
_____ Photography
_____ Product Evaluation
_____ Time & Motion Study
_____ Engineering Economy
_____ Assurance or Control
_____ Advanced Quality Assurance or Control
_____ Industrial Design
_____ ____________________
_____ ____________________

_____ Human Relations
_____ Introductory Economics
_____ Advanced Economics
_____ Business Law
_____ Financial Management
_____ Management Principles
_____ Industrial Relations
_____ Customer Relations
_____ Industrial Marketing
_____ Sales Management
_____ Operations Research
_____ Production Supervision
_____ Industrial Purchasing

Communications

_____ Public Speaking
_____ Technical Writing
_____ Audio-Visual Methods
_____ Psychology
_____ ____________________
_____ ____________________

3. Based on four-year preparation (which normally amounts to 124 units), what percentage of time ideally should be devoted to each of the following subject categories?

a. General or Liberal Education
b. Communication Skills
c. Mathematics
d. Science
e. Technical Subjects
f. Business Administration

100% Total

Comments:

4. What changes in needs and requirements for industrial technologists do you anticipate for the next five years?

For our purposes, we would:

a. Hiring: (cont'd)

(4)______ Have no preference as to type of technology graduates.

(5)______ See no need for technologists to receive more than two-year (junior college) preparation.

(6)______ See a definite need for a person to hold a master's degree in industrial technology.

(7)______ See little or no need for a person holding a master's degree in industrial technology.

b. Function:

(1)______ Distinguish between graduates of four-year industrial technology and engineering technology curriculums according to the duties performed.

(2)______ Use graduates of four-year industrial technology and engineering technology curriculums interchangeably.

c. General Preparation:

(1)______ Recommend separate curriculums for industrial technologists and engineering technologists because the job duties of each are distinct.

(2)______ Recommend that Engineering and Industrial Arts Departments cooperate in developing a single curriculum for technologists.

d. Specific Preparation:

(1)______ Prefer technologists with a concentration in a specialized area, e.g. electronics, automotives, etc.

(2)______ Prefer technologists with a broad background in two or more related areas of technology and business administration.

e. Degree Terminology:

(1)______ Prefer B.S. to B.A. degree-holders.

(2)______ Have no preference between B.S. and B.A. degree-holders.

For our purposes, we would:

f. **In-Service Training:**

(1)______ Expect to provide appropriate in-service training.

(2)______ Do not expect to provide in-service training.

g. **Industrial Experience:**

(1)______ Prefer technology graduates to receive industrial experience through cooperative work-study internship or other type of arrangement.

(2)______ Prefer tech-ology graduates to have educational experience only, but including laboratory work.

(3)______ Be willing to participate in cooperative work-study, internship or other type of educational arrangement with a nearby State College.

Please feel free to modify or comment further in this space:

7. Please use this space to make any general comments you wish to.

THE CALIFORNIA STATE COLLEGES
5670 Wilshire Boulevard
Los Angeles, California 90036

APPENDIX E

Charts Developed by B. M. Cunningham, "Applied Sciences and Industry," Bradley University, Peoria, Illinois, April 1966.

Chart I: Divisions and Functions of Construction and Manufacturing Industries
Chart II: Source of Educational Content for Curricula in Industrial Technology

APPENDIX E

Charts Developed by B. M. Cunningham, "Applied Sciences and Industry," Bradley University, Peoria, Illinois, April 1966.

Chart I: Divisions and Functions of Construction and Manufacturing Industries

Chart II: Source of Educational Content for Curricula in Industrial Technology

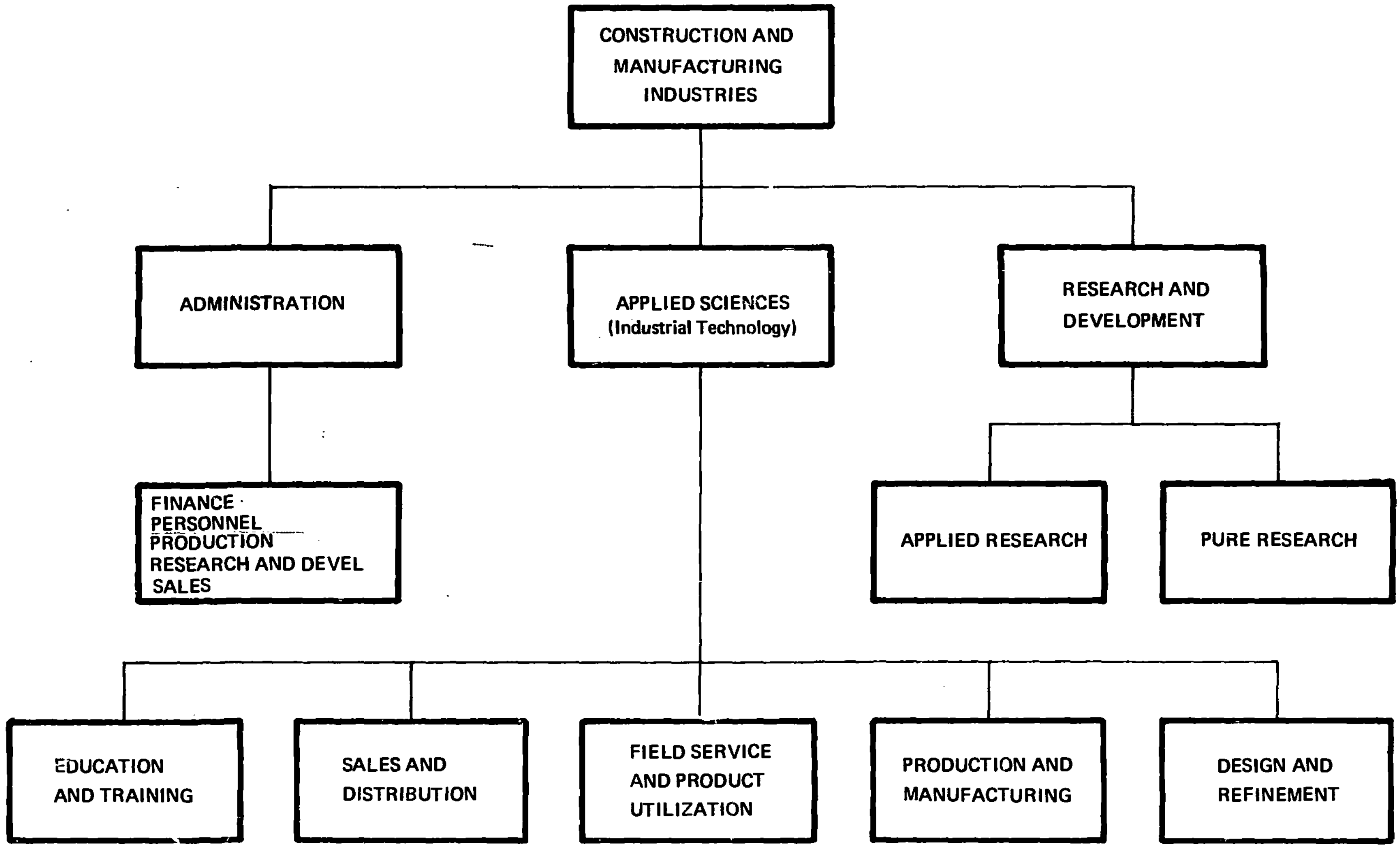

CHART 1. DIVISIONS AND FUNCTIONS OF CONSTRUCTION AND MANUFACTURING INDUSTRIES

Source: "Applied Sciences in Education and Industry" by Berly M. Cunningham

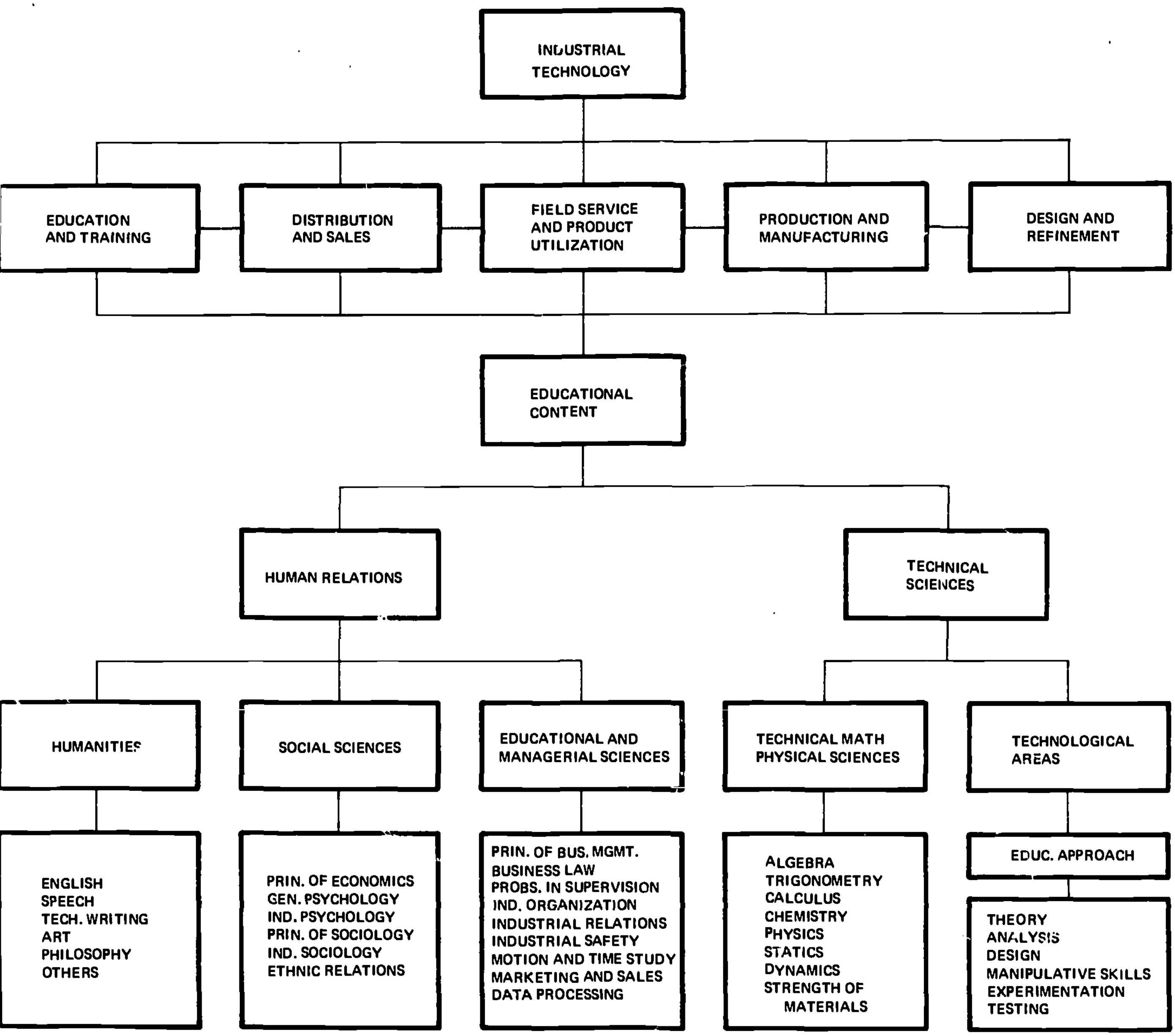

CHART II. SOURCE OF EDUCATIONAL CONTENT FOR CURRICULA IN INDUSTRIAL TECHNOLOGY

Source: "Applied Sciences in Education and Industry" by Beryl M. Cunningham

APPENDIX F

Breakdown and Summary of Requirements, Industrial Technology Programs, California State Polytechnic College, San Luis Obispo, California State College, Long Beach, Fresno State College, and San Jose State College, 1969-70.

CALIFORNIA STATE COLLEGE, LONG BEACH
(Semester Courses)

Construction Technology Option

Mathematics
- College Algebra and Elementary Functions (4)
- Survey of Analytic Geometry and Calculus (4)

Science
- Fundamentals of Chemistry (4)
- General Physics (4-4)

Business/Economics
- Fundamentals of Economics (3)
- Elementary Accounting (3)
- Business Law (3)
- Real Estate Principles (3)
- Industrial Purchasing (3)

Technical
- Surveying and Mapping (3)
- Industrial and Architectural Drafting and Design (7)
- Construction (7)
- Materials of Industry (3)
- Industrial Electricity (3)
- Mechanics of Materials (2)
- Industrial Safety (2)
- Foremanship and Supervision (3)
- Construction Cost Estimating (3)
- Landscape Design and Drawing (3)
- Plant Layout and Planning (3)
- Industrial Proposals and Specifications (3)
- Utilities Design (3)
- Site Analysis and Development (3)
- Construction Methods (3)
- Electives (7)

Electronics Technology Option

Mathematics/Science: Same as for Construction Technology above.

Business/Economics
- Fundamentals of Economics (3)
- Elementary Accounting (3)
- Introduction to Statistical Inference (3)
- Job Analysis and Evaluation (3)

Technical
- Industrial Drawing (3)
- Metal Processing (3)
- Materials of Industry (3)
- Kinematics and Machine Design (2)
- Process of Industry (3)
- Industrial Safety (2)
- Foremanship and Supervision (3)
- Electronic Circuit Analysis (2)
- Electronic Testing and Troubleshooting (2)
- Production Analysis (2)
- Industrial Proposals Specifications (3)
- Production Technology (2)
- Electives (9)

Manufacturing Technology Option

Mathematics/Science: Same as for Construction Technology and Electronics Technology above.

Business/Economics: Same as for Electronics Technology above.

Technical
- Tool and Machine (7)
- Machine Shop (6)
- Mechanics of Materials (2)
- Kinematics and Machine Design (2)
- Metrology (3)
- Heat Treating (2)
- Tool Design (3)
- Foundry Technology (2)
- Materials of Industry (3)
- Industrial Electricity (3)
- Process of Industry (3)
- Industrial Safety (2)
- Foremanship and Supervision (3)
- Production Analysis (2)
- Industrial Instrumentation (3)
- Industrial Proposals and Specifications (3)
- Production Technology (2)
- Electives (13)

FRESNO STATE COLLEGE
(Semester Courses)

Manufacturing Industries Option

Mathematics
- Elementary Mathematical Analysis 1 (3)
- Elementary Mathematical Analysis 2 (3)

Science
- Introductory General Chemistry (3-3)
- General Physics (4-4)

Business/Economics
- Principles of Economics (3-3)
- Automation and Data Processing (3)
- Principles of Management (3)
- Production Management (3)
- Personnel Management (3)

Technical – (Core Requirements for all Emphases)
- Applied Drawing (3)
- Basic Electricity (3)
- Basic Machine Tool Metalworking (3)
- Energy Conversion and Utilization (3)
- Industrial Processes and Materials (3)
- General Building Construction (3)
- Technical Illustration (3)
- Materials of Product Design (3)
- Graphic Reproduction Techniques (?)
- Senior Problems in Industrial Technology (3)

<u>Electricity/Electronics Emphasis</u>
- Industrial Process Control and Instrumentation (3)
- Fundamentals of Electronics (3)
- Advanced Electronics (3)
- Industrial Electronics (3)
- Fundamentals of Electrical Machines (3)
- Fundamentals of Electrical Power Distribution and Wiring (3)
- Electives (9)

<u>Graphic Communications Emphasis</u>
- Basic Graphic Arts (3)
- Rendering (3)
- Advanced Photo Offset Lithography (3)
- Advanced Letterpress and Gravure Printing (3)
- Typographical Layout (2)
- Printing Economics (2)
- Electives (11)

<u>Metals Emphasis</u>
- Basic Metalworking (3)
- Metallurgical Processes (2)
- Advanced Principles of Metalworking (3)
- Advanced Metallurgical Processes (2)
- Metal Fabrication Processes (3)
- Advanced Machine Tool Metalworking (3)
- Machine Tool Technical Problems (3)
- Advanced Machine Tool Problems (3)
- Electives (5)

<u>Drafting/Design Emphasis</u>
- Descriptive Geometry (3)
- Metallurgical Processes (2)
- Machine Drawing (3)
- Tool Design (3)
- Advanced Principles of Metalworking (3)
- Electives (13)

<u>Transportation Emphasis</u>
- Basic Automotive Systems (3)
- Basic Metalworking (3)
- Metallurgical Processes (2)
- Advanced Automotive Systems (3)
- Automotive Technical Problems (3)
- Automotive Diagnosis and Correction (3)
- Automotive Systems Repair Procedures (3)
- Electives (7)

<u>Wood Products Emphasis</u>
- Basic Woodworking (3)
- Wood Machining (3)
- Advanced Wood Machinery (3)
- Woodworking Specialties (3)
- Wood Technology (3)
- Wood Processing (3)
- Electives (6)
- – Chemistry: Elementary Organic Chemistry (3)

Construction Option

Mathematics/Science: Same as for Manufacturing Industries Option

Business/Economics
- Principles of Economics (3-3)
- Principles of Management (3)
- Personnel Management (3)
- Urban Land Economics and Real Estate Principles (3)
- Principles of Accounting (3)

Technical – (Core Requirements for all Emphases)
- Architectural Drawing (3)
- Basic Electricity (3)
- Energy Conversion and Utilization (3)
- Industrial Processes and Materials (3)
- General Building Construction (3)
- Estimating and Bidding (3)
- Materials of Construction (3)
- Technical Illustration (3)
- Graphic Reproduction Techniques (3)

<u>Light Building Construction Emphasis</u>
- Light Building Construction (3)
- Scheduling and Control (3)
- – AgM: Farm Surveying (2)
- – Mktg: Principles and Psychology of Salesmanship (3)
- – Bus: Law and the Business Environment (3)
- Electives (15)

<u>Heavy Building Construction Emphasis</u>
- Descriptive Geometry (3)
- Heavy Building Construction (3)
- Scheduling and Control (3)
- Fundamentals of Electrical Power Distribution and Wiring (3)
- – AgM: Farm Surveying (2)
- Electives (15)

<u>Architectural Drafting Emphasis</u>
- Descriptive Geometry (3)
- Construction Detailing (3)
- Architectural Drawing (3)
- Rendering (3)
- – Geog: Cartography (3)
- Electives (15)

<u>Building Materials Industries Emphasis</u>
- – Mktg: Principles of Marketing (3); Principles and Psychology of Salesmanship (3)
- – Bus: Automation and Data Processing (3); Business Statistics (3); Production Management (3)
- Electives (15)

<u>Real Estate Emphasis</u>
- – Bus: Law and the Business Environment (3); Law and Business Activities (3); Valuation of Real Property (3); Urban Real Estate Investment and Management (3); Real Estate Law (3)
- Electives (15)

SAN JOSE STATE COLLEGE
(Semester Courses)

Mathematics
- Intermediate Algebra (3)
- Trigonometry (3)
- Elective (Calculus) (3)

Science
- Introductory Chemistry (3-3)
- General Physics (4-4)
- Life Science (3)

Business/Economics
- Principles of Economics (3)
- Principles of Accounting (3)
- Business Law I (3)
- Introduction to Manpower Administration (3)
- Fundamentals of Management (3)
- Business Communications (3)
- Business Elective (2)

Technical – (Core Requirements for all Emphases)
- Principles of Technical Drawing (3)
- General Metals (3)
- Machine Tool Practice (3)
- Electricity-Electronics (3)
- Advanced Technical Drawing (3)
- Industrial Materials (3)
- Polymer Technology (2)
- Instrumentation and Automation Technology (3)
- Senior Lecture – Industrial Technology (1)

(Approved Technical Electives Chosen From One of the Following Concentrations:)

Electronic Technology – Eighteen Units Selected From:
- Electronic Principles (3)
- Applied Electronics (3)
- Transistors and Semiconductors (3)
- Industrial Electronics (3)
- Industrial Drafting (3)
- Electronic Graphics (3)
- Automation and Numerical Control (3)
- Quality Technical Systems Planning (3)
- Quality Administrative Systems Planning (3)
- Industrial Metals Technology (3)
- Cooperative Education (2-4)

Metals and Manufacturing – Eighteen Units Selected From:
- Advanced General Metals (3)
- Industrial Metals Technology (3)
- Advanced Machine Tool Procedures (3)
- Quantity Production in Precision Metalworking (3)
- Automation and Numerical Control (3)
- Industrial Drafting (3)
- Quality Technical Systems Planning (3)
- Quality Administrative Systems Planning (3)
- System Effectiveness Measurement (3)
- Electronic Principles (3)
- Transistors and Semiconductors (3)
- Cooperative Education (2-4)

Drafting and Design Technology – Eighteen Units Selected From:
- Industrial Drafting (3)
- Industrial Illustration (3)
- Electronic Graphics (3)
- Electronic Principles (3)
- Transistors and Semiconductors (3)
- Industrial Metals Technology (3)
- Automation and Numerical Control (3)
- Quality Technical Systems Planning (3)
- Quality Administrative Systems Planning (3)
- Cooperative Education (2-4)

Quality Technology – Eighteen Units Selected From:
- Quality Technical Systems Planning (3)
- Quality Administrative Systems Planning (3)
- System Effectiveness Measurement (3)
- Industrial Drafting (3)
- Electronic Graphics (3)
- Advanced General Metals (3)
- Industrial Metals Technology (3)
- Automation and Numerical Control (3)
- Electronic Principles (3)
- Transistors and Semiconductors (3)
- Cooperative Education (2-4)

Graphic Arts Technology – Eighteen Units Selected From:
- Graphic Arts (3)
- Industrial Illustration (3)
- Electronic Graphics (3)
- Printing Techniques (3)
- Photolithography (3)
- Industrial Photography (3)
- Quality Technical Systems Planning (3)
- Cooperative Education (2-4)
- Basic Photography (3)

Automotive and Power Technology – Eighteen Units Selected From:
- Automotive Principles (3)
- Automotive Electronics (3)
- Automotive Chassis (3)
- Power Theory and Application (3)
- Power Transmission Conversion and Utilization (3)
- Industrial Metals Technology (3)
- Electronic Principles (3)
- Transistors and Semiconductors (3)
- Electronic Graphics (3)
- Quality Technical Systems Planning (3)
- Cooperative Education (2-4)

CALIFORNIA STATE POLYTECHNIC COLLEGE, SAN LUIS OBISPO
(Quarter Courses)

Industrial Technology (Basic Curriculum)

Mathematics
- Mathematics for Engineering (5)
- Technical Calculus (4)

Science
- Applied Biology (3)
- General Inorganic Chemistry (4-4)
- College Physics (4-4-4)

Business/Economics
- Survey of Economics (3)
- Industrial Relations (3)
- Human Relations (3)

Technical – (Core Requirements for all Options)
- Technical Computation (2)
- Introduction to Industrial Technology (2)

CALIFORNIA STATE POLYTECHNIC COLLEGE, SAN LUIS OBISPO (Cont.)

Power Technology (2-2)
Graphic Arts Processes (3)
Fundamentals of Technical Drawing (2)
Manufacturing Processes (2-2-2)
Technical Sketching (2)
Electronics, D.C. and A.C. (3-3)
Industrial Electronics Circuits (3)
Mechanical Systems (3)
Industrial Design (2)
Modern Industrial Materials (2)
Senior Project (2-2)
Undergraduate Seminar (2)
--Audio Visual Methods (3)

Industrial Sales and Technology Option
(Courses added to basic curriculum)

Business/Economics
- Principles of Economics (3)
- Basic Accounting (6)
- Marketing Principles (4)
- Business Law Survey (3)
- Quantitative Methods and Controls in Business (3)

Technical
- Mechanical Systems (6)
- Product Evaluation (2)
- Electronic Systems (9)
- Customer Relations (2)
- Industrial Marketing (2)

Industrial Education Option
(Courses added to basic curriculum)

Technical
- Industrial Wood Processes (2)
- Wood Technology (3)
- Advanced Graphic Arts (3)
- Principles and Practices of Industrial Arts (5)
- -- Educational Psychology (3); Public Education in American Society (3)
- Technical Requirement (19)

SUMMARY OF INDUSTRIAL TECHNOLOGY REQUIREMENTS

	Math	Science	Business/ Economics	Technical	Technical Electives
California State College, Long Beach					
Construction Technology	8	12	15	51	7
Electronics Technology	8	12	12	30	9
Manufacturing Technology	8	12	12	51	13
California State Polytechnic College, San Luis Obispo*					
Industrial Sales and Technology	9 (6)	23 (15.4)	23 (18.7)	65 (43.3)	
Industrial Education	9 (6)	23 (15.4)	9 (6)	82 (51.3)	
Fresno State College					
Manufacturing Option					
Electricity/Electronics Emphasis	6	14	18	48	9
Graphic Communications Emphasis	6	14	18	46	11
Metals Emphasis	6	14	18	52	5
Drafting-Design Emphasis	6	14	18	44	13
Transportation Emphasis	6	14	18	50	7
Wood Products Emphasis	6	17	18	48	6
Construction Option					
Light Bldg. Constr. Emphasis	6	14	24	41	15
Heavy Bldg. Constr. Emphasis	6	14	18	39	15
Architectural Drafting Emphasis	6	14	18	39	15
Building Materials Industries Emphasis	6	14	33	27	15
Real Estate Emphasis	6	14	33	27	15
San Jose State College					
Electronic Technology	9	17	20	24	18
Metals and Manufacturing Technology	9	17	20	24	18
Drafting and Design Technology	9	17	20	24	18
Quality Technology	9	17	20	24	18
Graphic Arts Technology	9	17	20	24	18
Automotive and Power Technology	9	17	20	24	18

*Semester Unit equivalents are indicated in parentheses

APPENDIX G

Follow-up on 1968 Graduates of Industrial Technology Program at California State College, Long Beach

SURVEY OF INDUSTRIAL TECHNOLOGY GRADUATE PLACEMENT
CALIFORNIA STATE COLLEGE, LONG BEACH
Selected Graduates, Spring, Summer 1968

C – Construction Option
E – Electronics Option
M – Manufacturing Option

NAME OF FIRM	OPTION	JOB TITLE AND DESCRIPTION	SALARY
National Cash Register Co.	M	Programmer – Management Trainee Data Processing Job is trainee position for management and involves periodic travel, corresponding with customers, writing programs, and supervising a trainee programmer.	$700-950/mo.
Autonetics, Division of North American Rockwell	E	Technician Staff IV Reliability engineering, encompasses all phases of design, production and modification in the lowering of failure rates. Analyze function, processes specification, testing, quality control, materials, etc., in isolating failure causes.	$12,300/yr. plus
Square D. Company	C	Field Engineer Act as sales and consulting person representing the company's line of industrial electrical equipment. Recommend product use and circuit configuration associated with product.	$750/mo.
North American Rockwell Corp. Space Division	M	Health and Safety Representative for Central Manufacturing Consult with and advise supervisory and other technical employees on all matters of industrial hygiene and safety. Prepare and conduct safety meetings. Apply Federal, State, County, City, and Company codes and ordinances. Review jobs to determine placement of physically handicapped employees. Develop safety criteria and policies as required.	$865/mo.
Douglas Aircraft	M	Associate Industrial Engineer Direct contact with administration in production, suggesting methods improvements, work sequencing, planning changes and revising time estimates of various jobs through observations and standard rate guides.	$750/mo.
Babcock Electronics Corp.	E	Senior Manufacturing Project Engineer Responsible for all manufacturing planning, liaison, methods, valve engineering, etc., on major electronic programs.	$850-1200/mo.

NAME OF FIRM	OPTION	JOB TITLE AND DESCRIPTION	SALARY
Astro Science Corp.	E	Junior Manufacturing Engineer Works on sequences of building and magnetic tape recorders as far as electronic components and harness are concerned.	$700/mo.
Pacific Telephone & Telegraph	E	Accounting Staff Assistant In the data processing department. Involved with logic development, flow-charting, coding, documentation and maintenance of computer programs. Working with an IBM 360-40 computer.	$750-800/mo.
McDonnell-Douglas Aircraft	M	Associate Industrial Engineer Perform a liaison function with Facilities & Manufacturing Depts. to establish data for cost justification of new capital equipment. Gather data based on time studies, standard data and man and machine charts.	$690-710/mo.
Teledyne Systems	E	Project Engineer Supervise and coordinate the electrical, logical, and mechanical design, the procurement, assembly, and check-out of digital computer test equipment.	$811/mo.
Autonetics	E	Quality Engineer Analyze and verify compatibility of model and functional test specifications. Evaluate test criteria and procedures. Analyze system/subsystem/component test data with respect to system performance and evaluate failure criteria.	$725/mo.
Westinghouse Molecular Electronics Division	E	Assistant Manager,Marketing Systems Responsibility for all advertising and sales promotion for the division. Indirect responsibility for market planning.	$800/mo.
Collins Radio Company	M	Industrial Engineer Provide engineering assistance to department manager as needed. Write capital equipment proposals, derive time standards, write operation sheets, investigate new processes & manufacturing techniques, value engineer, product design changes.	$180-225/wk.
McDonnell-Douglas Aircraft	M	Associate Industrial Engineer Work as an analyst to evaluate and provide assembly time standards, tool, analysis, schedule status, manload requirements, employee cost reduction suggestions, and method improvements for production assemblies.	$710/mo.
Sea–Space Systems, Inc.	M	Engineer Company engaged in high altitude balloon research, assist in designing instrument packages,	$725/mo.

NAME OF FIRM	OPTION	JOB TITLE AND DESCRIPTION	SALARY
Sea-Space Systems, Inc. (continued)		tracking equipment, and work in field in launching, tracking, and recovering the balloon.	
U. S. Atomic Energy Commission	C	Project Engineer Responsible for coordinating the engineering effort on construction projects undertaken by the AEC. Coordination is between the A-E firm responsible for the design and user agencies and other AEC branches.	$9100-10,010/yr.
U. S. Air Force (Titan III M Airborn Engineering)	E	Project Officer Review and monitor all contractual and specification documents from a technical point of view concerning the electrical & electronic systems on the Titan III M booster.	$500/mo.
Continental Device	C	Production Supervisor Supervise female employees in doing various tasks in the fusion of alloy junction diodes. Extra duties include coordination of material flow, industrial engineering, writing process specifications.	$700/mo.
Varian Assoc. (Palo Alto, Calif.)	E	Engineer C Render engineering services through the entire production sequence of medium power klystron amplifiers.	$775/mo.
International Business Machine Corporation	E	Customer Engineer Responsible for the customer's fullest utilization of his equipment and general satisfaction of the product and the service. Great skill and tact in business conduct, as the engineer is often regarded as "IBM" by the customer.	unknown
Douglas Aircraft Company	E	Associate Engineer/Scientist Prepare and update engineer drawings and layouts on military A3/A4 Aircraft. Provide interface between engineering and development areas.	$824/mo.
McDonnell-Douglas Test	E	Engineer Perform testing utilizing a CDC 924 Computer on the Saturn SNB stage. Responsible for various ground support units operation and tests. Compile test reports and revise test procedures.	$800-950/mo.
R & B Development Co.	C	Project Engineer Responsible for quality control (inspections), all field paperwork, purchasing on job. Also	$900/mo.

NAME OF FIRM	OPTION	JOB TITLE AND DESCRIPTION	SALARY
R & B Development Co. (continued)		responsible for bidding, contract negotiation, and contract administration.	
Autonetics	E	Senior Test Engineer Control of testing operations of data systems, receiving inspection department.	$950-1400/mo.
Xerox	M	Associate Industrial Engineer Responsible for engineering of entire production line. Reports to a senior engineer. Specific responsibilities include implementation and tryout of new processes and tooling; also troubleshooting assembly line troubles.	$725/mo.
McDonnell-Douglas Corp.	M	Engineer/Scientist Analysis and design of aircraft structure. Assistant to leadman and assume leadman functions in his absence.	$987/mo.
Atlantic Research Corp.	M	Senior Engineer Systems project engineer responsible for assigned programs from proposal stage through completion, including: preliminary analysis, proposal, detail design, process, specifications, testing and final delivery of product.	$1300-1630/mo.
Pacific Valves, Inc.	E	Electrical Engineer Design an automation system or automatic machine to produce parts for valves. The design includes the following responsibilities: electrical curcuit design, planning, making certain the required parts are ordered, working with shop personnel, drawing the circuits, and making any required changes.	$650/mo.
Collins Radio Company	E	Industrial Engineer Work with the development and application of time standards for the various product lines.	$800-850/mo.
North American Rockwell	E	Analyst Transcribe knowledge and analysis of general electronic circuits to a written format.	$750/mo.
General Electric Company	E	Sales Engineer Analyze customer equipment specifications (request for bid) and compare to G. E. products; and subsequently, prepare quotations with regards to price and technical compatibility. Will be G.E. Industrial Representative coordinating sales and technical requirements.	$750-850/mo.

NAME OF FIRM	OPTION	JOB TITLE AND DESCRIPTION	SALARY
Applied Research Laboratories	C	Research Assistant Research in optical emission spectroscopy. Debate probable solutions, builds apparatus, sets up and runs experiments.	$575/mo.
Autonetics	E	Test Engineer Responsible for the task of F-111 diagnostic techniques analysis, evaluating system performance, analyzing anomalous conditions and acceptance data, providing technical support to Quality Assurance.	$654-1055/mo.
Autonetics	E	Instrument Repair - Precision Perform calibrations in flow, acceleration, length, pressure, and optical measurement disciplines. Calibrate shock and vibration accelerometer systems, pneumatic and hydraulic flow devices, manometers and barometers, and gage blocks.	$665/mo.
U.S. Atomic Energy Commission Nevada Operations Office	C	Engineering Intern AEC's Career Placement Development Program is of one year's duration, designed to provide accelerated personal development toward the assumption of responsible engineering duties with the Commission. These duties are concerned with the Commission's Program of peaceful uses of atomic energy and the national defense and security.	$9500-9900/yr.
Autonetics	C	Manufacturing Engineer Analyze and develop solutions to operating problems and recommend improvements in existing methods and procedures.	$750-1300/mo.
Westinghouse Electric Corporation	E	Associate Process Engineer Responsible for Inconel 718 grid strap punching and plating, grid assembly area, and new tooling design.	$650-911/mo.
Oakmount Construction Company	C	Project Manager In charge of tract and apartment developments, i.e., scheduling, billing, specifications, and purchasing.	$1000/mo.
Westinghouse Electric Corporation	M	Welding Specialist Represent the Welding Division of the Southeastern U. S. This includes sales of machines and consumables, college recruiting for the division and some speeches in colleges and societies.	$850/mo.
City of Long Beach	E	Programmer—Analyst Prepare programs for electronic data processing	$715-1118/mo.

NAME OF FIRM	OPTION	JOB TITLE AND DESCRIPTION	SALARY
City of Long Beach (continued)		and perform work involved in formulating systems requirements, determining techniques for processing data, and prepare general procedure and detailed flow charts, coded machine instructions and clerical control and computer operation instructions.	
Continental Device	E	Quality Control Engineer Responsible for the quality of all incoming sub-assemblies, all manufacturing of diodes, transistors and integrated circuits. Review all purchase orders for compliance to drawings and specifications.	$12000-13000/yr.
Continental Airlines	C	Facilities Engineer National and international airport planning and development and construction project management.	$850/mo.
North American Rockwell	E	Engineer Reliability Write program plans, prepare proposals, monitor performance against contract and plans, special projects for management.	$832-1058/mo.
Griffith Construction Company	C	Field Officer Engineer Purchase construction materials, expedite subcontractor work and coordinate, design and draft working drawings for falsework and forms, keep quantities for computing costs, survey and figure cross–sections for dirt quantities; write the daily report for the Superintendent and Project Manager, etc.	$820/mo.
Atomic Energy Commission Nevada Test Site Support Office	C	Project Engineer – Intern Review criteria, drawings and work orders and then authorize these documents. Insure work is done in an economical and efficient manner.	$10,860/yr.
Swedlow, Inc.	E	Project Engineer Plan and coordinate the development of new uses of acrylics.	$700/mo.
Kaiser Steel Corporation	M	Junior Industrial Engineer Develop incentive programs, justify projects involving capital expenditures.	$715-755/mo. plus 25% Profit Sharing
Factory Mutual System	C	Field Engineer Give advice and consulting service to top management officials about best engineering loss prevention principles.	$8,500/yr. with raise in five months
Autonetics	E	Member Technical Staff Responsible for coordinating and planning in-plant engineering tests on flight control hardware tests and on flight control hardware for the Minuteman Missile	$850-1150/mo.

NAME OF FIRM	OPTION	JOB TITLE AND DESCRIPTION	SALARY
Autonetics (continued)		Program. Also coordinate the design, development, fabrication and utilization of special test equipment.	
Walt Disney Productions	E	Systems Analyst Apply computers to Disney entertainment enterprises. Determine feasibility and implement applications.	$13,000-15,000/yr.
Pacific Gas and Electric Company	C	Gas Engineering Trainee Trainee spends twelve months going to the departments in gas operations: gas control, gas systems design, gas system planning, pipeline operations, gas distribution, etc. At the end of one year transfer to one of the departments for permanent position.	$770/mo.
Northrop Corporation	E	Senior Cost Estimator Responsible for preparation of cost proposals to customers. Support proposals through audit and negotiation.	$187-287/wk.
North American Rockwell Corporation	M	Industrial Engineer Determine facilities requirements for new operations, develops and coordinates design of material handling/parts protection equipment.	$900/mo.
Western Gear Corporation	C	Structural Draftsman Job is somewhat equally divided between mechanical drafting, structural formulations, and public relations. Emphasis is placed on being able to discuss working problems with clients.	$500-600/mo.
John Deere Killefer	C	Industrial Engineer Set incentive standards and other I. E. oriented projects (Audits Work Measurement Studies).	$9000-12000/yr.
Collins Radio Company	M	Industrial Engineer Research and justification of capital equipment, mechanical design, methods and planning of product at fabrication level, solutions to fabrication and process problems as well as major cost savings by reviewing present methods and processes.	$11,000-12,000/yr.
University of Southern California	E	University of Southern California Graduate School of Business Administration	

APPENDIX H

Letter to Cal Poly, San Luis Obispo, Approving Engineering Technology on an Experimental Basis

November 13, 1968

Dr. Robert E. Kennedy, President
California State Polytechnic College,
San Luis Obispo
San Luis Obispo, California 93401

Dear Dr. Kennedy:

I am pleased to inform you that your request for recognition of the engineering portion of the Industrial Technology program at California State Polytechnic College, San Luis Obispo, has been approved as a separate degree program leading to the Bachelor of Science in Engineering Technology.

Your request is being approved at this time because such a move appears to aid your efforts to secure ECPD accreditation, and the Division of Academic Planning wishes to cooperate in every way that is reasonable to help you to achieve this recognition. It would have been preferable to wait for the systemwide study on industrial technology to be completed and the report approved, so as to be in accord with its clarifications and recommendations. The distinctions between engineering technology and industrial technology are not yet sufficiently clear, and the desirability of a college offering both these programs is open to question. Because of the uncertainties involved, the experience of the San Luis Obispo campus with offering the two programs simultaneously in the School of Engineering may help us determine the direction which the education of technologists should take in the future. Your dual program should therefore be regarded as an experimental model, to be observed and evaluated over a period of time so that conclusions may be drawn concerning the long-range development of engineering technology in the California State Colleges.

I certainly hope that Cal Poly-SLO will receive ECPD accreditation of its stronger engineering programs as a result of the visitation next fall. In view of the Trustee resolution on accreditation and of Coordinating Council action on engineering education, we will await the outcome with much interest and review its implications carefully.

Sincerely,

Gerhard Friedrich
Acting State College Dean
Academic Planning

GF:pz

cc: Dr. C. R. Webb
Dr. John Baird
Mr. John Banister

END