1990

Curricular trends in four-year baccalaureate degree industrial technology programs

Clayton Ray Diez
University of Northern Iowa

Order Number 9109221

Curricular trends in four-year baccalaurate degree industrial technology programs

Diez, Clayton Ray, D.I.T.

University of Northern Iowa, 1990

U·M·I
300 N. Zeeb Rd.
Ann Arbor, MI 48106

CURRICULAR TRENDS IN

FOUR-YEAR BACCALAUREATE DEGREE

INDUSTRIAL TECHNOLOGY PROGRAMS

A Dissertation

Submitted

In Partial Fulfillment

of the Requirements for the Degree

Doctor of Industrial Technology

Approved:

Advisor

Co-Advisor

Committee Member

Committee Member

Committee Member

Clayton Ray Diez

University of Northern Iowa

Department of Industrial Technology

August 1990

ACKNOWLEDGEMENTS

The writer wishes to express his gratitude to Dr. Ronald D. Bro, Dr. E.A. Dennis, Dr. John T. Fecik, Dr. Jack F. Kimball, and Dr. Donald W. Schmits for their guidance and encouragement throughout this project.

Acknowledgement is also made to Dean Henry Tomasek and Dr. Myron Bender for their support and encouragement which enabled the writer to complete this research.

Finally, I wish to express my sincere gratitude to my wife, Julie, and my son, Jay, for their perserverance and understanding during the conduct of this study.

DEDICATION

This dissertation is dedicated to the loving memories of my grandparents, with whom I had so many adventures. My only regret is that I didn't take time to do more. With these thoughts I dedicate this study to:

Clara Mary Fleener Freiburghouse

Raymond Samuel Freiburghouse

Sylvia B. Jecminek Diez

Clayton Wiley Diez

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CURRICULAR TRENDS IN

FOUR-YEAR BACCALAURATE DEGREE

INDUSTRIAL TECHNOLOGY PROGRAMS

An Abstract of a Dissertation

Submitted

In Partial Fulfillment

of the Requirements for the Degree

Doctor of Industrial Technology

Approved:

Faculty Advisor

Dean of the Graduate College

Clayton Ray Diez

University of Northern Iowa

August 1990

ABSTRACT

The intents of the research were to determine both curricular trends in four-year baccalaureate industrial technology programs and the role accreditation standards have on such trends. The purpose was to present implications for future curriculum development and to provide a framework and point of reference for both curriculum developers and standards writers.

From the literature review, questionnaire items were designed to answer four research questions. The instrument was validated by a jury process and data were collected from 60 respondents, organized and compiled using National Association of Industrial Technology curriculum categories. Chi square and descriptive statistics were used to analyze the data.

It was inferred from several trends identified in the results that industrial technology will remain a dynamic field of study. Trends were identified in the areas of accreditation, major courses of study, course titles, concentrations/emphases, mode of change, and program specialization.

Representative trends include: Large student enrollments are found in technical accredited programs and smaller student enrollments are more frequent in nontechnical accredited programs. The titles of

baccalaureate degree programs are being changed to industrial technology more often than to any other title. Major courses of study are becoming more diverse. The number of baccalaureate degree major courses of study are increasing. Concentrations and emphases are more numerous and diverse for nontechnical accredited programs. Future technical accreditation was being planned for additional programs. Selection of an accrediting agency is becoming more diverse in the discipline. Technical accreditation is not the motivating factor influencing curricular change and accrediting agencies are being selected to meet specialized needs. The technical course work area of computer applications was shown to be significantly different. Course titles have become more diverse and reflect the emerging technologies.

Recommendations included: Curriculum developers must continue their dynamic diversity but focus on substantive change. The study should be used as a baseline for further study and future curriculum development. Common standards could be developed for programs with aspirations of technical accreditation by NAIT, ABET, or another technical accrediting agency to limit duplication. Additionally, several studies and needs assessments are recommended to be conducted concerning the curricula of industrial technology.

CHAPTER 1

INTRODUCTION

Industrial technology as a curricular area is a very diverse, complex, and often unrecognized field of study. Keith (1986) identified the focus of industrial technology as management-oriented activities for industry which were based on a strong technical background. The body of knowledge is derived from the technologies used by industry, and as industrial technologies change so must this curricular area. A technological change that has become an integral component of industry is the computer (Ginzberg, 1982). Its advance has led to the computerization of the economic-enterprise system.

Industrial technology education is the curriculum area designed to help educate people in society relative to the technological aspect of contemporary industrial culture. Evidence that the curricular area is abreast of changes associated with computerization is supported by Porchia's statement that "technical education continues to grow not only in size and interest but also in diversification" (1975, p.1). Pertinent changes in the underlying body of knowledge need to be reflected through curriculum development.

Keith (1986) reported that even though industrial technology was identified as a new curriculum at the First Annual Conference on Industrial Technology in American

Higher Education in 1965, it had developed from a varied background. He related that industrial technology programs had been provided in the United States for many years previous. These programs had evolved from industrial education curricula to meet the technical and managerial needs of industry. Many technical aspects of industrial arts education curricula were inherited by industrial technology curricula, but with added emphasis given to industrial management and human relations. Therefore, literature from related fields of study was scrutinized for relevant influences on curriculum development in industrial technology.

Statement of the Problem

The problem of this study was to determine curricular trends in four-year baccalaureate degree programs in industrial technology. Curricular changes in the past 15 years were investigated using the entry points of 1973, 1978, 1983, and 1988 for determining trends and changes projected hrough 1993.

Statement of the Purpose

The purpose of this study was to provide a framework and a point of reference for curriculum developers. It is evident that in order to educate industrial technologists, the curriculum of industrial technology must keep abreast of change. The identification of curricular changes and trends will yield an insight as to how industrial technology curricula have evolved. The study should show whether there have been curricular differences between accredited and nonaccredited programs of industrial technology.

Research Questions

The problem was composed of several subproblems presented as research questions. The research questions were designed to determine:

1. What trends are evident in curricula of four-year baccalaureate degree programs of industrial technology?

2. What differences in curricula between technical accredited and nontechnical accredited four-year baccalaureate degree programs in industrial technology exist for majors related to: management, manufacturing, design and drafting, energy and power, graphic communications, construction, and computer applications?

3. What differences in curricula between technical accredited and nontechnical accredited four-year baccalaureate degree programs in industrial technology exist for concentrations and emphases related to: management, manufacturing, design and drafting, energy and power, graphic communications, construction, and computer applications?

4. What differences in curricula between technical accredited and nontechnical accredited four-year

baccalaureate degree programs in industrial technology exist for coursework areas related to: general education or liberal arts, mathematics, physical sciences, management; and the technical areas of drafting and design, construction, energy and power, graphic communications, production, material science, and computer applications?

Statement of Need

The need for this study is supported from a historical perspective. A finding of Hansen (1964) in his dissertation was that "little formal research is being done in industrial technology curriculum development" (p. 7). Porchia (1975) indicated that even though many industrial technology programs had grown and evolved to reach the forefront of technological education, the programs were nevertheless experimental. Upgrading and refinement of programs will be necessary if the potential for future industrial technology programs is to be fully realized. Taba (1962) indicated that it is essential there be regular analysis of the content base and updating of curricula to take into consideration the important avenues of change. Technological change is important to curriculum developers as they strive to maintain viable and relevant educational programs in industrial technology.

The need for industrial technology curriculum analysis is not a new realization. Keil (1966) stated that

> The increasing rate of technological change has brought about new problems associated with equipping individuals with a wide range of abilities which will provide these persons with the flexibility necessary to be able to anticipate technological changes and their repercussions. (p. 26)

Talbott (1973) concluded that "a nationwide study of industrial technology and related programs, industrial needs, and other relevant factors affecting the quality of graduates of baccalaureate programs" (p. 138) should be conducted. Bender (1982) indicated that "a major challenge of our time is the development of human capacity needed to shape wisely and adapt actively to the rapidly changing technological society" (p. 57). To meet this challenge the scope of the technological society must be fully understood. Only then is the curriculum developer likely to make informed decisions as to appropriate methods for developing human capacity for understanding industrial technology.

The importance of curriculum analysis was also emphasized by Pickle and Parish (1984) when they stated that "Industrial Technology Departments (sic) need to evaluate their curricula and implement those courses most beneficial to the high technology industry . . . " (p. 8). The results of a study using a Delphi technique reported by Perreault (1986) " . . . indicated that our [industrial technology] research efforts should be primarily directed towards programmatic and curricular issues" (p. 5). The present study, through the acquisition and analysis of data and information of past, current and anticipated future curricular changes, was designed to provide valuable insight and direction for industrial technology curriculum planners.

Assumptions

Fundamental to this study were several basic assumptions related to the evolutionary history of industrial technology. It was assumed that:

1. Identifiable changes in industrial technology have taken place during the 15 year period 1973-1988.

2. There was within each department of industrial technology an individual sufficiently knowledgable about curricular change at that institution to provide accurate information relative to curricular change during the 15 year period, 1973 to 1988.

3. General technical curricular categories of the National Association of Industrial Technology were representative of most four-year baccalaureate degree programs of industrial technology.

4. Projections of change could be obtained for 1993.

Limitations

The limitations were identified to establish parameters to guide the researcher in completion of the investigation. This study was limited to:

1. A time period of 20 years, with data collected for the five year points of 1973, 1978, 1983, 1988, and changes projected for 1993.

2. Those faculty members who have been in residence at an institution offering a four-year industrial technology baccalaureate degree program for a minimum of 10 years, have received tenure, have been actively involved in curriculum development for industrial technology, and who also agreed to participate.

3. Four-year institutions at which baccalaureate degrees with majors, emphases or concentrations in industrial technology in the United States of America are granted.

4. The identification and analysis of curriculum changes in industrial technology curricula.

5. Using the accreditation guidelines of the National Association of Industrial Technology for making the curricular comparisons.

Definitions

Operational definitions were needed to promote understanding of the terminology used in this study. The following terms were defined to clarify their use.

Chair: the administrative leader of an industrial technology program: i.e. dean; department head or chairperson; director; division chairperson, director, or head; and program coordinator or leader.

Change: "the complete or partial alteration of an item in form, quality, or relationship; . . . on the whole, a characteristic of education that is dynamic rather than static" (Good, 1973, p.89).

Concentration: a series of courses within a major from which a student may choose in order to gain some degree of specialization within the major option area. For this study "concentration" was used interchangeably with "emphasis."

Curriculum change: "an alteration of the curriculum consisting in making different or restructuring the learning opportunities provided pupils at a given time and place" (Good, 1973, p.158)

Chi square: a statistical procedure used for analyzing frequency data which has been organized in a two variable contingency table. The chi square raw score formula is used for tables having all cell frequencies no smaller than five. The Yates correction in Ary, Jacobs, and Razavieh (1985) is used when a cell frequency falls below five. The chi square minimum analysis is a 2 x 2 double contingency table, which has two levels of each of two independent variables. In all cases of chi square, the dependent variable is a frequency count which expresses the simultaneous classification of the occurence of an event against one level of each individual variable.

Emphasis: a series of courses within a major from which a student may choose in order to gain some degree of specialization within the major option area. For this study "emphasis" was used interchangeably with "concentration."

Four-year institutions offering baccalaureate industrial technology programs: institutions of higher learning where baccalaureate degrees in industrial technology are offered.

Industrial technologist: a management-oriented technical professional who is well-qualified to use technology to tackle practical problems. An individual ". . . distinguished from a technician in being expected to cope with a wider range of problems and to be creative in developing new and more powerful tools and techniques" (Rowntree, 1981, p.317).

Industrial Technology: degree programs of study designed to prepare management-oriented technical professionals in the economic-enterprise system (NAIT Constitution and Bylaws, 1984).

Major: "the group of courses selected from a department's offerings, and sometimes from related departments, as a requirement for specialization for . . . professional preparation for graduation or certification" (Good, 1973, p.348).

Major option: "one of a number of alternatives (majors) from which a student is free to choose" (Rowntree, 1981, p.202) in a specialized industrial technology program.

Nontechnical accredited: programs that have received accreditation by an accrediting agency which accredits multidisciplinary instructional programs and institutions, such as the North Central Association (NCA).

Program: all the majors or courses of study within an academic department.

Technical accredited: programs that have received accreditation from an accrediting agency or association that has standards developed for technology programs such as the National Association of Industrial Technology (NAIT) and Accreditation Board for Engineering and Technology (ABET).

Trend: a predominant curricular tendency (20% change) persisting over a relatively long time span and affecting the character of prevailing institutions (Good, 1973).

Two year post-secondary institutions offering industrial technology programs: institutions of higher learning where associate degrees for technical studies are offered.

Organization of the Dissertation

The information reviewed and the data collected needed to be presented in a logical, sytematic manner. The study was sequenced and organized into the following chapters.

Chapter 1, Introduction, in which the statement of the problem, research questions, statement of the need, assumptions, limitations, definitions, and plan for the organization of the dissertation are defined. Chapter 2, Review of Literature, in which the development of industrial technology curricula are identified and delineated.

Chapter 3, Design and Procedures for the Research, in which the procedures for development of the research instrument, validation of the research instrument, identification of the population and sample, data collection, data organization, and data analysis are described. Chapter 4, Findings of the Research, in which the results, analysis, and interpretation of the data are presented. Each research question was addressed to reflect the statistical analyses. Chapter 5, Conclusions, in which the summary, conclusions, implications, and recommendations are presented.

Summary

This chapter provided the foundation for development of the study. The problem statement and research questions identified what was to be studied. The statements of purpose and need established why this study was to be conducted. Assumptions, limitations, and definitions were identified to provide research boundaries.

CHAPTER 2

REVIEW OF THE LITERATURE

Knowledge about the scope of the technological society may be attained by studying the past, knowing the present, and thinking of the future (Lacroix, 1983). This review of literature covered characteristics of change and various curriculum development stategies used to cope with change. A review of curriculum development in industrial technology since the establishment of the first industrial technology programs in the 1920s is included in this chapter. Identified in the literature review are various curriculum development activities of industrial technology related fields of study, accreditation activities, and the initiation of programs which established the foundations for current programs.

Change and Curriculum Development

Change is composed of different levels. The curriculum developer must be cognizant of these levels, the conditions, and purposes evident in change to be able to cope with change. In making reference to change Cuban (1988) identified first and second order changes in education. He related that changes to make what already exists more efficient and effective are first order changes. The basic belief of educators making use of first order change is that existing goals and structures are adequate and desirable.

Conversely, second order changes are those that alter the fundamental ways in which organizations are put together. New goals, structures, and roles are introduced that transform old ways of doing things into ways of solving persistent problems. First order change is more conservative and is aimed at improving quality but remaining fundamentally constant. Second order change is a departure from the traditional because the constants of the past which give stability to the present are threatened.

London (1988), cited by Lauda (1988a), presented four conditions that must be evident to cope with change.

> Specifically, four conditions must be evident: respect for the past, ability to adapt, confidence in the future, and recognition of the inevitability of change itself. Without these conditions, change can be disabling; with them, it can be invigorating, even ennobling. (pp. 256-7)

Martin (1983) contended that two things must happen when analyzing change. These are:

> First, and foremost, the profession must address the purpose for change that it is trying to accomplish. Second, once the people are convinced that there is, in fact, a purpose for change, its direction must be addressed. (p. 4)

The curriculum developer must also be versed in the processes, stages, and phases of curriculum development. Knowledge of the currciulum development process will enable the curriculum developer to make sound decisions. Tyler (1950) identified four major emphases in curriculum development as: the learner, content, instructional materials and methods, and evaluation. The content of a field of study is identified by the types and areas of knowledge common to the field.

Ziegler (1979) related that curriculum development is a process inclusive of many stages and phases.

> The developmental stages of curriculum include the selection and specification of a philosophic base, rationale, function, assumptions, and procedures. Further, the curriculum developer must consider all phases of curriculum: the purposes, content, organization, evaluation, environment, objectives, time, and instructional procedures. (p.170)

Once the stages and phases of curriculum development are established, the next step is to determine how curriculum is applied within institutions or programs. Ziegler (1979) reported that one common method used to determine curricular practice is to observe the activities and practices of education.

The fundamental focus of a curriculum is the knowledge domain. Ziegler (1979) purported that content ("knowledge, skills, attitudes, values, goals, and purposes necessary for the maintenance and/or improvement of an existing societal order") (p. 174) has levels of activity and was derived in respect to the philosophy and objectives of the domain. High derivational activities in the curriculum process indicate that curricular stability may be low while content sequencing activities indicate high stability. Philosophy and assumptions dictate to a large degree sequencing of content. Few content related activities indicate a relatively solid content base. Finally, a low-order of activity within the content would indicate a relatively solid content base (Ziegler, 1979).

Development of a sound curriculum development plan will depend on how well the future is anticipated. The success of the plan hinges on proper identification and analysis of trends and issues which provide the major impetus for future years (Edgar, 1984).

Technological Change

Parish (1988) recognized that rapid technological transformation has caused acceleration of the industrial technology movement. To ensure that needed changes are made in curriculum Parish (1988) stated that "Educators should constantly review their academic programs in order to ensure the content is current and appropriate" (p. 55).

Miller (1989) noted that changing technology not only demands new programs, it also demands continual attention to the curriculum, facilities, instructors, and the marketplace. A careful assessment of the market into which graduates move and return for retraining is a critical element of maintaining first-rate industrial education programs designed for employment.

Schilleman (1987) commented that "change is best accomplished by subtle, on-going modification rather than drastic revision usually suggested by proponents of high tech" (p. 28). A second opinion offered by Schilleman (1987) added "the basic skills and achievements acquired in a traditional industrial education program will never become obsolete and they can apply to more sophisticated technical equipment in postsecondary programs or on the job at a later date" (p. 28).

Miller (1988) provided a summary of change as a challenge to curriculum developers. He summarized that:

> . . . the primary challenge is to those individuals responsible for programs in . . . postsecondary institutions, . . . to (a) clarify and communicate the mission and goals of the program, (b) demand quality in all aspects of the program [personnel, curriculum, instructional materials, and facilities], (c) build systems of collaboration among schools and with business and industry, and (d) redouble the efforts in the public relations area. (p. 41)

Curriculum Directions

Understanding of curriculum development in industrial technology can be aided by an understanding of how its curricula have have been developed and if curricular directions are different from the past. In the following sections these directions are reviewed.

Ziegler (1979) determined that two strong content movements; the cluster concept initiated in the 1920s and a product of the late 1940s, technology-based industrial arts; were dominate through the 1970s. Examples of each are found in current literature.

The cluster concept was initiated when Bonser and Mossman suggested food, clothing, and shelter as cluster concepts in 1923 (Ziegler, 1979). Since origination of the cluster concept various researchers have proposed others. Warner offered power, transportation, manufacturing, construction, communication, and personnel management. Olson provided the addition of electronics, research, and services and differed from Warner by excluding communication. Cluster concepts of construction and manufacturing were identified by Towers, Lux, and Ray as major components of the Industrial Arts Curriculum Project. The "Secondary Exploration of Technology Project" submitted materials analysis and processing, power conversion and transmission systems, and industrial communication systems.

The technology-based curriculum structure was slow to develop because of controversy over curriculum direction. The difference in opinion centered on whether curriculum content be needs-based or objective-based. Research ultimately would reveal the path to follow (Ziegler, 1979).

Feirer and Lindbeck (1964) recognized that change was occurring in the field of industrial arts. The majority of that change had taken place since World War II. They identified the apparent trends/changes in curriculum as:

1. The development of power mechanics as a content area.
2. The development of electronics programs.
3. The growth of instruction in plastics.
4. More emphasis on understanding industry.
5. Greater emphasis on engineering and manufacturing.
6. Increased emphasis on applied science and mathematics. (pp. 83-85)

Feirer and Lindbeck (1964) attempted to identify some factors which would affect change in industrial arts. They identified 10 factors, but this researcher selected four that seemed to impact more on the technological aspect of society. They were:

> 1. Increased technological change.
> 2. Increased need for a large supply of trained and technically qualified manpower.
> 3. Better communications and transportation.
> 4. Reduction in opportunities for unskilled labor. (pp. 89-90)

Feirer and Lindbeck (1964) projected what industrial arts would be like in 10 years. Their projections included:

> 1. The curriculum should be geared to changing technology.
> 2. Applied science and mathematics should be emphasized throughout the industrial arts programs so that the students can see the relationship between basic sciences and the technology of industry.
> 3. Greater emphasis should be placed on the use of oral and written communication in the industrial arts program.
> 4. More attention should be given to drafting as a basic method of communication. (pp. 93-94)

The influence of the high technology era on curriculum directions can be traced to about 1970. New technological discoveries made possible the advent of affordable pocket calculators and desktop computers for individual and small business use (Vanderslice, 1984).

Change in world economy has propelled electronics, a neophyte industry 15 years ago, into the fourth largest by 1990. Vanderslice (1984) reported a projection that only the energy industry will be larger by century's end.

Additionally America's workforce has changed. Employment by the information and services industries total over 75% of the workforce, compared to 20% and 3% involved in manufacturing and farming respectively (Vanderslice).

Even though computers now use electronic memories to "keep track of materials, process orders, make out payroll, prepare bills, handle correspondence, and retain a record of all the work" (Vanderslice, 1984, p. 4), new technologies will have the greatest impact on manufacturing. Change will occur with the greater utilization of technologies such as: "robotics, a generation of versatile programmable controllers, and computers that aid in design, production, and testing" (Vanderslice, p. 4). The incorporation of these and future inventions into industry will allow future factories to operate as an integrated system. Advantages include more flexible production scheduling and faster response to the demands of market conditions. Improvements such as these and improvements in ideas and processes provide salvation for America's manufacturing industries (Vanderslice).

Conole (1986) ascertained that curriculum developers in education should repond to rapid change by demonstrating curricular modifications reflective of contemporary society. He contended that course offering descriptions and titles are important, but a need exists for conciseness not the strict regimentation used to describe course offerings in the past. He proposed a method to best fit titles and descriptions to subject matter and complexity. Curriculum developers are obligated to consult the literature and to interact with local business and industry. In the curriculum development process, developers need to examine content and select an appropriate title, not just fit content to a terrific title. Curriculum developers should also communicate course content changes in the selected title.

Future Developments

Curriculum directions are important for the curriculum developer to understand, but its is also important that they have a perception of the future. Some possible future changes and developments are reviewed in the following.

Wiens (1987) stated that "Industrial arts, industrial education, industrial technology, technology education, regardless of the term used, the profession has been trying to define its content and determine its clientele for nearly a century" (p. 7). Martin (1983) noted that even though " . . . Change is the most constant characteristic in the world today," the profession has been identified as " . . . a group of historically conservative thinking professionals. . . . " (pp. 4-5) in relation to change. Israel (cited by Lemons, 1988, p. 66) reiterated the profession's lack of future orientation as being based on present conditions not the future, resulting in a minimum of long-range planning.

All too often, curriculum developers fail to recognize that content must be, to some degree, futuristic. Nelson (1980) determined that new and emerging occupations needed to be checked so educators can keep "on the cutting edge of new technology" (p. 43). Russell (1982) believed one must be an investigative reporter to forecast curriculum needs. Finch (1983) maintained that the investigator must study new trends, review technical literature, communicate with experts, search for occupational projections, locate existing programs, and ultimately make a decision.

Identifying futuristic curriculum content is a task more involved than identifying current content. Kicklighter (1985) found that non productive programs can be constantly revised, updated, or eliminated to meet the needs of modern industry. To achieve a productive program overlap should be eliminated, repetition limited, faculty and facility utilization should be optimized, and intradepartmental cooperation should be encouraged. Kicklighter also encouraged the use of industrial advisory committees, past graduates, accreditation by the National Association of Industrial Technology and interaction with industry to aid in the establishment of strong programs.

Lauda (1988a) proposed a curriculum change strategy effort fashioned to reflect culture for a long lasting impact. The effort must include " . . . the selection of content and instructional strategies for the individual . . . " (Lauda, 1988a, p. 257) after thorough analysis of the profession's representative disciplines " . . . (technology education/industrial arts, industrial technology, and vocational education)" (p. 261).

Lauda predicted that future industrial technology programs will continue to be broad-based but more group activity, a greater emphasis on technology assessment, and an emphasis on interdisciplinary problem-solving will be included. The alliance between technology education and industrial technology will be strengthened. He stated:

> Major changes in industrial technology will include the study of new technical fields such as bio-technology; increased coverage of the impact of scientific and technological decisions upon people, institutions, and the environment; and a closer alliance between industrial technology and the business and industrial sector. (p. 264)

The cooperative atmosphere created will strengthen both programs. In addition, the role of vocational education will be enhanced because of renewed efforts to meet the needs of contemporary business and industry.

Continuance as a dominant force in the shaping of our economy will depend on how well the profession can prepare individuals to deal with emerging economic forces. The Office of Technology Assessment has identified four major forces that provide the profession with future opportunity for curriculum development efforts. These are:

1. New technologies: primarily those built around microelectronics.
2. The loss of U.S. preeminence in international markets.
3. The possibility that the price of energy and other resources may increase sharply by the turn of the century.
4. Changes in consumer and labor markets and a new attitude toward public regulation of economic activity, resulting, at least in part, from new values and tastes. (Office of Technology Assessment, 1988, p. 15 cited in Lauda, 1988a, p. 266)

The need for cooperation among professional organizations in regard to curriculum development is important and could prove beneficial as Streichler (1988a) editorialized. He noted the recent successes of technology education and industrial technology as prime examples.

Streichler defended the need for cooperation by using the argument that industrial educators were accountable for industrial technology program development. He noted that this occurence was not so far fetched when identifying the following events:

1. A significant number of industrial technology college instructors and leaders were originally prepared as industrial educators educators or received their doctoral degrees for industrial teacher education programs.
2. The technical content of technology teacher education and industrial technology programs is very similar, if not identical, in many institutions of higher learning. In fact, a review of the history of the development of these programs reveals that each owes much to the other regarding curriculum and structure.
3. Membership in professional associations crosses boundaries.
4. Many students who complete programs taught by technology education and industrial vocational-technical educators in the public schools or students who complete two-year college

> programs in this area enter four-year colleges or universities to pursue careers in technology education or industrial technology. (p. 5)

Streichler (1988a) stated that:

> Industrial technology is a field of higher education that is most analogous to new technology systems curricula evolving in industrial arts. (p. 6)

Streichler further expounded that contemporary curriculum concepts were generally "based on industrial technology systems" (p. 6) for education from junior high through baccaluareate levels.

Bjorkquist (1988) determined that the climate for change exists when estimates of benefits exceed those of costs. However, the opportunities in that climate need to be discovered, they don't just happen. Bjorkquist identified these opportunities as the result of " . . . information gathering and interpretation, developing conclusions and proposing hypotheses, and rational risk taking . . . " (p. 33). Bjorkquist wanted the profession to not underestimate the powerful effect of change and how growth and advancement can be effected. Resultant future curriculum development opportunities would be realized if the attitude of the profession held that good will come from change.

Historical Overview

The intent of the historical overview is to review past happenings and trends of curricular development in industrial technology and related fields. An understanding of this review should aid in understanding curricular development for industrial technology.

Historians in the field have identified several early types of training which were forerunners to current industrial technology education. They were basically craft-oriented, had minimal ordered educational processes and were not management-based (Talbott, 1973).

Industrial technology education which involved "skill of hand" (Bennett, 1926, p. 11) activities can be traced to before recorded history (Bennett). The Egyptians used imitation of task training to pass skilled craftsmanship from generation to generation. This training had no formalized process to qualify it as technical education.

Apprenticeship Method

The first evidence of a rationalized process of educational thought appeared with the advent of the apprenticeship method (Bennett, 1926). The skills and knowledge of the craftsman were taught to the "apprentice" as he and the master worked together. Bennett noted that the apprenticeship method began with the ancient Jews, who believed that boys attending school for formal instruction must, in addition, learn a trade from their fathers. Bennett also determined that even though the Greeks relegated the apprenticeship instructional method to the lower classes, essentially the same method was used by the upper classes. The Christian monasteries were the centers of intellectual life through the Middle Ages up to the time of the Renaissance. The monks believed that hard labor in skilled crafts was as essential as the study of the The Seven Liberal Arts (Bennett, 1926). The Renaissance era also embraced the master-apprentice system as the major training method for craftsmen.

The early American Colonists embraced the strong English tradition of the apprenticeship system. Martin and Luetkemeyer (1979) determined that the apprenticeship system emphasis was instruction in technical skills and related knowledge for the primary purpose of developing skilled workers in the various handicraft technologies.

Arts and Crafts Guild

Near the end of the Renaissance era a new system of education was introduced which was called the arts and crafts guild. The guild system was based on the father-son or master-apprentice system, but the master was required to additionally teach reading and writing (Barlow, 1967).

Educational Reform

From the sixteenth century to the nineteenth century educational reform was initiated. Leaders of the reform movements included Locke, Rosseau, Pestalozzi, Neef, Von Fellenberg, Froebel and others. These reform movements focused on the teaching of academic skills in addition to the skills of work (Barlow, 1967).

One educational leader during this period had a definite bearing on the future of industrial education. John Amos Comenius, credited with being the father of modern pedagogy, advocated "methods of the arts" which provided rationale for the teaching of practical subjects (Cochran, 1970). The work of Comenius in educational theory, curriculum, and method was typified by his efforts to proceed from the simple to the complex, his approach to education through sense experiences, and his interest in teaching students to "learn by acquaintance" with actual objects. Much of the thinking of Comenius paved the way for a wider application of experience-oriented activities in the eighteenth and nineteenth centuries and provided insight into some of the cultural elements of modern time.

Johann Pestalozzi proposed that natural objects and models be used to progress from things to words. His influence prompted Phillip von Fellenberg and Frederick Wilhelm Froebel to follow his lead and implement his ideas (Cochran, 1970).

The apprenticeship system was entrenched in America until the nineteenth century when, in an era of change, Benjamin Franklin opened an academy in Philadelphia to teach craft courses (Cochran, 1970). Subsequently, engineering education and the technical dimension (tool skills) in industrial arts education evolved as outgrowths of the apprenticeship system. A result of these developments was an industrial revolution in America that was similar to the one in England. This was demonstrated by the growth of manufacturing plants which prior to 1830 had operated as small mills. This growth continued until the modern factory system became established.

The resultant goal of industrial training became educated labor. A major contributing factor in this development was the Morrill Act of 1862 which served as the mechanism for the establishment of the land grant institutions of higher learning. The land grant institutions provided a vehicle for students to become educated in the mechanical arts as well as academic subjects.

Secondary Education Movements

Education for industry in secondary schools was not recognized as a part of general education. It was a specialized type of education. Several developments needed to take place before education for industry assumed a position in general education. The following secondary education movements provided the needed foundation for the evolution into general education curricula. Each made contributions to the development of the field.

Russian School

The ideas of shop instruction developed by Della Vos and his faculty for the Russian school influenced the development of industrial training. The purpose of the Russian system was to teach the basic elements of a trade. Cochran (1970) noted that it " . . . was based upon an analysis of operations, processes, and manipulative work, resulting in a series of exercises with little or no concern for the construction of useful projects" (p. 2). Vaughn and Mays (1924) described the organization of the Russian System as the undertaking of scientific tool instruction:

> by a series of exercises that involved in a systematic way the fundamental tool processes. . . . the way to do this was to analyze the tools, the processes, the crafts, trades, and materials into their elements and to these elements in methodical courses of instruction. (pp. 26-27)

The engineers and builders could then work as teams to design and build products. The foundation of this system was the analysis of manipulative operations and exercises designed to accentuate those operations (Silvius & Curry, 1971).

Swedish Sloyd

Another contributor to manual training was the Swedish sloyd movement. The sloyd system was a highly organized hand work program with instructional projects that could be marketed upon completion. The production of useful articles provided Swedish sloyd a position of influence in general education (Cochran, 1970). The sloyd system became a part of general education in Finland in 1866. In 1877, Sweden's Salomon refined educational sloyd to include " . . . (1) making useful objects, (2) analysis of operations, and (3) educational method" (Silvius & Curry, 1971, p. 534).

Martin and Luetkemeyer (1979) described American Sloyd as different from Swedish sloyd because students worked from mechanical drawings rather than models. The need for drafting in American industry provided the impetus for its inclusion in the curriculum.

Manual Education

Initial attempts to forge collegiate and high level manual training programs resulted in various rapidly developing curricular patterns. The bases of which were:

> a theory of formal discipline which stressed education of the mind through the hands, developing the powers of observation through the senses, and instilling an appreciation for the dignity of labor. (Cochran, 1970, p. 2)

Manual education was proposed and promoted by Woodward and Harris. The first manual training school established by Woodward in 1879 (Barlow, 1967) as the Manual Training School in St. Louis and the School of Mechanic Arts at the Massachusetts Institute of Technology established and developed by John D. Runkle, was at the forefront of manual training. Worcester was the first institute to combine the provided Swedish sloyd a position of influence in general education (Cochran, 1970). The sloyd system became a part of general education in Finland in 1866. In 1877, Sweden's Salomon refined educational sloyd to include " . . . (1) making useful objects, (2) analysis of operations, and (3) educational method" (Silvius & Curry, 1971, p. 534).

Martin and Luetkemeyer (1979) described American Sloyd as different from Swedish sloyd because students worked from mechanical drawings rather than models. The need for drafting in American industry provided the impetus for its inclusion in the curriculum.

<u>Manual Education</u>

Initial attempts to forge collegiate and high level manual training programs resulted in various rapidly developing curricular patterns. The bases of which were:

> a theory of formal discipline which stressed education of the mind through the hands, developing the powers of observation through the senses, and instilling an appreciation for the dignity of labor. (Cochran, 1970, p.2)

Manual education was proposed and promoted by Woodward and Harris. The first manual training school established by Woodward in 1879 (Barlow, 1967) as the Manual Training School in St. Louis and the School of Mechanic Arts at the Massachusetts Institute of Technology established and developed by John D. Runkle, were at the forefront of manual training. Worcester was the first institute to combine the elements of theory and practice, scientific reasoning, and shop/laboratory activities into an experience as educational as laboratory work in science (Bennett, 1926).

Woodward believed in combining theory and practice to gain understanding of principles basic to all trades. He proposed that systematic study of the manual arts be included in the general education system (Barlow, 1967). Olson (1963) stated that through the efforts of Woodward and others " . . . manual training came to be the first form of organized, shop-type education in American public schools" (p. 2). The first curriculum " . . . consisted of two hours of woodshop and one hour each of mathematics, science, Latin or English, and drawing" (Barlow, 1967, p. 36). This approach underscored Woodward's 1886 perspective that manual training's purpose was not to make mechanics of students, but to provide a well rounded education that would enable students to function as good citizens (Olson, 1963). Bennett (1937), however, viewed manual training as preparatory instruction for those interested in the engineering or architectural professions. He also recognized that manual training could serve those wishing to enter the work force with technical skills.

Schenck (1983) idealized Bennett as a pioneer teacher educator and publisher of literature for the profession. He felt that Bennett deserved a place with Woodward, Runkle, Belfield, and other pioneers who laid the groundwork of industrial education and industrial arts in the United States (Bawden, 1942). Bennett faced the question of which manual arts should be taught, and decided on the graphic arts, mechanic arts, plastic arts, textile arts, and bookmaking arts. Bennett (1937) provided the following rationales for manual arts: vocational exploration, consumer competency, aesthetic appreciation, transmission of ideas and culture, and social efficiency.

Bennett's concept of manual arts emphasized the content aspect of this type of education in contrast to the performance or skill aspect of manual training. He maintained that the project was the logical medium through which the student could acquire vocational exploration, consumer competency, aesthetic appreciation, and social efficiency and through which ideas and culture could be transmitted. Upon ending his discussion of industrial arts, Bennett (1937) said,

> its meaning is essentially the same as the term "manual arts," though its connotations are different. In the term industrial arts, the "industrial" is emphasized; while in manual arts, the "arts" is historicallly the distinctive word and, in the term manual training, "manual" is the important word. (p. 455)

Bennett's contribution to modern industrial arts were distinct areas of study, the project, and development of objectives.

Bennett's original concepts of industrial education and his success as head of the St. Paul school led to an invitation in 1891 to organize and head as department of manual arts at Teachers College, Columbia University. Here Bennett originated the first two-year curriculum to prepare manual training teachers in America (Cochran, 1970). Two years later Columbia University replaced Teachers College as the degree granting institution. This change enabled manual training courses to be accepted as part of an advanced degree, the first graduate level manual training course (Bennett, 1937). Bennett then moved to Bradley Poly Technic Institute (now Bradley University) where he oversaw all aspects of the manual training program. He was the organizer, planner, developer, and overseer for the curriculum, a faculty, and the design and construction of buildings, shops, laboratories for instructional activities (Cochran, 1970). A change in emphasis, however, was in the future.

Cochran (1970) identified three forces that provided influence to the profession for changing emphasis to industrial-oriented classes. The first was an editorial by Charles Richards in the Manual Training Magazine which presented the case for a name change to industrial arts by citing psychological support for the change. The article helped pave the way for the later change from manual training through manual arts to industrial arts.

The second force pushed the vocational point of view. The momentum came from the Commission of Industrial and

Technical Education or the Douglas Commission. The recommendations of the Commission resulted in providing more industrial emphasis and vocational program expansion in Massachusetts.

The third factor prior to 1910 was the National Society for the Promotion of Industrial Education. The organization leaders proposed to undertake four objectives:

> (1) focus public attention on the importance of the field, (2) study and discuss various phases of the problem, (3) disseminate material concerning the field, and (4) promote the establishment of programs of industrial education. (Cochran, 1970, p. 4)

The Society succeeded in attaining many of its objectives in addition to being a key player in developing vocational legislation subsequently enacted.

Industrial Education

The concept of manual training remained strong through the first decade of the twentieth century. About 1910 a debate about and movement toward the concept of industrial education was initiated. The Mississippi Valley Conference membership was organized in 1909 to discuss problems relevant to manual training education. The Mississippi Valley Conference was largely responsible for the philosophical and curricular development of manual arts and industrial education. Three leaders who greatly influenced the Conference during the formative years were Bawden, Bennett, and Selvidge (Barlow, 1967).

Industrial Arts Curriculum Precursors

Early advocates of departure from manual arts wanted industrial arts to provide more realistic experiences. Richards was influenced by Dewey's educational concept that industrial occupations be a focal point of elememtary curriculum. Richards also proposed in 1904 that the profession's name be changed to industrial arts (Martin and Luetkemeyer, 1979). Russell in 1909 advocated that "...stages of production, distribution, and consumption of such raw materials as foods, metals, textiles and woods" (Cochran, 1970, p. 6) be included in an industrial arts course.

Bonser and Mossman's view of industrial arts revolved around man's changes of materials to increase value for human consumption (Bonser & Mossman, 1924). A second movement in the industrial arts was a transformation of shops with a single activity shops to those supporting multiple activities. The profession thus embraced the general shop as an organizational tool (Cochran, 1970). The emphasis of the profession remained static during the 1920s although improvements in teaching standards were attempted.

The industrial arts movement continued to develop during the 1930s and 1940s. One investigative study, two curriculum movements and three publications were influential during this period. The "Terminological Investigation" study was a reflection of the Dewey-Bonser philosophy and influenced curriculum development of the 1930s (Martin & Luetkemeyer, 1979). They also found that the "Terminological Investigation" was an attempt to end confusion about terminology. The definition found in the publication is as follows:

> Industrial Arts is one of the Practical Arts, a form of general education, which provides learners with experiences, understandings, and appreciations of materials, tools, processes, products, and of the vocational conditions and requirements incident generally to the manufacturing and mechanical industries. (p. 33)

Cochran (1970) identified Warner's multiple activity oriented Laboratory of Industries as having a focus on the terms "industry" and "laboratory". Martin and Luetkemeyer (1979) identified the "Ohio Prospectus" as teaching relationships between industries.

Martin and Luetkemeyer (1979) identified two publications, "Improving Instruction in Industrial Arts" and "An Industrial Arts Curriculum to Reflect Technology at all School Levels", that influenced the direction of industrial arts after World War II. A third influencing publication was Wilber's "Industrial Arts in General Education". The definition of industrial arts promulgated by Wilber has served as the basis for most contemporary definitions. He defined industrial arts " . . . as those phases of general education which deal with industry(;) its organization, materials, occupations, processes and products(;) and with the problems resulting from the industrial and technological nature of society" (Wilber, 1948, p. 2).

The trend toward accepting industrial arts as the name for the profession was culminated at the 38th Mississippi Valley Conference. The philosophy of the Conference had held education for industry as its main thrust since its inception. Members had by 1948 recognized that manual arts and manual training were methods of the past. The members attending the 38th Conference therefore changed its terminology to industrial arts from manual arts (Barlow, 1967). The term industrial arts identified the profession until the change to technology education in 1985.

The "Curriculum to Reflect Technology" was the initial step to including technology as a part of industrial arts curricula. Warner (1965) with the help of his students in 1947 developed a curriculum which proposed to use technology as its basic premise. The content was derived by examining the socio-economic enterprise system rather than by traditional means. The 1965 update provided a series of detailed content outlines for each of the identified technology subject areas. Streichler (1980) recognized Warner as one innovator of curriculum change for the 1947 AIAA convention report that identified divisions of industrial arts content. These areas included power, transportation, manufacture, construction, and communication and management. It was determined to be a stimulus for the field to reflect technology in its curriculum.

Warner (1965) in "A Curriculum to Reflect Technology" identified content as in the following:

> Content in the new Industrial Arts curriculum is derived via a socio-economic analysis of the technology and not by job or trade analysis as of old from the commoner village trades such as those of the carpenter, the blacksmith, the cabinet maker,...Now, the subject matter classifications are conceived of as including:
>
> a. Power: tidal, solar, atomic, electrical, muscular, hydraulic, combustion...;
> b. Transportation: land, sea, air, space;
> c. Manufacturing: includes the basic industrial methods of changing raw materials into finished products such as foods, textiles, ceramics, metals, woods, plastics, and leathers, similar but broader in concept and application than has been developed in the so-called "general" shop of the past forty years;
> d. Construction: simple fabrication, housing, public works, industrial national defense,...;
> e. Communication: graphic arts including drawing, letterpress, planography, intaglio, and the miscellaneous processes in addition, to electricity, electronics, and other communications media; and
> f. Management: including Line and Staff as in business and industry, or labor as well as management. (pp.41-42)

Industrial Arts in the 1950s

Curriculum development of the 1950s was characterized by a distinctive movement. That movement was designed to use technology as the content base. This was a continuation of the trend initiated in the late 1940s. Four plans were typical of this format. Two plans, the "Minnesota Plan" and the "Research and Experimentation" (later known as the Maryland Plan), (Cochran, 1970; Martin & Luetkemeyer, 1979) had emphasis placed on "research, experimentation, and technically oriented programs . . ." (Cochran, p. 11). A third plan, "The New Industrial Arts Curriculum", was organized about the three functions of consumption, production, and recreation. The content was relevant to " . . . power, transportation, construction, communication, manufacturing, and personnel work" (Cochran, 1970, p. 10). Streichler (1980) recognized Olson's "Technology and Industrial Arts" as containing eight major categories of industry: manufacturing, construction, power, transportation, electronics, research, services, and management. A final influence of this period was the report, "Industrial Arts in Education". The report provided the industrial arts with definitions for the educational role, instructional areas, and program character at different levels.

Industrial Arts Curriculum in the 1960s

More change and curricular movement trends were initiated in the 1960s than any decade previous. The greatest influence on the new innovations was provided by Sputnik and the ensuing emphasis on space exploration. Even though the new programs were being embraced in numerous schools, many schools continued to follow the traditional content of automotive, crafts, drafting, electricity, graphic arts, metalworking, and woodworking.

Swanson (1965) noted what others had observed that the diversity of industrial arts programs had a long history and that it (diversity) is sometimes viewed as good. Swanson stated "almost any definition of industrial arts includes mention of the study of occupations, tools, machines, processes, materials, and products of industry" (p. 49). Bennett's description (cited in Swanson) of manual arts content in five areas included " . . . graphic arts, the mechanic arts, the plastic arts, the textile arts, and the bookmaking arts" (p. 49).

Curriculum designers have built on this foundation and as Swanson (1965) noted relative to two thrusts: materials and the trade, craft, or occupational groupings. Characteristic of these programs are studies in metals and woodworking. Topics included the crafts of welding, machine shop, sheet metal and foundry for the former and carpentry, cabinet making, and pattern making in the latter.

Swanson (1965) related:

> There are obvious advantages to visualizing industrial arts as the study of tools, processes, materials and operations. Content is relatively easy to identify and organize; the kind of facility needed can be readily justified; and the preparation of teachers (at least in their technical competence) is clear. Further, it is possible to assign a wide variety of purposes to the study of the same content. Some students may use it for learning a job, others may base further learning on it, and still others may develop problem-solving abilities for use in future activities. (p. 51)

Swanson (1965) indicated that " . . . industrial arts is the study of the applications of science to the solutions of man's problems: the study of technology" (p. 51) represented the viewpoint of some in the field. He also noted that mathematics and science principles have consistently been a part of industrial arts. An approach used to extend and upgrade curricula in industrial arts is to adopt parts of another discipline for industrial study. Examples included electricity and electronics, hydraulics, mechanics, and pneumatics as power mechanics (Swanson). Swanson felt that a greater understanding of scientific principles would show that " . . . industrial arts is related to science in much the way engineering is . . . " (p. 54). Swanson related that the study of industry was related to the utilization of " . . . the basic resources of men, materials, machines, and money to produce goods or provide services" (p. 54).

Woodward and Decker (1967) determined the differences among manual training, manual arts and industrial arts centered on the approach to curricular content. The focus of manual training had been on hand skills, woodworking, occupations, engineering school entrance, and student retention. Development of useful articles utilizing skill, selected projects, and good design were key aspects of manual arts. The emphases of industrial arts were on design, problem solving and content with a focus on drafting, woodworking, metalworking, and electricity.

Curricular change in industrial arts was traced by Woodward and Decker (1967) to innovative industrial arts teachers. These teachers recognized changes in industry and modified content to reflect these changes. Inclusive of content refinement were design, material selection, planning, and product development. Later they identified content elements for a standardized curriculum as:

1. Automotive mechanics
2. Crafts (in recent years the term crafts has been replaced in many areas by the term industrial crafts
3. Drafting (including engineering, drawing, and architectural drawing)
4. Electricity-elctronics
5. Graphic arts
6. Metals
7. Power mechannics
8. Woods (p. 145)

Woodward and Decker (1967) also reported indications that showed plastics, hydraulics, fluid mechanics, and industrial controls were to become part of industrial arts curricula. Additionally, they identified three curriculum projects as advancements in industrial arts education: the Industrial Arts Curriculum Project, the American Industry Project, and the Maryland Plan.

Barlow (1967) indicated that the research and writings of Keith, Olson, Roney, and Schmitt reflected the need for inclusion of technology in the industrial arts curriculum. Olson and Keith had identified the need for managerial skills in industry for those with application skills. Barlow (1967) concluded that:

> the curriculum in post-secondary institutions will have a base of applied science, mathematics, drawing, general technology, and an appropriate program of general education. Review of the curriculums offered indicates little standardization of content. The tendency of such curriculums is, however, directed toward clusters of closely related occupations rather than the needs of a single occupation.
>
> . . . A newcomer to the field of technician education would be confronted with a mass of ideas, points of view, trends, relationships, and predictions that seemingly have no relationship and that lead to a confused educational situation. This is merely an indication of the complexity of the total problem and suggests that the edcucational specialist must pay more than usual attention to the nature of this rapidly changing field. (p. 424)

Swanson (1965) developed four major headings to aid in classifying curriculum innovation in industrial education. These headings were:

1. The study of common life needs created by or related to industrial and technological advance.
2. The study of crafts or trades, processes, tools, machines, materials, and products.
3. The study of applications of mathematics and the sciences.
4. The study of industry. (p. 47)

Cochran used this classification system to help determine commonalities of various curriculum movements in industrial education. Four basic approaches were gleaned from his analysis of contemporary programs. The four approaches were:

1. Integrative programs
2. Interpretation of industry programs
3. Occupational family programs
4. Technology-oriented programs (1970. p. 22)

Cochran's (1970) first contemporary approach category was integrative programs. These programs were those that had "interrelationships between two or more subjects" (p. 22).

The second contemporary approach category identified by Cochran (1970) was: Interpretation of Industry Programs. Five programs were determined to be members of this grouping. Early influencing factors for the position expounded by these programs came from the work of Warner's "Laboratory of Industries" and Wilber's "Industrial Arts in General Education".

The third major category of contemporary programs identified by Cochran (1970) was occupational family programs. These programs were centered on the development of salable skills and competencies in an occupational cluster and were developed based on local or regional needs. Cochran (1970) identified the final contemporary approach as "Technology-Oriented Programs". The basis for this category has roots in Warner's "Laboratory of Industry", and succeeding technology oriented proposals; "The Ohio Prospectus" and "A Curriculum to Reflect Technology". The motivation for this approach is founded on the premise that technology is more than technical developments, it also draws on "...scientific management, product demands, and the role of the individual in society" (Cochran, p. 73).

Lux (1967) used Swanson's four groups of industrial arts curriculum proposals to classify nine curricular innovations in secondary school industrial arts. Of the nine identified only the Maryland Plan was developed to meet the needs of common life as "created or related to industrial and tecnological advance" (Swanson cited in Lux, 1967, p. 155). The second group included the Galaxie Program, the Orchestrated Systems Approach, the Partnership Project, and the Study of Technology (Kent State). The third group included the Maryland Plan and the Alberta Plan. All nine programs were included in the fourth group: each of those previously identified plus the Study of Technology (Oswego, NY), the Industrial Arts Curriculum Project, and the American Industry Project.

Two possible leading conclusions were suggested by Lux (1967). The first was that previous curriculum guidelines and methods for comparison cannot cope with emerging developments. Second was that a new method for curriculum comparison was needed.

Householder (1974) also classified alternative curriculum project efforts using a similar system which drew from this classification system. Several curricula that focused on the technology-centered approach were determined by Householder (1974). A second alternative category was the Career-Occupation Emphasis. He further identified alternative curricular strategies that revolved around career or occupational education. One area of alternative programs was individual development emphasis. Householder (1974) finally identified a category for evolutionary approaches to industrial arts. He determined that the emphasis in these programs was based primarily on ". . . the improvement of the existing industrial arts curriculum" (p. 33).

The two curriculum classifications that had the greatest impact on the development trends of industrial technology currciula were the interpretation of industry and technology-oriented programs. The following examples were included in these classifications.

The interpretation of industry programs included the American Industry Project (Cochran, 1970; Lux, 1967; Streichler, 1980), the Functions of Industry (Cochran, 1970; Streichler, 1980), Orchestrated Systems Approach (Cochran, 1970), the Industriology Project (Cochran, 1970), and the Georgia Plan (Cochran, 1970). The most widely accepted program from this classification was the American Industry Project. Many of its characteristics are typical of programs in this classification. The "American Industry Project" directed by Face and Flug derived two broad based subject matter objectives (Streichler, 1980) from educational theory based on the Seven Cardinal Principles of Education. "They are (1) to develop an understanding of those concepts that apply directly to industry, and (2) to develop the ability to solve problems related to industry" (Cochran, 1970, p.40). The instructional content was developed via a taxonomy which included thirteen common industrial concepts. "These included communication, transportation, finance, property, research, procurement, relationships, marketing, management, production, materials, processes, and energy" (Cochran, p. 40). Lux (1967) identified a fourteenth concept, physical facilities.

The technology-oriented programs were represented by the Alberta Plan (Cochran, 1970; Householder, 1974; Lux, 1967; Streichler, 1980), Enterprise: Man and Technology (Householder, 1979), Study of Technology: Kent and Oswego (Lux, 1967), The Industrial Arts Curriculum Project (Cochran, 1970; Lux, 1967; Streichler, 1980), Technology as Discipline (Householder, 1979; Streichler, 1980), The Maryland Plan (Cochran, 1970; Streichler, 1980), The Maine State Plan (Cochran, 1970; Olson, 1963), and the Parma (Ohio) Approach (Cochran, 1970). The most recognized curriculum plan in this classification is the Industrial Arts Curriculum Project (IACP). A broad overview of technology was provided by the IACP as compared to conventional industrial arts coursework. The rationale and structure for the project were formulated by " . . . representatives from education, business, industry, and labor" (Cochran, 1970, p. 78). Streichler (1980) viewed the IACP as a refinement of earlier work completed in industrial arts curriculum. It delimited the content of industrial arts into two distinct categories: manufacturing and construction. The content was then organized for ease of instruction.

Two phases, "The World of Construction" and "The World of Manufacturing", were identified as the means to deliver instruction meeting established objectives. The objectives were designed to emphasize industrial knowledge from general knowledge. Industrial technology was defined in the IACP " . . . as that knowledge which is used to satisfy man's wants for industrial material goods, and it is composed of two principal industrial divisions: construction and manufacturing" (Cochran, 1970, p. 79).

The remaining two curriculum classifications, the integrative and occupational family programs, have not contributed in a significant manner to the development of industrial technology curricula. No programs from these classifications will be included in this literature review.

<u>Industrial Arts in the 1970s and 1980s</u>

Streichler (1980) retraced industrial arts curricula to its roots of woodworking, metalworking, and drafting. He also noted that little change occurred during the 1960s and 1970s as indicated by the Schmitt and Pelley report of 1966 and the Schmitt follow-up of 1976. He did note, however, that while fewer students were enrolled in traditional courses the new courses were merely an extension of materials and processes not a broader interpretation of technology.

Streichler (1980) found that Schwalm developed a concept-based curriculum that was interdisciplinary in nature. The difference being that he selected only graphic arts and developed the curriculum in depth around visual communications. Likewise Householder (1974) found that Risher had developed a similar program but for Applied Technical Power.

Streichler (1980) analyzed the 1978 Industrial Teacher Education Directory and found that 80% of the teaching areas continued to follow trade, material, or process oriented activities. Additionally, Streichler identified in his analysis titles of academic units which used technology as a modifier to either give credence or communicate diverse practices. These titles included:

Industrial Education and Technology
Industrial Arts and Technology
Industry and Technology
Engineering Technology
Industrial Technology
Technology Education
Applied Science and Technology
Engineering and Technology
Applied Science and Technology

Engineering and Technology

Technology (Dept. of, Div. of, School of, College of)

Science and Technology

Scientific and Technological Studies

Vocational Education and Technology

Streichler (1980) further supported his argument of little change in titles by comparison to his 1970 study. This study of topics included in NDEA Institutes reflected diversity in the field. When compared 10 years later to the Industrial Teacher Education Directory, little change had occurred.

Lauda (1988b) related that although technology education has not been fully applied in the entire country, its curricular design has responded to the needs of our culture. It is a sound concept, is attainable, and addresses primary technical activities. The curriculum is designed around the systems concept of the inputs, processes, and outputs for technologies of construction, communication, manufacturing, energy/power, and transportation.

Sterry (1987) proposed the context of the Jackson's Mill human adaptive systems be used to analyze technology content of systems, productive processes, resources and outputs until something more appropriate is devised. The taxonomy of content concepts for the Jackson's Mill project was used to describe inputs, productive and managerial processes, and outputs. Content was developed to suit the school's needs.

Savage and Morris (1985) recognized that industrial arts began in United States school programs as manual training. Drafting, metalworking, and woodworking courses were organized to develop technical literacy by addressing needed technical attitudes, knowledge, and skills. Typically, emphasis was placed on education for the technical skills and American industry. They determined that current needs now dictate that focus should be on developing technological literacy. This would provide an understanding of our highly technological world and the relationship to humankind as it affects our future industrial-technological culture.

The Technology Systems Matrix model was proposed by Savage and Morris (1985) as an attempt to encompass the breadth of industrial technology. The Technology Systems Matrix had three dimensions of technology in its content structure as proposed by McCrory. These elements were "elements of technology, contexts of technology, and levels of complexity" (McCrory cited in Savage & Morris, p. 7). Conceptually, the Technology Systems Matrix integrated "four industrial technology systems with eight content areas at four levels of instruction . . ." (Savage & Morris, p. 7). The content areas in a hierarchial model for each industrial technology system in the matrix are: "(a) society and culture, (b) environment, (c) research and development, (d) tools, (e) resources, (f) techniques, (g) maintenance, and (h) management" (Savage & Morris, p. 7). Likewise, a learning task hierarchy for each industrial technology system is provided: "(a) introduction, (b) application, (c) sophistication, and (d) progression" (Savage & Morris, p. 8).

Savage and Morris (1985) designed the second-generation matrix for independent application of each industrial technology system to each content area for each level of instruction. The purpose was to add clarity and direction to the technology system when constructing courses.

Additional course construction clarity and direction are achieved in the third-generation matrix. Independent application of industrial technology component areas to content for each level of instruction was possible. Applications for the technical methods from a second-generation matrix component area were also included at this level. The integration of technical methods, content areas, and level of instruction composed the complete third generation matrix. Within the matrix, isolation of a technical method for a specific content area at a distinct instruction level was provided for instructional purposes (Savage & Morris, 1985).

Bjorkland (1988) identified two curriculum innovations of the 1960s and 1970s; "Industry and Technology Education" authored by Sterry and Wright and "The Illinois Plan for Industrial Education" in 1983; that provided a firm foundation for technology based innovations. Each reflected a focus on industrial clusters rather than materials. The former was patterned after the "Jackson's Mill Industrial Arts Curriculum Theory" and developed content structures for " . . . the systems of communication, construction, manufacturing, and transportation" (p. 116). The latter curriculum was developed to emphasize the industrial technologies of communication, energy utilization, production, and transportation. He also noted that Minnesota's curricular plan had been revised to utilize four clusters similar to the Illinois Plan.

Sutton and Carter (1986) identified a redirection for the future role of industrial arts. They proposed that students be provided with realistic activities in utilization and manipulation of "materials, tools, processes and systems being developed and utulized in industry and society" (p. 12). Further they recognized that evolution from manual training through manual arts to industrial arts was a response to societal change. Sutton and Carter determined that a change to industrial technology programs would best "reflect the 'science and technology' thrust of present and future technological development" (p. 12).

A comprehensive industrial technology education program focused on action-based activities impart knowledge about "technical means, their evolution, utilization, and significance with industry, its organization, personnel systems, techniques, resources, products, and their social/cultural impact" (Sutton & Carter, 1986, p. 12). Sutton and Carter found that student time was spent "learning about technological devices and systems with emphasis on developing basic skills in robotics, lasers, electronics, energy systems, computer drafting and design, telecommunications, and other technologies" (p. 12).

The following content organizers were used by Sutton and Carter (1986) when setting goals for industrial technology education:

1. Communication Systems. This area includes courses in drafting, graphic communications, computer graphics (CAD), computer communications systems, and related content.
2. Construction Systems. Courses included are construction materials, construction techniques, wood technology, and related content.
3. Manufacturing Systems. Courses included are materials and processes, metal fabrication, plastics and composites, production manufacturing systems, and related content.
4. Power/Energy/Transportation. Courses included are power and energy, electricty and electronics, automotive principles, fluid power, environmental issues, nuclear power, alternative energy systems, and related content. (p. 13)

Sutton and Carter (1986) proposed that the major instructional objectives of industrial technology education programs at the secondary level should be:

1. To assist students to develop an insight into and understanding of industry and technology, its place in our society and the free enterprise system.
2. To assist students to discover and develop

individual talents, aptitudes, interests, and potentials as related to industry, science, and technology.

3. To assist students in developing an understanding of industrial processes and the practical application of scientific principles.
4. To assist in developing technical problem-solving and creative abilities involving the use of materials, processes and products of industry and technology.
5. To assist students to develop an understanding of industrial and technological career opportunities and their requirements and develop those traits which will help students obtain and maintain employment. (pp. 12-13)

Holloway (1987) defined high technology as "the application of state-of-the-art automated, instrumented, or computerized complex systems, devices, or machines which are relatively new to the marketplace" (p. 12). For proper application of high technology curricula it must be understood that high technology is systematic, has many technologies characterized by computer and microprocessor utilization, and is subject to rapid changes in technical content.

Achievement of overall program objectives and provision of job entry skills should be the goal for high technology curriculum content and organization (Holloway, 1987). He also identified common core competencies needed for successful graduates of high technology programs. Basic core competencies needed:

Broad based knowledge in multiple technologies.
Understanding the systems concept and interrelationship among systems components.
Working knowledge of electronics, computer science, mathematics, physics, and chemistry.

> Ability to assemble, install, operate, maintain, troubleshoot or repair electronic, mechanical, electromechanical, fluidic, thermal, and optical devices, components and systems.
> Expertise in communicating with a variety of personnel within the occupational hierarchy.
> Flexibility in adapting to new assignments, new situations and changing job requirements. (p. 13)

McCrory's (1985) viewpoint of technology education was that it had a broader base than did industrial technology. Industrial technology he contended only impacted on the technologies of industry and did not take into account the effects of technical systems on individuals and society.

Industrial technology education is limited in scope (McCrory, 1985). He contended that its focus was to educate young people about the "organization, materials and procedures of specific manufacturing industries" (p. 2) for careers in contemporary industry. The role of those with postsecondary education is management.

McCrory (1985) recognized that content organizers of both technology and industrial technology education were the same but content emphasis differed. Technology education has a macro view of the evolution of technical developemnts and the impact on society as a whole. Industrial technology conversely focuses on the "knowledge and skills used in contemporary industries" (p. 2) employing the task-analysis approach.

DuVall (1984) determined that because of rapid change taking place in industry in response to high technology inputs the future will differ from the past. Significant of this change are flexibility and lower capital expenditures that permit industry to adjust their product, service, or process to meet society's needs. High technology companies typically locate near universities to establish a research link with the univeristy, to have a reliable source for technically trained personnel, and to have the capacity to keep up with new technology. DuVall (1984) also recognized the potential these developments have for curriculum development. Some offerings in universities have changed in response. Representative courses include "CAD/CAM/CIM . . . more intensive offerings in computer technology, electronics, communications, and robotics" (p. 9). DuVall implied that curriculum change that anticipates the future will help students be prepared for careers that do not yet exist.

Goetsch (1984) postulated that high technology marked the birth of a new age potentially as significant as the Industrial Revolution. Impacts on industrial education include the need of new training programs for high technology positions, curriculum revision, equipment modernization, facility reorganization, and in-service education for personnel.

In deference to Vanderslice, Goetsch (1984) determined the birth of high technology coincided with the invention of the integrated circuit in the late 1950s. Schuler (cited in Goetsch, p. 17) defined high technology as:

> the application of programmable integrated circuits and programmable systems based on integrated circuits to areas including, but not limited to, data processing, manufacturing, information management and transmission, education, national defense, entertainment, energy management, pollution control, safety, communications and efficient utilization of natural and human resources.

Six characteristics of high technology occupations have been identified by the Center for Occupational Research and Development (CORD). The characteristics:

> require that workers have a broad knowledge base
> involve heavy and frequent computer use
> involve rapid and continuous change
> are systems oriented
> require an in-depth understanding of underlying principles
> require a flexible work force. (cited in Goetsch, 1984, p.17)

To educate for high technology occupations a four-part learning core "of applied math and science, communications, socioeconomics, and technical prerequisites" was recommended by CORD. The integral parts of the core are outlined in Goetsch (1984):

> The applied math and science portion of the curriculum includes algebra, trigonometry, analytical geometry, applied calculus, and physics.
>
> The communications portion covers technical communications and computer basics, . . . socioeconomics includes economics and industrial relations.
>
> The technical prerequisites include electricity, electronics, properties of materials, mechanical devices, manufacturing processes, circuit analysis, heating and cooling, fluid power, instrumentation and control, computer applications, and industrial electrical power and equipment. (pp. 17-18)

Upon completion of the common core, students specialize in an area of high technology.

To meet the challenge of high technology developments traditional industrial education programs must be updated. Goetsch (1984) proposed a two-part solution that included:

> developing, implementing, and maintaining new high technology programs, and updating and maintaining existing programs that are affected by high tech developments. (p. 18)

Cooperation between education and industry to pool resources and share financial burden is required if satisfactory solution of the high technology challenge is to be achieved. Strategies proposed to aid this process include: formation of industry-education councils for decision-making about curriculum development, facilities, equipment, expert personnel, how to share expertise of each entity, how to share budgeting for high technology equipment, and methods by which educators can be updated about high technology (Goetsch, 1984).

Industrial Technology

Industrial technology as a field of study is broad, yet diverse. Definitions, characteristics objectives of early industrial technology programs are needed to help delineate the development of the field.

Weber (1961) provided the following definition of industrial technology in the results of his doctoral study:

> ...an educational program designed to give the student an insight into how goods are produced (through shop courses), a knowledge of the problems of management and distribution (through commerce courses), and the ethical foundation for making decisions (through general education courses). (p. 175)

The characteristics of industrial technology programs were discovered by Weber (1961) as:

> (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 programs, and (5) qualifications of instructional staff are identical to those of other four-year college programs. (p. 176)

Weber (1961) identified that the major difference between industrial technology and industrial arts education or technical institute training was " . . . in the general area of preparing students for positions in management" (p. 176).

Kleintjes (1969) paraphrased the list of the most accepted objectives for industrial technology programs from Keith's study. The objectives were to:

> (1) provide instruction in the technology of a specific industry, (2) prepare for managers and supervisors in industry, (3) prepare for industrial positions that do not require engineers, (4) give a broad general background, and (5) familiarize students with basic tools, materials, and processes used in manufacturing industries. (p. 119)

A 1966 report published by the American Vocational Association (cited by Kleintjes, 1969) defined the industrial technologist as follows:

> The 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, and human relations with extensive educational experience in technical theory and manipulative abilities in a field of specialization as well as in closely related fields. He is able to work with scientific personnel and contribute to their ideas as well as to supervise and manage people and to coordinate their efforts in the utilization of materials and machines for producing and distributing industrial products. (pp. 94-95)

Cunningham's study (cited in Kleintjes, 1969) used the following to identify the applied scientist (now industrial technologist) as:

> A student who successfully pursues one of the industrial technologies as a field of specialization along with approved courses in other technical sciences and in human relations . . . humanities, social sciences, educational and managerial sciences, . . . is an applied scientist.
>
> The applied scientist is 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, and human relations with extensive educational experiences in technical theory and manipulative abilities in a field of specialization as well as in closely related fields. He is able to work with scientific personnel and contribute to their ideas as well as to supervise and manage people and to coordinate their efforts in the utilization of materials and machines for producing and distributing industrial products. (p. 95)

Keil's (1966) paraphrase of Weber's definition of the industrial technologist was a good summary. It stated:

> Industrial technologist. A college graduate who is associated with technical, supervisory or managerial activities in an industrial field. He is management oriented, rather than engineering oriented, in his approach to technical, scientific or human relations problems. The industrial technologist's background is broad and general rather than specialized; he has had a solid foundation of courses in mathematics and physical sciences; he has had a variety of experiences in shops and laboratories designed to give him insight into how goods are produced; he has had some courses in business

> administration designed to give him insights into the problems of management, distribution and economics; and he has had general education courses designed to equip him with communication and human relations skills and an ethical foundation for making decisions. (p. 12)

Developmental Eras of Industrial Technology

A 1973 study by Talbott identified four distinct eras of development for industrial technology: 1912-1950, 1950-1960, 1960-1965, and 1965-1971. These eras represented groupings of activities and trends shaping the curriculum. For the purpose of organization this researcher has added a fifth era to include the years 1971-1988.

The first era, 1912-1950. Slow progress characterized industrial technology as a curriculum area in the era prior to 1950. The first era was characterized by programs designed to meet the needs of students and local industry (Talbott, 1973). The first four-year industrial technology degree program was established at Bradley University in 1923. The program " . . . (was) termed applied science and is a part of the School of Engineering and Technology" (Lewis & Robinson, 1969, p. 78). Five other four-year industrial technology programs were established prior to 1950. They were at Alabama A. & M. College, Arizona State University, Kansas State College, Southern Illinois University, and West Virginia State College (Hauer, 1963). Talbott further identified the founding of programs by 1950 at Utah State University, Colorado State University and

Montana State University. Cunningham observed that the technical manager works within industry's industrial technology division and has need for " . . . three basic skills: technical, human, and conceptual" (1969, p. 36). The technical manager is responsible for four industrial functions: " . . . planning, organization, actuating, and controlling" (Cunningham, p. 37). A broad educational background is needed for this person as defined previously in the 1966 American Vocational Association report (Kleintjes, 1969).

The second era, 1950-1960. Advances in materials, techniques, and management methods helped define the programs of the second era. The programs that met the new challenges evolved from departments of industrial arts (Talbott, 1973).

Adding impetus to the industrial technology movement was the emphasis removal from skill and management courses in engineering curricula. The resultant graduates no longer had preparation for supervisory positions in industry. Industry needed universities to provide them educated, technically competent individuals with supervisory capabilities (Boaz, 1965). Gallington (cited in Silvius & Curry, 1971) stated:

> The demand for college graduates is based on the need for more and more managerial-type personnel. Generally, it is preferred that persons advanced into

> leadership positions in industry have at least a baccalaureate degree. (p. 20)

Higher education institutions rapidly initiated industrial technology programs "to prepare graduates for teaching in industrial technical education and for managerial employment in construction and manufacturing industries" (Cunningham, 1969, p. 38).

The report of the Four-year Technology Committee of the American Vocational Association (cited in Kleintjes, 1969) about emerging four-year technology programs can be summarized in the following. Industrial technology curricula were designed to train for supervisory and middle management positions rather than for a specialized occupation. These students are prepared for leadership positions in industry. The graduates need knowledge of engineering and management, industrial processes, machine and equipment operations, and applied technical and performance skills. The breadth of training is an asset to a graduate of this program. Industry has a need for individuals with a broad education background to be able to cope with the rapid change in tools, processes, and techniques yet still be able to function in a responsible administrative capacity.

Technology programs began to spring up all across America, but the period was characterized by random growth and little communication among programs (Talbott, 1973).

These programs Weber (1961) identified as originating from three basic sources:

1. Industrial arts departments with a non-teaching option in industrial technology,

2. Industrial technology departments which were separate from or included the industrial arts programs, and

3. Engineering technology options which were staffed by engineering departments.

Hauer (1957) recommended an exhaustive study of industrial technology programs as a result of his study. It included a section about curriculum comparison where the elements compared were general education, professional education, and technical education.

General education courses were "classified in the general areas of communications skills, social studies, biological and physical sciences, mathematics health and physical education" (Hauer, 1957, p. 4). Requirements varied with one area, communications, having a high of 18 required hours. This area included speech and technical writing requirements in addition to English. Mathematics had a minimum nine semester hour requirement and analytics and calculus were indicated as being beneficial. Science requirements for students preparing for industry included both chemistry and physics. A student's areas of concentration dictated the number of credit hours (3-9) in economics. The data also tended to support, to a lesser degree, that one general psychology course was required and in some instances, industrial psychology.

Comparison of professional education requirements (Hauer, 1957) indicated that course offerings in industrial technology generally required "a sufficient number of industrial engineering type courses to give a broad understanding of industrial organization and management" (p. 4). Hauer listed courses representative of professional education:

> Industrial organization and management
> Production management
> Motion and time study
> Quality control
> Occupational analysis
> Industrial relations
> Industrial safety
> Accounting practices. (p. 4)

Hauer (1957) revealed in his comparison of technical education requirements that drafting was a must although the choice of concentration dictated the amount of credit hours. Semester hours required varied by institution but it was common for students to have basic preparation in all technical areas plus an area of specialization. Finally, electives within curriculums were provided to satisfy personal interest, to recognize individual differences, to provide a broader education or to enhance a field of concentration.

Hauer (1957) presented three conclusions in the results of his study. First, industrial technology curriculums seemed to be a mix of "industrial education and engineering with the field of concentration centered in industrial education" (p. 5). Second, the curriculums were broad in scope representative of "different areas of learning as well as cultural subjects and a very definite field of specialization" (Hauer, p. 5). Finally, even though industrial technology degree programs were fledgling, a definitive pattern of curriculum organization existed. Hauer identified these areas as: "general education, professional education, technical education, and electives" (p. 5).

Poyzer (1958) reported that the average number of credits required for majors had changed. He compared average semester credit hours required in 1948 (39) to 1958 (41.5) and to a projected average semester hours for 1960 (52.4). Poyzer's conclusions were: majors have changed since 1948; the greatest changes were in "mechanics, electricity, graphic arts, and crafts" (p. 2); and that weaker majors have strengthened because credit hours have been expanded. Also noted were suggestions by respondents that an increase in course work could be found in the areas of electricity and power mechanics. Still others suggested that consideration or requirement of course work in physics, mathematics, science in general, design, and English would be added. A final suggestion that areas of specializataion within majors would be advanced. However, those colleges providing specialization typically represented "large-city-colleges" (Poyzer, p. 2).

Glazener (1959) reported that 75% of departments trained students for degrees other than industrial arts education. Seventy-nine responses were received identifying nine different names for degree options. Three degree names were predominant: Industrial Arts Majors (27), Vocational I. E. Majors (23), and 4-year Industrial Technology (16). The average number of students enrolled as majors in these degree options were 90, 15, and 65 respectively.

It was the opinion of Glazener (1959) that industrial arts teacher education programs offer other options to meet the needs of students who wish to enter industry-related occupations. Another observation focused on the offering of non-teaching options to prepare students for occupations pertinent to local industry. He also noted that degree requirements were practically the same between the teaching and non-teaching options. His final statement made note that Industrial Technology was the most frequently used name for non-teaching degree options.

By 1963 industrial technology degree programs were represented by 50 institutions in 27 states. The majority of these programs were located in the mid and far western United States. Industrial education and industrial arts were the typical department titles. However, some change to titles that included science and technology was noted

(Hauer, 1963). Hauer also indicated in this study that during the decade 1950-1959 twenty-four programs were initiated.

Hauer (1963) reported that designation of degree type for industrial technology followed four practices. These practices were:

> (1) The greater number of institutions chose to offer the B.S. in Industrial Technology. (2) Several institutions offered the B. S. in Industrial Education with the designation of non-teaching option. (3) Others chose to title the degrees according to the specific area of concentration, such as B. S. Aeronautical Technology or B. S. Tool and Manufacturing Technology; and finally, (4) there were those institutions that offered a degree that was more descriptive of their particular curriculum and which may be called unique such as listed below:
> B. S. Industrial Technology - 20
> B. S. Technical Science
> B. S. Industrial Science
> B. S. Industrial Distribution
> B. S. Business and Industry
> B. S. Industrial Supervision
> B. S. Education for Industry
> B. S. Industrial Management
> B. S. Applied Science
> B. S. Industrial Preparation
> B. S. (Major in Industry)
> B. S. Engineering Technologies
> B. S. Industrial Education (Non-teaching or Option)
> B. S. Aeronautical Technology
> " Electrical Technology
> " Technical Design
> Etc. (p. 238)

Hansen (1964) studied catalogs of several land-grant college and university catalogs and determined that many different industrial-technical programs were offered with a variety of titles. Typical programs were found " . . . in the college or school of engineering, . . . college of agriculture, and many technical curricula . . . in the industrial education departments of teachers colleges" (p. 48).

It was concluded by Hansen (1964) that "Degree curricula in industrial technology are broad in scope, highly successful, and dynamic in the institutions which were investigated" (p. 197). Lewis and Robinson (1969) revealed after a comparison with curricula of the time that " . . . differences in depth of coverage in mathematics, physics, chemistry and electronics, . . . " (p. 84) exist. The differences identified were shown to be that industrial arts required education courses, and engineering concentrated on special course work. Industrial technology was found to be more broad-based and included business, management, and more in-depth technical course work.

Erber (1969) stated that to understand the differences in these programs one must have:

> A meaningful apprehension and appreciation of the highly sophisticated technological systems of industry demand mastery of the fundamental principles of mathematics, mechanics, physics, chemistry, and many other aspects of basic science. An understanding of these disciplines is imperative to the rational interaction of man with industrial tools, machines, instruments, materials, processes, and the computerized technological systems of the future. (p. 46)

Cunningham (1969) determined that:

> The division of industrial technology is composed of the areas of design and refinement, production and manufacture, field service and product utilization, distribution and sales, and education and training". (p. 34)

The third era, 1960-1965. Talbott (1973) depicted the third era as one of rapid, random growth accompanied by a search for direction. Hauer (1963) reported that by 1963 approximately 44 institutions offered programs in industrial technology. Of these, 13 were established during the years 1960-63. Another seven with no founding date had also been established and many programs were being planned (Hauer).

Programs had developed along diverse and conflicting courses. As a result, two definitive program types had evolved: the general and the specialized (Talbott, 1973). The general type stressed production and management. The specialist type focused on special field technical training (Talbott).

Barnhart (1963) subdivided industrial technology curricula into two main categories, general programs and specialized programs.

> The former appear to be designed primarily for the preparation of personnel for managerial and supervisory positions, requiring a broad technical background combined with a working knowledge of business and managerial techniques. The "specialized' programs place less emphasis upon the professional courses, and require a fairly extensive specialized training in one technical field, supported by a broad basic knowledge of all fields of technology. (p. 240)

Talbott (1973) found that in the era, 1960-1965, these "technology" programs searched for a definition and two basic groups of programs, "general" or "specialized", developed. Kicklighter (1987) related that:

> The "general" program was the most common and was centered around production and management. The "specialized' program was generally structured around in-depth technical courses and eventually formed the base for many engineering technology programs. (p. 15)

Further classification of specialized programs described the following groups: "Aeronautics, Automotives, Building Construction, Drafting and Design, Electricity-Electronics, Graphic Arts, Metals and Manufacturing, and Woodworking" (Barnhart, 1963, p. 240). A final classification for professional needs courses identified categories for "Communication, Science and Mathematics, Professional and Technical Areas" (Barnhart, 1963, p.240).

Barnhart (1963) had made the following assumptions prior to tabulation of the survey of institutions with membership in the Mississippi Valley Industrial Arts Conference. They were:

> 1. Communication was assumed to include courses in Rhetoric and Composition, Technical Writing, Speech, and similar titles, but to exclude courses in literature and languages.
> 2. Science and Mathematics included, for the purposes of this report, only Physics, Physical Science, Chemistry, and Mathematics, since it was felt that Biological Science would bear little relationship to the industrial occupations for which these curricula were designed. In nearly every case, the required courses tabulated as Physics or Physical Science were in the area of Physics.
> 3. Professional courses were assumed to include non-technical courses which would aid the industrial technologist in the performance of managerial duties. Typical titles of these courses are Industrial Management, Industrial Psychology, Labor Relations, Industrial Safety, Personnel Administration, Accounting, and Business Law.

> 4. Technical courses were grouped according to whether they functioned as supporting courses by providing a general technical background, or contributed directly to the technical knowledge required in a narrow industrial field. In the case of the "general" Industrial Technology programs, all technical courses were listed under the "general" heading, although it should be noted that in one or two instances, students were advised to build up one or two minor areas of technical specialization, even under the "general" program. (p. 241)

Cunningham and Erber (cited in Erber, 1969) divided the industrial technology curriculum identified by Cunningham into two components: human relations and technical sciences. Human relations was further divided into subparts consisting of humanities, social sciences, and educational and managerial sciences. The technical sciences were subdivided into technical mathematics, physical sciences, and fields of technological specialization.

Barnhart's (1963) analysis revealed a wide variation among individual program requirements but a great similarity between the mean requirement per subject among the programs. An influencing factor may have been the number of programs offered in fields of technology by larger departments. Individual perspective differed among programs as some required no chemistry, or no mathematics, or no professional courses.

Given the rate of expansion for industrial technology programs, Barnhart (1963) suggested that agreement is needed on basic ingredients for these programs. The minimum consensus should be for "terminology and requirements in various subject areas" (p. 242).

This period witnessed significant growth and, according to (Boaz, 1965), 68 colleges offered industrial technology (IT) programs in 1963. The years following 1965 saw the organization of the NAIT (1967) and an increase in the number of institutions offering technology programs to over 80 institutions in 1966 (Harris, 1969).

Silvius and Curry (1971) wrote that a report from the Thirty-Fourth Annual Report of Engineers' Council for Professional Development for the Year Ending September 30, 1966 had determined that:

> A number of colleges and universities throughout the United States, . . . , are initiating four-year technology curricula in response to the needs of industry. (p. 20)

Defore (cited in Silvius & Curry, 1971) revealed " . . . that more than 80 institutions had established curricula to prepare technologists, and that many had been organized since 1960" (p. 20).

To offset the rapid growth of technology programs in the 1960s, engineering educators examined accreditation of four-year engineering technology programs as a possible alternative to ensure strong engineering education (Talbott, 1973).

Erber (1969) noted that problem solving was an application of knowledge for which industrial technology education is particularly well suited. Cunningham (1969) agreed that industrial technology education knowledge areas met the needs of industry for the areas of "design refinement, production and manufacture, field service and product utilization, distribution and sales, and education and training" (p. 34). Erber (1969) related in response:

> Therefore, educational institutions are responding to this demand through the establishment of curriculums in industrial technology that provide a foundation for the development of professional efficiency in these specified areas. (p.56)

Groneman (1963) identified curricula offered by institutions granting baccalaureate degrees in industrial technology and presented requirements of each. The 4-year Bachelor of Science curricular program at Arizona State University had a common core that was designed to prepare students for specialization in one of six options. Students could specialize in:

1. Aeronautic Technology.
2. Electronic Technology.
3. Graphic Arts Technology and Management.
4. Technical Design.
5. Tool and Manufacturing Technology.
6. Welding Technology. (p. 256)

The Bachelor of Science degree at Long Beach State University was identified as industrial technology. The program was designed to provide options in:

1. Building Construction Coordination.
2. Electronics.
3. Tool and Manufacturing. (p. 256)

Western Michigan University's program was designed to offer Bachelor of Science degrees in:

1. Mechanical Engineering Technology
2. Electrical Engineering Technology
3. Automotive Engineering Technology
4. Industrial Engineering Technology
5. Industrial Supervision. (p. 256)

Brooks (1970) reported a 50% response rate to his survey. He found that eighty institutions now offer "some type of industrial or other type technology program" (p. 98). The two most frequently used department names were industrial technology and industrial education. The following comprise a complete 1970 listing of department names:

Industrial Technology
Industrial Education
Industrial Education and Technology
Industrial Arts and Technology
Industrial and Technical Education
Industry and Technology
Industrial Education Technology
Engineering Technology
Division of Technology
School of Industry
Industrial and Technical Studies
Applied Science and Technology
Industrial Studies
Occupation Education
Industrial Arts
College of Industry
Applied Science
Vocational and Techncial Education
Technical and Applied Arts
Industrial Management
Education for Industry (Brooks, 1970, p. 98)

Brooks (1970) delineated the organizational pattern in which industrial technology programs exist. He indicated that school of technology was preferred, but names in the following list illustrate that was not the norm.

School of Technology
College of Technology
Division of Technology
School of Engineering and Technology
College of Engineering
Department of Industrial and Technical Education
College of Education
Division of Industrial Educational (sic) and Technology
School of Industrial Educational (sic) and Technology
Department of Applied Science
School of Science and Technology
School of Vocational Education
College of Applied Science and Technology
School of Professional Studies
School of Business and Industry
School of Industry
School of Arts and Sciences
College of Professional Schools (Brooks, 1970, p. 99)

The respondents indicated that courses and areas of instruction were shared between industrial arts and industrial technology. However, separation of the two areas was desired by several respondents. There was a tendency indicated by the respondents that technology students were involved in more advanced industrial technology courses than were industrial arts students (Brooks, 1970).

Gunderson (1964) reported that 120 courses were dropped and 151 courses were added to industrial arts curricula in thirty-six post-secondary programs. Representative of dropped courses in three programs were saw fitting, farm and home mechanics, concrete work, fundamentals of mathematics, geography, public health, aeronautics, machine shop, advanced artmetal, multilith printing, multigraph printing, elementary surveying, and mechanical drawing. Numerous other courses with a frequency of two were dropped. These courses seemed to be categorized into four groupings: woodworking (7), aviation (6), drafting (5), and general industries (5).

The most frequently identified courses added to the curricula were electronics (13) and electricity (4). No other course was mentioned more than two times. However, 28 courses were indicated in this frequency range. Identifiable categories among these courses were drafting (8), metalworking (5), facility design (3), and general industrial arts (3).

Mathematics requirements for students majoring in industrial education were selected from 34 varied course titles. The most frequent responses were represented by college algebra (13) and trigonometry (10). The average semester hours required for member programs of the Mississippi Valley Industrial Arts Conference was 4.25 and for non-members the average was slightly higher at 4.85 semester hours. The composite was 4.59 semester hours.

Alternatives to requirements in the sciences could be selected from 28 different courses. Physics (28), chemistry (13), and physical science (13) were representative alternative courses. The semester hours average for science requirements was 8.11 for Conference members. This compared with 11.36 semester hours for non-members and a composite of

10.09 semester hours (Jarvis, 1959). It is possible that these differences reflected program emphasis. The more traditional industrial arts curricula was representative of Conference members while non-members requirements were indicative of a shift in emphasis to industrial technology curricula.

Dell (1964) presented that the focus of his paper was that change was permanent in society. He supported this supposition with data from selected surveys of various schools. The data were organized to demonstrate courses added and dropped from the curriculum. The following lists were developed to show the relationship of courses and hours either dropped or added in individual schools representative of these states.

Nebraska School

Courses Added	Hrs.	Courses Dropped	Hrs.
Crafts	9	Fundamentals of Woodworking	(combined - 3)
Electricity-Electronics	6	Woodworking for Women	2
Graphic Arts	13		
Metals	6		
Graduate courses	45		

Kansas School

Courses Added	Hrs.	Courses Dropped	Hrs.
Occupational Analysis	2	Carpentry Square	2
Industrial Arts for Elementary Teachers	2	Industrial Arts for Elementary Teachers (no support from education department)	2
Advanced Industrial Drafting	3		
Drafting Problems and Techniques	2		
Dynamotive Analysis	3		
History and Philosophy of Industrial Arts	2		

Oklahoma School

Courses Added	Hrs.	Courses Dropped	Hrs.
Complete Electronics Program	____	Bench Woodwork	____
Moving toward Power Mechanics (Engineering Hydraulics, Fluid mechanics, Refrigeration, etc.)	____	Industrial Arts Design	____
		Care of Shop Equipment	____
		Wood and Metal Finish	____

Missouri School

Courses Added	Hrs.	Courses Dropped	Hrs.
Electric Drawing & Computation	2	Three in Drafting have been refitted and contents revised -- Total credits hours in the three courses (grand total in Drafting -- 18 hours).	8
Electricity - Electronics	14		
Power Mechanics	14		
Woodworking	3		
Graphic Arts & Photography	8		
Metals	3		
Drafting	2		
Graduate Industrial Arts	29		

(p. 83)

The fourth era, 1965-1971. Talbott (1973) determined that the fourth era started when the first of three annual preliminary Conferences on Industrial Technology in American Higher Education was held in October 1965 at Kent State University. It was determined that by 1967 the number of industrial technology programs had blossomed to over seventy-five with more programs being planned (Cunningham, 1969). The organization and initiation of the National Association of Industrial Technology in October, 1967 was a direct result of these conferences and the blossoming of industrial technology programs (Talbott).

During the third conference five task forces were organized to formulate the foundation for future growth of the association (Keith, 1986). Of the five Task Force Teams, only teams "A" and "C" are pertinent to this review. One of the first reports of "Standards and Curriculum Guides" by Task Force Team "A" at the 1967 Conference concerned the development of curricular guidelines for four-year baccalaureate programs in industrial technology (Keith). Task Force Team "A" identified three categories of the curriculum upon which to focus: liberal arts, technical speciality, and minors and electives (Keith). Task Force Team "C", Industrial Technology Program Trends and Recent Developments", presented at the 1967 Conference two trends or developments that were developing in industrial technology. The first was " . . . that the use of internships and cooperative field experience was growing . . . " (Keith, p. 8). The second was that program development was diversifying " . . . based on two factors -- the college setting and the area which the college is serving" (Keith, p. 8).

Hunter (1970) reported that since 1945 little change in general education requirements occurred. He noted that there appeared to be "a very limited trend toward grouping of English, speech, social studies, philosophy, history, and psychology into a block and requiring from eighteen to twenty hours of these courses" (p. 4). Hunter was surprised at the few changes planned for the succeeding five years. He also found little interest for internship programs. He concluded that students were not being prepared at the baccalaureate level in computer programming.

Reid (1970) reported that 26 of 42 schools with teacher education programs also had technology programs. Respondents indicated that technology majors were needed by industry for "sales and promotion, electronics, power mechanics, and general technicians" (p. 110).

Streichler (1977) reported on a program development process initiated in 1967-68 at Bowling Green State University (Ohio). The focus was on the cluster concept. It was organized to enhance a proposed new degree, the Bachelor of Science in Technology. The program development was in response to the number of students being employed by industry. The majority of the technical content was defined by three acronyms: MACO, GRACO, and EPIC. MACO was synthesized from manufacturing, construction and material science and encompassed 21 courses. Graphic communication (GRACO) had 14 courses in design, engineering graphics, and printed media production. Energy, power, instrumentation, and control (EPIC) were represented by 10 courses. An industrial internship was added to complete the curriculum.

The technical areas were supported by course work from the College of Arts and Sciences and the College of Business. "Computer science, physics, chemistry, mathematics, industrial psychology, professional speech, and industrial psychology" (Streichler, 1977, p. 7) were typical

Arts and Sciences courses. Course work content for "management, marketing, quantitative analysis and control, organizational behavior, production and personnel problems, and procurement" was provided through the College of Business (Streichler, p. 7).

Streichler (1977) indicated that the clusters had not changed during the past 10 years. The content and specific courses however had evolved in response to industry needs, development of faculty competencies, and physical plant changes.

A comparison of 1967 pre-cluster course offerings and the cluster course offerings of 1977 was conducted by Streichler (1977). The construction cluster had developed as a new concept to include 14 courses. The design area had evolved from four to 12 courses. General technology had grown to 12 courses from one. The newest concept, the internship, had expanded from zero to three course options. Manufacturing had expanded from 10 courses to 21. Energy, power, instrumentation and control/electronics had evolved from three courses to include 14, and visual communication now counted 15 courses as compared to four. It should be noted that few course titles had remained static.

Program development was not envisioned to stop at this juncture. Streichler (1977) previewed plans for continued development. A new program proposed was for the preparation of industrial trainers. Specializations for the areas of electrical and mechanical were being examined for inclusion in the construction area. Architectural/environmental and mechanical/product specializations were being developed for the area of design technology. Supervision, quality assurance and control, and plant and energy technology were being developed to augment current course work. A concentration in electronics that focused on digital computer electronics had been developed for the EPIC cluster. The most innovative development perhaps was the interdisciplinary approach the visual communication technology faculty initiated. Students could select courses from eleven university departments to augment course work in the visual communication cluster. The students were aided by advisors during the course selection process to ensure that course work matched the desired career path of each individual student.

Streichler (1977) had described a typical specialized program in a presentation to the 64th Mississippi Valley Industrial Teacher Education Conference. A core of technical/professional courses, support courses from other academic entities, and an area of specialization comprised the program requirements. This program had evolved in the course of ten years from a general program with specific requirements to a specialized program with flexibility in requirements.

The fifth era, 1971-1988. Van Nest (1973) presented the design for a model program to prepare students for a career as managers in mechanical contracting firms. The curriculum was composed of three major components: general education, major requirements, and electives. The general education was a 36 hour block of courses required of all students. The remaining 88 hours were divided among " . . . general education required of major, major requirements, and electives." (p. 150). Van Nest listed the following courses as the major department requirements for this program.

Introduction to Industrial Technology
Design Fundamentals
Preparation of Technical Documents
Industrial Law
Business Statistics
Marketing
Principles of Accounting I
Construction Blueprint Reading
Quantity Surveys and Estimates
Estimating and Contracts
Construction Supervision
Business Law and Building Codes
Heating and Air Conditioning
Refrigeration
Heating Design
Air Conditioning Design
Heating, Ventilating, and Air Conditioning Equipment
Building Equipment
Plumbing Design
Electives (pp. 150-151).

Gavin (1978) presented results of a study that was designed to determine if technological advancement had influenced curricula in college level industrial technology or industrial education. He selected a jury of 10 leading industrial education educators to identify "the 10 most recent technologies we should be teaching about in our curriculums" (p. 1). Of the 40 items in the survey 14, were identified by two or more jury members. The 14 technologies were:

> solar energy, numerical control, micoprocessors, computer graphics, computer assisted or computer managed instruction, lasers, new materials, synthetic materials, technology's impact on society, communication systems, environmental controls, construction modules, non-traditional metal-separating (EDM-ECM) and material handling (robots). (Gavin, p. 4)

Responses from members representing Mississippi Valley Industrial Education Conference institutions totaled 84.6 %. Eight of the fourteen items identified by the jury received responses from 50 percent or more of those responding. The six exceptions were computer assisted or computer managed instruction, lasers, technology's impact on society, environmental controls, construction modules, and non-traditional metal-separating (EDM-ECM). Items identified by 50 percent of the respondents but not identified by the jury included lamination, electronic control technology, alternative energy sources, and engineering safety. Gavin (1978) concluded that technological advancement had influenced college level industrial technology or industrial education curriculum in approximately two-thirds of those institutions surveyed.

Connor (1986) studied Kansas industries, grouped by Standard Industry Code (SIC), which were employers of industrial technology graduates. The purpose of the study was to determine appropriate industrial technology curriculum content. The findings of the study had three implications for future curriculum development. The first was that a common core of courses from required curriculum areas in industrial technology; with the exception of industrial chemistry, computer programming, and graphic arts technology; could be used to prepare students for employment in any company with job classifications identified by the Standard Industry Code. The second was that curriculum developers needed to recognize the specific needs of certain SIC industries. The third implication was that curriculum developers should realize that leaders in industry still do not sufficiently understand the content of industrial technology (Connor, 1986).

Talbott (1984) noted that although industrial technology has progressed, the programs still do not have wide national recognition. Connor (1986) supported this observation with his third implication. Talbott identified three needs of industrial technology before it can gain widespread recognition. They are: establishment as a unique discipline; attainment of unity among institutions, faculty and students; and development of support from graduates employed in industry. Two years later, Betando (1986) challenged the industrial technology profession to propose methods for increasing cooperation between industry and education. One of the direct benefits of industry involvement would be graduates who are better prepared for work in industry.

Miller (1988) conducted a curriculum study intended to identify changes in industrial technology during the previous five years and to project the directions of curriculum changes in the next five years. An open-ended questionnaire with seven items was developed and sent to 181 department chairpersons. Findings of this study indicated the following: (a) in the past five years numerous curricular changes had taken place in industrial technology, (b) response to curriculum needs is being attempted, (c) required coursework from departments outside the major has changed, and (d) oral and written communication courses were not emphasized to the degree recommended by industry personnel. Miller regarded his study as a contribution to the " . . . empirical basis for rational curriculum development . . . "(p. 26). A basis is provided by the study for debate about whether the profession is responding to the appropriate issues of industrial technology curriculum development and establishment of curriuclum standards.

Kicklighter (1987) conducted a comparison among programs of industrial technology, engineering, and engineering technology. The following differences were revealed. Industrial technology programs had the most general education courses indicating greater breadth of preparation. More management courses for preparation of management-oriented technical professionals were offered by industrial technology programs. Engineering programs had the most requirements in mathematics and the sciences. Engineering technology programs had almost as much mathematics and science as engineering, but had more technical course work subjects than either program.

Kicklighter (1987) also related differences in job functions among graduates of these programs. These differences were identified in the following

> Industrial technologists perform production supervision, quality assurance, field testing, reliability testing, manufacturing analysis, product improvement, and customer services. Engineers are prepared for applied research, product design, systems design, and project engineering. Engineering technologists frequently work as field engineers, technical representatives, engineering associates, and maintenance engineers. The type of job functions frequently held by technicians include installation, troubleshooting, maintenance, and production. (p. 15)

Industrial technologists were not engineers but professionals who could interact with engineers, technicians, and upper management. These people compare with the engineer of the 1950s. Engineering curricula of that era required course work that included drafting, welding, and the use of machine tools (Malstrom, cited in Kicklighter, 1987).

> Industrial technology graduates today have knowledge and experience in CAD/CAM, CIM, (including applications of advanced electronics such as: robotics, machine vision, programmable logic controllers, and other manufacturing automation applications), cornet (sic)

> inventory control concepts, production and process control applications, MRP II statistical process/quality control, product and tooling design, and manufacturing operations management. (pp. 16-17)

Since 1963, the Bachelor of Science in Industrial Science at Fitchburg State College has been offered in cooperation with the Missle Systems Division of the Raytheon Company for credit earned through an evening school program. The original goal of the off-campus, evening baccalaureate program was to educate engineering support personnel in electrical/manufacturing technology. The present program is an outgrowth of the original and includes concentrations in manufacturing, industrial management, electrical engineering and computer science (Kokernak, 1987).

Approximately 600 students currently are enrolled from three Raytheon manufacturing plants within the Commonwealth of Massachusetts, and one installation in Saudi Arabia. Another 100 students from Alpha Industries, a program expansion to inlude the precision microwave devices manufacturer, matriculate in a program similar to Raytheon's electrical engineering concentration (Kokernak, 1987).

A 10 course core curriculum is required of all students, regardless of major area of study, who pursue the 126 semester hour Bachelor of Science degree in Industrial Science. Upon completion of the core, coursework in one of four major areas: manufacturing, industrial management, electrical engineering, or computer science is begun. In addition, nine hours of free electives and 15 hours of electives in the Humanities and Social Sciences must be completed (Kokernak, 1987).

The content is highly technical, is reflective of the state-of-the-arts needs for a high profile defense contractor, and is responsive to developments in technology through new course additions. The function of the program was unique. The college provided educational management and industry provided technical expertise (Kokernak, 1987).

The study of technology must involve the tools, techniques, materials, and systems of the broad applications of technological problems in order to be useful. The intent of Owen's (1988) study was " . . . to determine technology needs of industry and education within the State of Louisiana" (p. 11). He believed that provision of skills and knowledge relevant to gainful employment was education's responsibility. To accomplish this goal, the training materials used and researched for use required adopting and/or adapting to match newly acquired state-of-the art high tech equipment. Industries designated "islands of innovation" were contacted for input to the process. The impetus was provided by a recruitment policy of Louisiana industries that requires "either a B.S. in Engineering or Industrial Technology" (Owens, p. 23). He also noted that a future requirement would be for individuals preferably trained in computer-aided-design.

Savage, Kruppa, Palumbo, and Schwerkolt (1988) found that industrial technology programs have a strong linkage to industrial teacher education programs. The problem with that linkage was that the core curriculum for those programs was carried over to industrial technology programs. The teacher education core or remnants of its general education and professional courses may limit the progress of the industrial technology major. Another concern was the increased number of courses needed to graduate.

The issue of selecting a core curriculum for industrial technology program options was the investigative purpose of Savage, et al. (1988). They presented three approaches to the problem:

> 1) a data based approach derived form a study of the status of existing practice, 2) a philosophical based approach which presents a body of knowledge in industrial technology and 3) an orientation base which attempts to present an overview of all program areas in the academic unit. (p. 9)

Yurjevic's study (cited in Savage, et al., 1988) revealed common core curriculums present in 38 of 43 institutions responding. The common core was categorized into five course groups: " . . . design, manufacturing, construction, energy and power, and 'other' courses" (p. 9). Forty-four diverse course offerings were distributed in the categories. The six most commonly occurring courses were drafting and drawing, material processing, industrial safety, introduction to manufacturing, introduction to technology, and power systems. Savage, et al. surmised that a representative data-based common core for the field could be made of these courses.

The philosopical based core rationale as subjected by (Savage, et al., 1988) was centered on production, communication, and automation systems. Each of these systems were perceived to be critical to the whole of technological society. The proposed core would include a course for each system and an introductory course in technology.

Savage, et al. (1988) recognized a broader knowledge of industrial technology as well as including technical coursework outside the field was needed for the graduate. The proposed third approach would be organized into five-week mini-courses. Courses would be represented from each of the programs of the academic unit plus an overview or introductory course for the major.

Three alternatives for a common core curriculum were identified by Savage, et al. (1988). Which is accepted for future use depends upon the goals, objectives, and direction of an individual academic unit.

It was reiterated by Horton (1988) that "Typical content areas are identified from a variety of sources and resources for curriculum development . . . (p. 1)." For example the broad terms recognized as the basis of management are planning, organizing, directing, and controlling. To properly develop a curricula for supervision these elements need to be included and analyzed (Horton, 1988).

The question asked by Horton (1988) was "What does a representative program format from an association look like" (p. 2)? He identified the most common program in the midwest as "Basic Principles of Supervision". The program is offered as a 30 to 32 hour program with individual modules of two to four hours each.

Horton (1988) related that curriculum based on the needs of employer's associations for new supervisors addressed " . . . values, roles, expectations, self-awareness, and sound career development principles" (p. 2). Functions of supervision and necessary sources for results-oriented supervisors are identified. A supervisor's primary goal is to improve production efficiency. To accomplish this supervisory objective courses address the managerial leadership and interpersonal and business communication from the classic organizational viewpoint. Horton also discovered that advanced courses of supervision put emphasis on productive efficiency and effective communications as well as performance appraisal.

Kicklighter (1987) related that schools of technology need engineering research and equipment funding, are pursuing applied research and development, and other industrial problem-solving activities as are engineering schools but industry seems to disregard these activities in industrial technology. Industrial research and development activities of both professions are needed if the United States is to progress technologically. These programs cannot continue to be neglected by industrial leaders.

Parish (1988) investigated in his study various methods used by institutions to make a successful shift to industrial technology from traditional industrial arts teacher education. Data were collected from faculty in 28 departments of industrial technology. He found that industrial technology was the dominant title, a nearly 80% majority also offered industrial arts education, and an additional 26 degree programs with various titles were overseen by the departments.

Parish (1988) found from those departments surveyed that five originated with the title "industrial technology", 20 evolved from industrial arts/education departments, and the remaining three had had other titles. He further indicated that 82% of the current industrial technology/technology programs had industrial arts/education as curricular roots.

Parish (1988) determined that the leading reason for the change to industrial technology was the need for a noneducational major. The other major reason was that graduates either demanded or requested the change. The data also indicated three lesser reasons for the change: " . . .

graduate job market, teacher educators finding careers in industry, and educational trends . . . " (p.56).

A second part of Parish's (1988) study was concerned with the importance of courses to industrial technology curriculum. Respondents indicated that courses focusing on development of the education professional be dropped from the industrial technology curriculum. Representative courses included organization and administration of industrial education, history and philosophy of industrial education, curriculum development/construction, shop/labor organization, and shop maintenance. Technical coursework to be eliminated from the industrial technology program comprised crafts, world of construction, world of manufacturing, and woods. Remaining technical courses identified did not receive a mandate for removal as only three responses were received for each.

The final segment of Parish's survey (1988) was designed to determine transitional methods for change to industrial technology programs. The two methods rating higher than 80% were new course introduction, and course content changes. The next three methods were indicated by 70% of the respondents: departmental policy change; inititated business/management courses; and required more mathematics, computer science, and physical science. Other strategies receiving at least 50% of the responses were elimination of courses, change professional affiliations to reflect industry rather than education emphasis, increased use of industrial internships for students, established advisory boards, created more technical laboratories, and required industrial experience of new faculty members.

The following conclusions of the study were revealed about elements common to departments making the change to industrial technology. The conclusions of the study by Parish (1988) were:

> A change in program philosophy from traditional teacher education to industrial technology.
> A closer working relationship with business and industry.
> An increased program emphasis in management, mathematics, computer science, and the physical sciences.
> A greater emphasis on integrating the computer into the laboratory and classroom.
> An increased use of the problem-solving approach and less project emphasis in laboratories.
> Either an elimination of or less emphasis on laboratory courses, such as woods, welding, foundry, basic metals, and energy and power. (p. 58)

Parish (1988) summarized that departments have successfully made the shift and that the biggest problem that remained was how to maintain enrollment in technology education programs.

Industrial technology programs were found in 148 universities as recorded in the 1989-90 Program Directory (Gore, 1989). Many were associcated with schools or colleges of technology that had a wide variety of technology programs. Forty institutions have NAIT accredited programs and the list is increasing (Gore).

Accreditation

Talbott (1984) identified the need for unique programs of industrial technology. One way to achieve uniqueness given the trend toward diversity in industrial technology programs is to accredit programs. The purposes of accreditation, a historical perspective, and the accreditation process of NAIT are presented in the following section.

Background. Armstrong (1958) described the purposes of accreditation. The purposes included:

> . . . to establish some basis for helping officials of institutions and lay public to judge the quality of educational programs offered in various institutions, to stimulate institutions, to improve their educational programs, and, to some extent, to establish regional and national norms which would give the United States at least the semblance of a national system of higher education. (p. 1)

Armstrong (1958) also delineated the differences between general accreditation and professional accreditation. He stated:

> General accreditation provides assurance of the general strength of a college or university. From the standpoint of program, it covers liberal education and, to the extent that an institution offers programs which prepare for professions, general accreditation covers the relationship of the professional programs to the institution as a whole. For society, general accreditation offers assurance of the financial stability of the institution, the effectiveness of its administration, the adequacy of its facilities including library and laboratories, the apporpriateness of its general curriculum, the general strength of its faculty, the quality of its student personnel program, and the quality of instruction. (pp. 2-3)

> . . . Professional accreditation begins where general accreditation stops. Using general accreditation as a base, professional accreditation evaluates the professional program concerned: covering the professional objectives, the organization of the institution for providing the professional program, student personnel policies relating to the profession, the qualifications of the professional faculty, and the adequacy of the facilities available for offering the professional program. (p. 3)
>
> . . . Because general accrediting bodies consist of associations of institutions, they emphasize self-evaluation. And because of their specialized interests, professional accrediting bodies place mroe emphasis on compliance with standards. (p. 3)

Historical perspective. Wigen (1958) delineated the historical development of industrial arts teacher education accreditation. Four studies were identified as forerunners of accreditation standards for industrial arts.

Whitney's study (cited in Wigen, 1958) was a master's degree thesis that was:

> a study of the entrance requirements, faculty qualifications, shop facilities, general training, curricular standards, distribution of required credits, and major and minor courses in twenty-two teacher training institutions accredited by the North Central Association. (p. 11)

A status description of the departments in those colleges studied was provided by the results of the study. The second study by Hutton (cited in Wigen, 1958):

> was an attempt to satisfy the need for more uniformity in teacher training for industrial arts education. A set of criteria for evaluation is developed with detailed suggestions for application. The study suggests an organizational form for accrediting through N. E. A., the American Industrial Arts Association, and the National Accreditation Associations, for institutions offering industrial arts teacher training. Hutton's was the first study located that was directly

> related to the problem of accreditation standards for industrial arts teacher education. (p. 11)

Gallington's doctoral study (cited in Wigen, 1958) was of current practices in teacher education programs. It was an:

> appraisal of objectives, professional education, organization, and methodology of programs of teacher education by fifty-two specialists and a check-list study of twenty outstanding teacher education programs. The study identified many significant practices of industrial arts education. (pp. 11-12)

Proctor's study (cited in Wigen, 1958) was to develop " . . . the purposes, criteria, policies, and procedures for the accreditation of industrial arts teacher education programs for the baccalaureate. . . . " (p. 12) and proved " . . . a valuable source of data pertaining to accreditation standards for industrial arts teacher education" (p. 12).

The American Industrial Arts Association did not qualify as a accrediting agency (Wigen, 1958). Accreditation for "specials" were run through a national agency in the field of teacher education. The American Association of Colleges for Teacher Education (AACTE) was the accrediting vehicle for industrial arts.

Wigen (1958) reported that the first accreditation criteria were developed as a result of Baysinger's study. He prepared a tentative schedule of standards in his study which were submitted for approval. The original schedule was revised to include the following:

Standard I - Definition, Objectives and Organization of a College for Teacher Education
Standard II - Admission, Selection, Guidance, and Placement
Standards III and IV - Preparation and Teaching Load of Faculty
Standard V - Curriculum - Instructional Patterns
Standard VI - Professional Laboratory Experiences
(p. 16)

The first application of these standards was to serve as criteria guidelines for the evaluation of Wayne State University's industrial arts teacher ecucation program. Wigen (1958) found that Baysinger's work was the basis on which Helton developed his survey to study industrial teacher education for the purpose of developing an evaluation instrument. The tentative standards were identified as: organization and administration, the student personnel program, the faculty, the curriculum, student teaching, and facilities and laboratories. Upon completion of the tentative standards, the evaluative criteria were developed. The standards and criteria were submitted for approval by The National Council for Accreditation of Teacher Education (NCATE) which superseded the AACTE, after its accrediting function was discontinued. NCATE revised its general standards and suggested the development of supplements to augment the standards. Wigen (1958) related that the supplements were to be used to upgrade programs in three areas: " . . . faculty, curriculum, and facilities" (p. 58).

The original standards for technology education have been affected by change in the technological society. In pursuit of the perfect program, diverse programs have been provided by evolutionary maturation (Pinder, Bame, & Dugger, 1985).

Diversity is needed to enhance facilitation of change. However, some elements must be retained to provide the foundation for the profession (Pinder, et al., 1985).

Program assessment must be accomplished through comparison with common standards. The standards have to have criteria with the flexibility to provide for those programs that have varying needs. Diversity within programs has provided opportunity for professional growth resulting from assessment, evaluation, planning, and implementation of program elements (Pinder, et al., 1985).

Industrial technology. Harris (1969b) noted that lack of evaluation measures for industrial technology curricula was a major issue. In his dissertation Arvin (1972) noted that by 1969, final accreditation guidelines for evaluation of industrial technology programs had not yet been established. Harris (1969a) noted that the Engineers' Council for Professional Development (ECPD) was concerned that industrial technology would cause ECPD-accredited programs to lose students. Additionally, support for accreditation of programs that were non-engineering technology or vocational oriented was lacking.

A review committee was formed within the American Vocational Association to examine the development of accreditation guidelines and standards. The committee members determined that accrediting standards be developed by the National Association of Industrial Technology (Harris, 1969a).

Evaluation standards were designed to establish bases for objective examination of curricula. Resultant new programs would have guidelines to follow, students transferring between institutions would be expedited, and graduates would be better prepared for employment (Harris, 1969a).

An argument was also presented by Harris (1969a) for establishing guidelines specifically for industrial technology. He believed that, since industrial technology curricula content and objectives were identifiably different from engineering technology, evaluation criteria should be different even though similarities exist.

Arvin (1972) recognized the need for evaluative criteria to guide the rapid emergence and growth of industrial technology baccalaureate programs. Guidelines were needed to aid in meeting the requirements of industry and to provide a more universal content base among programs. Guidelines being researched and developed had seven distinct headings: program objectives, organization and administration, the faculty, the students, the curriculum, resources and facilities, and evaluation of the curriculum (Harris, 1969a). These guidelines were to serve as a frame of reference.

Accreditation for baccalaureate programs in industrial technology was a goal of the National Association of Industrial Technology (NAIT) from its inception in 1967. This professional organization has represented the field and had as members a majority of the industrial technology programs in the United States since 1967. The Standards and Accreditation Committee was appointed in October 1968 to prepare a proposal seeking approval as an accrediting agency for four-year programs of industrial technology. Arvin (1972) cited four documents developed and included with the application:

> 1) introductory statements identified as "General Practices in Accrediting Programs"; 2) general policy statements concerning standards for accreditation identified as "Standards for Accreditation"; 3) listed organizational specifications identified as "Organizational Structure Plans for Accreditation"; and 4) a comprehensive list of questionnaire items identified as "Questionnaire for Use by Institutions and Visiting Team in Accreditation Evaluation." (p.15)

In addition, the proposal was designed to aid and promote development of new and emerging programs. This initial proposal was submitted to the National Commission on Accrediting in January of 1970 (Arvin, 1972).

This proposal was general in nature and did not contain a detailed analysis of accrediting procedures, operational details, nor criteria. Arvin (1972) reported the decisions of the National Commission on Accrediting. He related that before an accrediting procedure could be implemented considerable effort was needed:

> to properly develop operational detail and criteria for evaluation of programs, to field test accreditation procedures, and to properly publicize complete and detatiled accreditation criteria, so that industrial technology programs could adequately prepare for accreditation. (Arvin, p.17)

In reference to the proposed evaluation guideline headings, Harris (1969a) identified two major components and discussed implementation strategy. The first concerned the relationship between curriculum content and objectives. The thesis of his remarks was that not only should content provide direction for a program but that objectives be measurable as outcomes. He believed that to best implement the program, revisions of the objectives were needed to fit and guide instruction within the program. The second focused on the selection and development of faculty. He recognized that the success of an industrial technology program was related to the competence of the faculty. Harris contended that this component be evaluated from the viewpoints of both the faculty and institution. The faculty should be held responsible for curriculum content, resources and facilities, and teaching and scholarship. The institution had a responsibility to fully develop and support its faculty through provision of a fertile working environment and growth opportunites. The success of a faculty was determined by the total evaluation of this relationship .

The purposes of accreditation by the NAIT are twofold; primary is recognition of the attainment of certain professional standards; secondary is encouragement of other programs to try to attain these goals and standards (Sutton & Kicklighter, 1987). As the only professional organization exclusively representing baccalaureate programs in industrial technology, services are provided to degree programs and professionals in industrial technology careers. The industrial technologist is prepared to work with:

> 1. The application of significant knowledge of theories, concepts, and principles found in the humanities and the social and behavioral sciences, including a thorough grounding in communications skills;
> 2. The understanding and ability to apply principles and concepts of mathematical and physical sciences;
> 3. The application of concepts derived from, and current skills developed in, a variety of technical disciplines including -- but not limited to -- material and production processes, industrial management and human relations, marketing, communications, electronics, and graphics and may include;
> 4. A field of specialization, for example: electronic data processing, computer integrated design and manufacturing, construction, energy, polymers, printing, safety, and transportation. (Official NAIT definition cited in Sutton & Kicklighter, p. 10)

Industrial technology curricula can be accredited if evaluation of the following elements meet established criteria. These criteria are:

1. Those combining liberal education with professional-level technical emphasis. Examples of

typical industrial fields are: production, communication, transportation, energy and distribution.

2. Programs which include general education with appropriate mathematics and science.
3. Those programs which prepare students for leadership responsibilities in industrial planning, supply, product utilization and evaluation, production supervision, management, market research and technical sales.
4. Those programs which reinforce industrial production, management, and marketing education appropriate laboratory experiences. (Accreditation Handbook, page 1 cited in Sutton & Kicklighter, 1987, p. 10)

NAIT accreditation activities have always been guided by the philosophy of its members as represented by the definition and description of program elements and primary purposes.

Recognition of the NAIT as an accrediting body was finally realized nearly 21 years after the initial committee began work. Kicklighter announced (cited in Streichler, 1988b, p. 4) that:

> On December 12, 1988 in Washington, D.C., the National Advisory Committee on Accreditation and Institutional Eligibility, U.S. Department of Education, voted unanimously to approve NAIT's petition for recognition as the accrediting agency for baccalaureate Industrial Technology programs in America. Formal approval is expected in a few weeks from the Secretary of Education, Lauro F. Cavazos.

The expected approval caused Kicklighter (cited in Streichler, 1988b, p. 4) to state that it:

> will not only confirm NAIT as the accrediting agency for Industrial Technology programs, but confirms Industrial Technology as a discrete field with documented quality and accepted by the population within its scope of activity.

Streichler (1988b) commended NAIT's leadership since the organization's inception for its perserverance in pursuit of a dream (accreditation). The realization of this dream has created a platform for future development of a professional organization that is dynamic and creative.

Summary

Industrial technology has a dynamic history which developed directly from industrial arts programs. The growth and development of these programs was in response to the need for technical-oriented managers in industry. The curricula for these programs developed from traditional industrial arts or education programs designed originally for teacher education. This curricula went through a process of evaluation and analysis that included investigations of content, learning processes, instructional materials and methods, and evaluation. Goals and objectives were developed and set. It was recognized that change was integral to the profession.

Technological change was identified as a major impetus for curriculum development. The advent of high technology has had a great effect on industrial technology curriculum. Affordable calculators and computers have made these technologies available to nearly all of the business and private sector. It has enabled society to cope with the growth of new information and the ability to keep track of it. Computers are projected to have a most profound effect on the manufacturing sector. They will and have permitted factories to be operated as integrated systems.

Curriculum has undergone periodic revisions and updates as identified by the various development efforts described. Not all of the efforts came to be accepted by the profession but each contributed to contemporary program development and the body of knowledge. The evolution of current industrial technology programs has been typically at the post-secondary level. Technology education has been identified in various forms at the secondary level. Each has its roots in industrial arts.

This literature review has provided insight into the evolution of industrial technology curricular development. It was evident that industrial technology has had a dynamic, evolutionary past. Bennett (1926) revealed that industrial technology hand skill activities originated before recorded history. Although this education was not formal, it provided a humble beginning. The development of the educative process progressed from this point through the apprenticeship and arts and crafts guild periods to an era of educational reform. Education for basic work skills was upgraded to a level of industrial training inclusive of academic skills was a product of the reform movement. The several educational leaders influenced the reform movement to develop the education process and help it become a part of secondary education. The secondary education movement of manual education began as a result of the examination and study of the Russian school and Swedish sloyd.

Manual education was a precursor of contemporary industrial technology. The evolution of the curriculum has been a process with stopping points that have included manual training, manual arts, vocational education, industrial arts, and industrial education on both the secondary and collegiate levels. Representative curriculum projects have contributed to the evolution of current industrial technology curricular practice. Included were the applied science curriculum of Bradley University, "The Terminological Investigation", "A Currciulum to Reflect Technology", the "New Industrial Arts Curriculum", and several others. These curriculum movements were characteristic of industrial arts and technology related education prior to the end of World War II.

A period that began in the late 1940s and continued through the 1950s and 1960s ushered in technology as a prominent force in curriculum development. Projects such as the "Laboratory of Industries", the "Ohio Prospectus", the "Minnesota Plan", "Research and Experimentation", and "Technology and Industrial Arts" provided the foundation upon which future improvements would be forged. Later curriculum projects which had a major influence on industrial technology education included the "Alberta Plan", the "American Industry Project", and the "Industrial Arts Curriculum Project".

The emphasis of technology was the focal point of these curriculum plans in existing industrial arts programs. However, as several writers made note, a need for personnel to serve as managers in industry was being recognized. Graduates of post-secondary industrial arts programs were taking jobs in industry. The result was programs being developed with a nonteaching emphasis. The course work for these programs had a management-oriented emphasis to enable graduates to effectively manage industrial processes and entities.

These programs became prominent during the 1950s and early 1960s. The movement had matured enough by 1965 that preliminary organizational meetings were held which led to the organization of the National Association of Industrial Technology in 1967. Two purposes were to provide a focal point for industrial technology curriculum and to develop an accreditation process for baccalaureate industrial technology programs.

Characteristic of these programs was course work areas inclusive of general education, mathematics, science, management, and technical subjects. These programs were identified as either generalized or specialized programs. General type programs typically had one nonteaching major inclusive of all technical areas. The specialized programs provided majors in more than one technical area. Course work that reflected management practices of industry were also becoming a curriculum focus.

The accreditation process was an immediate objective and goal of the fledgling national association. Accreditation was identified as a way to develop strong, uniform programs of industrial technology. The process was initiated during the first year of the NAIT's existence. It went through many reviews, revisions, and submission processes before finally achieving recognition as an accrediting agency. Over forty programs have received NAIT accreditation.

Current efforts in curriculum development revolve around the accredition guidelines of the NAIT and the needs of industry. These guidelines have been devised, evaluated, analyzed, and revised over nearly a quarter of century. The strength of an industrial technology program may be evaluated by comparison with the guidelines. They also assure that students will be prepared as management-oriented technical professionals. What direction or directions the curriculum development will follow for the future was the focus of this dissertation.

CHAPTER 3

DESIGN AND PROCEDURES FOR THE RESEARCH

In order to identify curricular change upon which to determine trends in four-year industrial technology programs, it was decided that an effective method would be to query faculty who have been engaged in curricular development in educational units of that type for a minimum of ten years. The general method of this study was to collect data to guide development of a research instrument, develop an investigative research instrument, have it validated, send the instrument to identified curriculum developers in the field, and analyze the acquired data. On the basis of these data, trends were identified, and implications for future curricular development were formulated. The conduct of the study procedure is presented in the following sections.

Development of the Research Instrument

The instrument was designed to be a questionnaire composed of discrete parts and quantifiable response options. In addition, an opportunity for limited open-ended responses was provided for the respondents. The research questionnaire (Appendices A and D) was developed and validated as presented in the following paragraphs:

The literature examined was primarily from research documents and publications relating to curricula in four-year baccalaureate degree programs of industrial technology. The intent was to identify those factors which were representative of past and present curriculum and could be indicative of the future. These findings are reported in Chapter 2 of this dissertation.

Literature relevant to curricular change was reviewed, analyzed, and classified for curricular characteristics pertinent to four-year programs of industrial technology. A listing of those characteristics which reflect past, present, and possible future practices was compiled.

The compiled listing served as the master reference list from which questionnaire items were developed. The items were designed to identify curricular modifications which prompted evolution from programs existing 15 years ago to present programs. Open-ended responses were designed to identify the perceived future importance of these characteristics for the five year period ending in 1993 for the curricula of the participating programs. The instrument may be seen in Appendix D.

Validation of the Research Instrument

The participants in the questionnaire validation were six professors (Appendix A) who the researcher believed would effectively critique the instrument. Four of the professors are employed at Bowling Green State University, San Francisco State University, the University of North

Dakota, and Wayne State College. Each is from a four-year institution offering an industrial technology program and listed in the "National Association of Industrial Technology Baccalaureate Program Directory" (Dufek & Gore, 1987). The remaining two professors were employed at the University of Missouri-Columbia and the University of Northern Colorado. Each has been active in curriculum development. To assure participation in the validation study, a telephone call was made to each professor. The questionnaire with a cover letter was presented for validation to six selected industrial technology colleagues. The participants were informed that it was a trial run in preparation for validating the instrument. In addition to responding to the items, they were asked to note directly on the form any problems they had in responding and to offer suggestions for improving the instrument. They were requested to provide comments and suggestions as to redundancy, explicitness, understandability, readability, and validity of the instrument.

The jury participants provided information about their respective programs and critiqued the survey instrument. In lieu of a follow-up letter and questionnaire, a telephone call was made to remind each participant not responding to the first mailing in 14 days. Upon receipt of the validation study responses, the critiques and suggestions were analyzed. The recommendations that were most relevant to the improvement of the instrument were recorded. Relevancy was assigned to the comments and suggestions of the jury as to redundancy, explicitness, understandability, readability, ease of response, and validity of the instrument. The responses were analyzed and utilized to refine the instrument. After the completion of this validation process, the refined instrument was reviewed by the five member dissertation advisory committee. The committee proposed several amendments to the refined instrument. The instrument was revised a second time and submitted to the advisory committee for approval. The committee approved the format with some suggested content changes. The changes were made and the instrument was approved for submisssion to the identified sample population.

Identification of the Population and Sample

The population of current faculty with tenure, experience in curriculum development, and more than 10 years of experience at institutions offering four-year industrial technology baccalaureate degrees in the United States was identified by the department chair in each institution. The publication, "National Association of Industrial Technology Baccalaureate Program Directory" (Dufek & Gore, 1987), was selected as the primary source for ease and accuracy in " . . . identif(ying) those institutions that offer baccalaureate and graduate programs in Industrial Technology" (Talbott, 1985, p.i). The institutions with four-year industrial technology baccalaureate degrees were identified from this directory as the population for the research. In addition, information was readily provided for the identification of contact persons and addresses.

A letter (Appendix B) was sent to the department chair of each of 152 four-year industrial technology programs in the United States. A complete listing of departments, institutions and addresses is provided in Appendix C. Each recipient of the letter was asked to submit the name of one faculty member and an alternate who

1. has been employed by that institution for a minimum of 10 years,
2. has obtained tenure, and
3. has been actively involved in curriculum development in industrial technology while employed by that institution.

The identified faculty members who agreed to participate in the research comprised the sample for the study.

The initial faculty qualification request letter yielded 86 responses (56.8%). The second mailing provided 21 additional returns for a final total of 107 (70.4%). Of the 107 responses, seven were determined to be unusable because the program had no one who met the criteria, the program was being phased out, or the program was new. The remaining faculty members identified (N = 100) were selected as the sample to receive the research instrument.

The faculty members identified (Appendix C) were sent a cover letter and the research instrument (Appendix D). Each contact person was informed that he/she was recommended by the department chair to participate and complete the questionnaire.

Data Collection

Data collection commenced with the mailing of the survey instrument and cover letter to the identified sample. The questionnaire was accompanied by a letter of introduction and an addressed, stamped return envelope. The letter of introduction included the purpose, scope, and importance of the study. The letter was printed on the letterhead of the University of North Dakota, where the researcher is employed, to help lend authenticity and credibility to the research.

The data collection process was comprised of four steps. The four steps are identified in the following listing.

1. The initial mailing was sent to the identified industrial technology faculty (N = 100) in the United States.

2. A follow-up card was sent 14 days later to those not responding to the initial mailing.

3. A second follow-up letter and survey instrument were mailed 17 days after the first follow-up card to those who had not responded to the second mailing.

4. The data collection process was to conclude 14 days after the second follow-up mailing. However, since a 75% return was desirable for more meaningful data (Tuckman, 1978), a final attempt to secure a greater return was made. Five nonrespondents were contacted by telephone and asked to reply to the survey. One additional response was received, resulting in a 66% return.

Data Organization

The collected data were compiled in relation to program characteristics identified on the questionnaire. The data were also organized within the general and specialized curricular areas identified in the National Association of Industrial Technology definition for the five year entry points of 1973, 1978, 1983, 1988, and projected for 1993. These entry points were also deemed necessary for the determination of trends and comparison of the collected data.

Summary

Presented in this chapter was the methodology by which this research was conducted. The design and procedures for the research was comprised of six distinct components: research instrument development, research instrument validation, population and sample identification, data collection, and data organization. The questionnaire developed by the researcher was based on a review of literature. Six professors in the field participated in a trial run of the questionnaire to provide input for validating the questionnaire. The questionnaire was refined, submitted to the researcher's Dissertation Advisory Committee, revised based on suggestions of the Committee, and approved for dissemination. The population was comprised of those programs with four-year industrial technology baccalaureate degrees. Faculty who were recommended by department chairs as meeting the established selection criteria comprised the sample for the study. Data collection was designed for an initial mailing and two follow-up mailings. Data were organized according to defined NAIT curricular areas and five year entry points representing the past, present, and future. Data were to be analyzed using the chi square statistic and descriptive statistics to determine trends in curricular change.

The results and interpretation of the data are presented in Chapter 4, Findings of the Research. The Summary, conclusions, and recommendations stemming from the reporting of the data are presented in Chapter 5, Conclusions.

CHAPTER 4

FINDINGS OF THE RESEARCH

The data collected to identify curricular change for the purpose of determining trends in four-year industrial technology programs were compiled, scrutinized, and analyzed to ascertain implications for future curriculum development. The data were compiled from three types of industrial technology programs: nontechnical accredited, technical accredited, and National Association of Industrial Technology accredited. The data were further subdivided into categories representing major courses of study, concentrations/emphases, and coursework. The identified categories of industrial technology were analyzed using descriptive statistics and the test of chi square for relatedness of variables. Results of the data analysis were used to answer the research questions which formed the basis of this study. The data analyses and interpretation are presented in the following sections.

Analysis of Collected Data

The compiled data were analyzed using descriptive statistics, the chi square statistic, or Yates correction for chi square where appropriate. The results of these analyses are presented in the following sections of this chapter.

Enrollment

Enrollment data of students majoring in industrial technology in 1988 are indicated in Table 1. Industrial technology programs with 99 or fewer students were represented by 28.33% of the sample. Programs with enrollments of 100-199 and 200-299 respectively were each represented by 18.33% of those responding.

Ten, (16.67%) of the programs had enrollments of 300-399 majors. The remaining two categories were representative of just over 18% of the sample. It is apparent that the majority of industrial technology programs

Table 1

Students Enrolled as Majors in Industrial Technology Programs in 1988

Enrollment	Programs	%
1-99	17	28.33
100-199	11	18.33
200-299	11	18.33
300-399	10	16.67
400-499	3	5.00
500 and above	8	13.33
	n = 60	99.99

(81.66%) have under 399 students enrolled as majors in industrial technology.

The strength of industrial technology programs can be determined by enrollment figures which show 83.33% of programs were either stable or growing. Twenty-six programs, or 43.33%, indicated that enrollment had grown since the program was identified as industrial technology. Another 40% or 24 of the programs were shown to have stable enrollment, while a decline in students enrolled as majors was exhibited by only 10 programs (16.67%).

There proved to be a significant difference between the size of enrollment and type of accreditation as shown in Table 2. In the total numbers of schools in this research, 67% were nontechnically accredited and 33% were technically

Table 2

Chi Square for Enrollment by Accreditation in 1988

	Enrollment			
Accreditation	1-199	200-399	400 & above	Total
Nontechnical	23	15	2	40
Technical	6	5	9	20
Total	29	20	11	60

Note. Chi square = (2, N = 60) = 14.35, $p < .05$

accredited. For the smaller enrollment programs (1-199) the proportion is nearly 80% nontechnical to 20% technical, for the middle sized enrollments (200-399) the proportions are 75% nontechnical to 25%, but in the largest enrollment programs (400 and above) the proportions shift, dramatically, to 18% nontechnical and 82% technical. There was an apparent relationship between nontechnical accredited and technical accredited programs with respect to enrollment.

Accreditation did not significantly cause industrial technology program enrollment figures to grow or decline between nontechnical accredited and technical accredited programs. No difference in program enrollment change is indicated by data shown in Table 3.

Table 3

Chi Square for Program Enrollment Change Over Accreditation

	Change			
Accreditation	Growth	Decline	Stability	Total
Nontechnical	16	8	16	40
Technical	10	3	7	20
Total	26	11	23	60

Note. Chi square = (2, N = 60) = .58, $p > .05$

Program Names

The lineage of program names preceding industrial technology numbered seventy-eight responses (respondents were asked to check all that applied). Talbot's observation (1973) that industrial technology programs evolved from departments of industrial arts can be supported. The data indicated 30 current programs had industrial arts as a former title. This represented 38.46% of all previous program names. As indicated in Figure 1, industrial technology programs have had several different program titles. Over 28% of the programs were previously entitled Industrial Education (12) or Industrial Education and Technology (10). Another nearly 8% were termed Industrial Arts and Technology (6). More than 10% began as Industrial Technology (5) or Industrial and Technical Education (3). The remaining twelve titles were distributed among Applied Science, Engineering Technology, and Industrial Science to identify a few (Appendix E).

Accreditation

Accreditation is intended to lend structure and viability to academic programs which attain and maintain the established standards. The accreditation of academic programs can be divided into two types: general or professional (Armstrong, 1958). In this research nontechnical accredited programs equate with general accreditation and nontechnical accredited programs equate with professional accreditation. Industrial technology

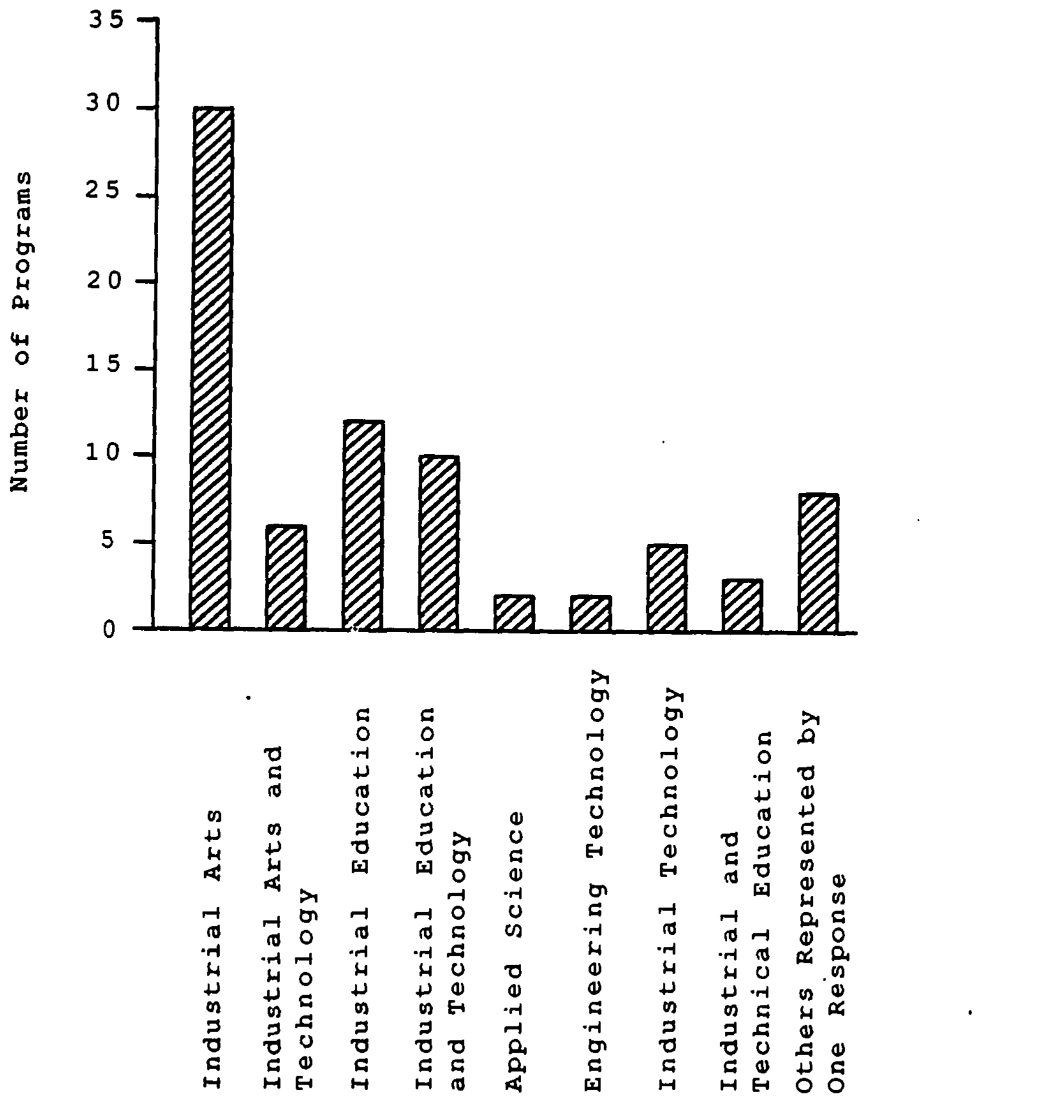


Figure 1. Industrial Technology Program Name Precursors

programs were divided into three distinct categories: (a) nontechnical accredited, (b) technical accredited, and (c)

NAIT accredited. Programs in 39 (65%) institutions were determined to be nontechnical accredited. There were 78 (69%) majors in industrial technology represented at those institutions. Respondents from the 30 (38.5%) nontechnical accredited major programs, indicated technical accreditation was being or will be pursued. Identified in Table 4 are the number of major courses of study for which technical accreditation will be sought in the future. Technical accreditation for 24 major courses of study was to be sought from the following accrediting agencies: Accrediting Board for Engineering and Technology (ABET), the National Association of Industrial Technology (NAIT), the American Council for Construction Education (ACCE), and the American Association of Safety Engineers (AASE).

The respondents indicated that accreditation was not desired for 27 major courses of study, provided no response for 17 major courses of study, and reported that 35 major courses of study were currently accredited by a technical agency. Technical accredited major courses of study were accredited among NAIT (29), ACCE (1), and ABET (5). The perceived importance of technical accreditation was determined by the increasing number of major courses of study achieving accreditation since 1973 (See Table 5).

Prior to 1973 no major course of study had achieved NAIT accreditation. It must be recognized, of course, that NAIT first became an accreditation agency in 1973 (Keith,

Table 4

Technical Accreditation to be Sought for Programs or Major Courses of Study

Accrediting Agency	No.
Accrediting Board for Engineering and Technology	11
National Association of Industrial Technology	9
American Council for Construction Education	3
American Association of Safety Engineers	1
	n = 24

Table 5

Year Technical Accreditation Granted

Years	No. of Programs	%
1974-1978	4	11.43
1979-1983	13	37.14
1984-1988	17	48.57
No Date	1	2.86
	n = 35	100

1986). NAIT accreditation was achieved for four (11.43%) major courses of study by 1978, 12 (34.29%) more had achieved accreditation by 1983, 12 (34.29%) more had attained accreditation by 1988, and no accreditation date was provided for another major course of study (2.86%). Only one (2.86%) major course of study was ABET accredited before 1983 and four (11.43%) more were approved in 1984. In 1987 one (2.86%) major course of study had achieved ACCE accreditation.

Nearly 83% (82.86%) of all current technical accredited major courses of study were accredited by NAIT. The remaining over 17% are divided between ABET (14.29%) and ACCE (2.86%). Future accreditation is planned for 24 major courses of study from four technical accrediting agencies. If accreditation plans came to fruition, accreditation will have been attained from a recognized technical accrediting agency by 1993 for 59 of 109 (54.13%) major courses of study. This would represent a 22.02% increase in technical accredited major courses of study from 35 of 109 (32.11%) in 1988. An apparent trend to technical accreditation was indicated by analysis of future accreditation plans for major courses of study in industrial technology programs.

A possible trend toward diversification of technical accrediting agency selection was indicated by an analysis of projected future accreditation plans for major courses of study. For the five year period ending in 1993, respondents indicated that technical accrediting agencies other than NAIT were being considered for the 62.5% of major courses of study for which accreditation was being sought. However, 38 of the 59 (64.41%) technical accredited major courses of study will still be accredited by NAIT in 1993. Prior to 1988 NAIT accreditation had been attained for 29 of the 35 (87%) technical accredited major courses of study. The percentage change from 1988 to 1993 would represent a 22.59% decrease for major courses of study with NAIT accreditation.

Degree titles were not significantly affected by accreditation based on chi square analysis of data shown in Table 6. It was discovered that no difference existed between course titles offered by nontechnical accredited and technical accredited industrial technology programs.

Table 6

Chi Square for Degree Titles and Accreditation

	Degree Title			
	BS	BSIT, BST, BSET, BT	BA, OTHER	Total
Nontechnical	49	16	10	75
Technical	20	10	2	32
Total	69	26	12	107

Note. Chi square = (2, N = 107) = 1.94, $p > .05$

Factors Influencing Faculty to Pursue Accreditation

Reasons why faculty were influenced to pursue accreditation for major courses of study in their baccalaureate programs are shown in Table 7. Respondents

Table 7

Factors Influencing Faculty to Pursue Program Accreditation

Factors	No.	%
Perceived institution expectations	31	23.7
Assistance to students in gaining employment	23	17.5
Assistance in obtaining funding and resources	16	12.2
Value of a "standardized curriculum"	10	7.6
Making major more meaningful to industry	25	19.1
Strengthening of academic standards	20	15.3
Other Reasons for Remaining Nonaccredited	6	4.6
	n = 131	100

were permitted to mark more than one item when replying to this issue. Perceived institution expectations was the leading influencing factor with a response rate of 23.7%. Making the major course of study more meaningful to industry was the second most influencing factor. The next two influencing factors involved aid to students in gaining employment and the enhancement of academic standards. The category item, Other, provided responses that included: industry pressure and curriculum standards, prestige, self-examination, and required by the Board of Regents.

Factors Influencing Faculty to Remain Unaccredited

Responses to single items in this category were nearly equally divided among three responses (a) lack of benefits to our major course of study (18.3%), (b) uncertain as to which accreditation to pursue (17.1%), and (c) costs involved (15.8%) as shown in Table 8. The 21 responses to the "Other" item were divided among 16 different factors. The most frequently occurring, "university", was identified 6 times. The remaining 15 factors in "Other" contained viewpoints which could be interpreted in a negative or positive context. Negative responses included size of school, number of offerings, accrediting guidelines may prevent program from being an education leader, concern for program becoming subservient to the accrediting association, and not thought to be relevant. Factors viewed to have a positive response to the query were: recently developed program, we're in the process of inviting the ABET, and plan to seek accreditation in 2-3 years.

Table 8

Factors Influencing Faculty to have Program Remain Unaccredited

Factors	No.	%
Amount of time involved	7	8.5
Amount of effort involved	8	9.8
Costs involved	13	15.8
Uncertain as to which accreditation to pursue	14	17.1
Lack of benefits to our major	15	18.3
Fear of current faculty being unqualified	4	4.9
Other	21	25.6
	n = 82	100

Major Courses of Study

One hundred eleven major courses of study with 45 different titles were identified by the respondents as being offered within baccalaureate degree programs of industrial technology. The most frequently offered major course of study was industrial technology (42). As shown in Table 9 the diversity of industrial technology programs is indicated by the identification of titles for 45 different major courses of study. Included were 31 titles identified by one response each. (Appendix E).

Table 9

Major Courses of Study: Frequency of Offering

Major Title	Frequency
Industrial Technology	42
Industrial Management	6
Manufacturing Engineering Technology	5
Industrial Education	4
Manufacturing Technology	3
Construction	3
Electronics Technology	3
Computer Technology	2
Graphic Communications	2
Electrical Engineering Technology	2
Engineering Technology	2
Technology Education	2
Construction Engineering Technology	2
Construction Management	2
Other Majors	31
	N = 111

Note. Although this research was designed to examine industrial technology baccalaureate programs, two majors representing Technology Education were reported. They were reported in this listing, but were not included in any other part of this research because they are not industrial technology major courses of study.

New major courses of study replaced a previous major course of study nearly 37% of the time when a new major course of study was initiated as indicated in Table 10. A new concept was represented in slightly more than 73% of the cases in the introduction of new major courses of study (See Table 11). The replacement of major courses of study and development of new concepts for major courses of study were indicators that adaptation has been made within industrial technology programs.

Table 10

Major Courses of Study Replacing a Previous Major Course of Study

Response	No.	%
Yes	40	36.70
No	60	55.05
No Reply	9	8.25
	N = 109	100

Table 11

Major Courses of Study Representing a New Concept

Response	No.	%
Yes	80	73.40
No	10	9.17
No Response	19	17.43
	N = 109	100

Major courses of study are organized and developed around a concept or concepts. The concept may be specific to a technology such as printing management or a broad-based general topic as industrial technology. A relationship was shown to exist between the replacement of a major course of study and change in the concept of the major course of study as a result of chi square analysis. It is shown in Table 12 that when a major course of study is replaced by a new course of study, the concept tends to be new. As a result new concepts are integrated into a major course of study when it replaces the previous major.

Table 12

Chi Square for Major Course of Study Replacement and New Concept Representation

	Concept		
Replaces	New	Old	Total
Yes	23	7	30
No	53	3	56
Total	76	10	86

Note. Chi square (corrected) = (1, *N* = 86) = 4.69, $p < .05$

Emphasis of Major Course of Study

Industrial technology programs are typically designed to prepare management oriented technical professionals. Therefore two components must be present in the formulation of a major course of study: management and technology. One survey question was designed to determine if, in administering industrial technology major courses of study, faculty placed an emphasis on one component over another. Nearly 46% of the programmatic major courses of study shown in Table 13 were reported to be designed to emphasize technology related courses. Almost 12% had been designed to place an emphasis on management related courses. Offerings of programs with a major course of study designed to place

Table 13

Design Emphasis of Major Course of Study

Emphasis	Number	Percent
Technology	50	45.87
Management	13	11.93
Equal	41	37.61
No Response	5	4.59
	N = 109	100

equal emphasis on management and technology were represented by almost 38% of the remaining major courses of study. It was indicated by these percentages that technology orientation was still the strength of industrial technology major courses of study. A case could be made, however, that more emphasis has been placed on management oriented course work since nearly 50% of all major courses of study had either a management emphasis or were equal in emphasis to technology related courses of study.

No change in the emphasis of a major was found when a major course of study was replaced by another as shown in Table 14. The categories, major course of study and

Table 14

Chi Square for Replacement of Major Course of Study and Emphasis of Major

	Emphasis			
Replaced	Technology	Management	Equal	Total
Yes	17	5	17	39
No	27	8	21	56
Total	44	13	38	95

Note. Chi square = (2, *N* = 95) = .36, $p > .05$

emphasis change of major, were shown to have little effect on each other.

The emphasis of the major course of study is shown in Table 15 to not have changed when a new concept was represented in a major course of study. In effect, no change in emphasis occurred from technology to management or equality when new concepts were introduced in a major course of study. No change of emphasis was noted from management to technology or equality, nor from equality to management or technology.

Year of Introduction

Hauer (1963) revealed that several programs had initiated major courses of study in industrial technology

Table 15

Chi Square for Major Course of Study Represented by a New Concept and Emphasis of Major

	Emphasis			
New Concept	Technology	Management	Equal	Total
Yes	34	9	31	74
No	4	3	3	10
Total	38	12	34	84

Note. Chi square = $(2, N = 84) = 2.34, p > .05$

and that many more were in the planning stages. Talbott (1973) reported that many programs had established major courses of study in industrial technology prior to 1973. These findings are supported by data shown in Table 16. Nearly 45% of all major courses of study in industrial technology baccalaureate programs were intitated prior to 1973. Continued growth in the introduction of industrial technology curricula can also be supported by data in Table 16. The five year period which reflected the greatest growth in introduction of major courses of study was 1979-83 when 23 major courses of study were approved.

Table 16

Year Baccalaureate Major Course of Study Approved

Years	No.	%
Prior to 1973	49	44.14
1973-1978	14	12.61
1979-1983	23	20.72
1984-1988	20	18.02
No Year Indicated	5	4.51
	N = 111	100

The second most active period was 1984-88 when 20 major courses of study were established. The least active period was 1974-78 when only 14 new major courses of study were approved. No projections were provided by respondents for the future five years.

Agreement with NAIT Accreditation Guidelines

Seventy-five major courses of study were identified as nontechnical accredited. Respondents provided responses for 70 major courses of study indicating comparison of coursework areas to NAIT accreditation standards. A response to these survey items was not provided for five major courses of study.

The extent to which nontechnical accredited major courses of study in industrial technology programs compared with NAIT accreditation standards was shown in Table 17. The NAIT accreditation guidelines in all six areas were met or exceeded by 36 major courses of study. Thirty-four courses of study were shown to be deficient in one or more content areas. Of these, 21 major courses of study did not meet standards guidelines in one of the content areas and 13 major courses of study were deficient in two or more content areas. It was revealed that in the subset with one deficient content area, mathematics (6 responses) and management (8 responses) were the most common deficient content areas. Three content areas in the subset with two or more deviations from the standards: mathematics, physical sciences, and management had eight responses each.

Table 17

Comparison of Nontechnical Accredited Industrial Technology Major Courses of Study to Accreditation Standards of the National Association of Industrial Technology

Meets	Exceeds	Below	Required Percentage	Coursework Areas
33	37	0	15-30%	General Education Humanities, English, History, Sociology, Psychology, Speech, Economics, and similar fields
48	8	14	5-15%	Mathematics Trigonometry, Analytical Geometry, Calculus, Statistics
55	6	9	5-15%	Physical Sciences Physics, Chemistry
40	14	16	10-20%	Management Production Control, Quality Control, Manufacturing Cost Analysis, Engineering Economics, Supervision, Production Management, Accounting, Business Law, Marketing, etc.
31	34	5	20-30%	Technical Plastics, Metalworking, Foundry, Welding, Electronics, Drafting, Mechanical Systems, Robotics, etc.
48	14	8	5-15%	Electives
			100%	

Note. A response was not provided to this question for 34 major courses of study because they are accredited by a technical accrediting agency. No response was provided to the survey items for five nontechnical accredited major courses of study.

Only one of the six areas, general education, was identified as having all nontechnical accredited major courses of study meet or exceed NAIT standards. The course work area with the least agreement with NAIT standards was management. Slightly less than 23% of the major courses of study did not meet the 10-20% requirement range of management coursework needed to obtain a degree. The category requirement range of 5-15% for mathematics was not met by 20% of the nontechnical accredited major courses of study. At this time technical accreditation has little effect on difference between percentages of course work offered when compared to standards.

Concentrations/Emphases

Respondents identified, as shown in Table 18, a total of 208 concentrations/emphases titles offered as options for major courses of study in four-year baccalaureate industrial technology programs. Manufacturing (19) was identified as the most frequently offered with electronics (11), construction (9), graphic arts (8), woods (7), metals (6), and drafting (6) rounding out those concentrations/emphases having six or more responses. Three areas were identified with four responses each, eight were identified with three responses each, and 12 titles were identified two times each. The remaining titles for concentrations/emphases were identified only one time each.

Table 18

Number of Concentrations/Emphases Titles Offered as Options in Industrial Technology Major Courses of Study

Title	No.
Manufacturing	19
Electronics	11
Construction	9
Graphic Arts	8
Woods	7
Drafting	6
Metals	6
Electricity/Electronics	4
Management	4
Visual Communications	4
Construction Management	3
Design	3
Industrial Technology	3
Manufacturing Technology	3
Mechanical Design	3
Plastics	3
Power & Energy	3
Production	3
Automotive	2
Communications	2
Computer Applications	2
Computer Electronics	2
Drafting/Design	2
Graphic Communications	2
Industrial Distribution	2
Marketing	2
Materials and Processes	2
Packaging	2
Power Technology	2
Quality Assurance	2
Other Concentrations/Emphases	82
	N = 208

It was shown in Figure 2 that concentrations/emphases are a trait of nontechnical accredited programs of industrial technology. Even though not as many new concentrations/emphases are currently introduced as prior to 1973, the disparity between nontechnical and technical accredited is great. For example, by 1973, 61 concentrations/emphases had been introduced in nontechnical accredited programs as compared to 36 for technical

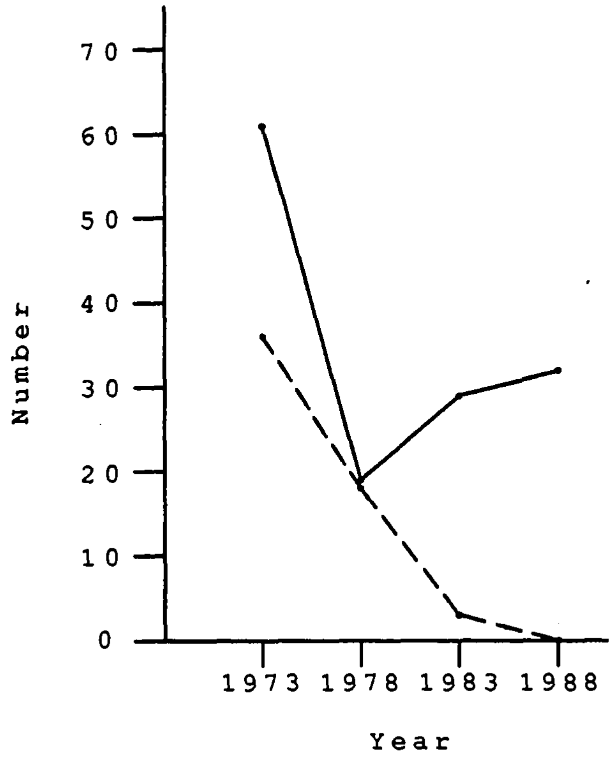


Figure 2. Concentrations/Emphases Offered by Year

———————— Nontechnical Accredited Programs

- - - - - - - - Technical Accredited Programs accredited programs. Between the years 1983 and 1988, 32 new concentrations/emphases were introduced in nontechnical accredited programs as compared to zero for technical accredited programs. This continued proliferation of concentrations/emphases for nontechnical accredited programs is an indication that these progams continue to provide generalized programs, while technical accredited programs have been moving toward specialization.

Future Program Modifications

The participants were asked to identify changes or additions which were anticipated in the next five years. Five survey questions were designed to obtain information about programmatic modifications. A sixth was designed to query about change of accrediting agencies.

Modifications to Major Courses of Study

Input about future major course of study modifications was provided by 25 respondents. The collected data were organized into five arbitrarily discerned categories for change. It was perceived by 10 respondents that either major courses of study or courses would be added. A second group of nine thought that major courses of study would be revised. Four respondents identified updating curriculum as the change process. Another respondent reported there was no consensus among faculty for change. The final respondent noted that movement in that program was toward program elimination.

Modifications to the Degree

Four arbitrary categories were obvious among the 16 responses to the question of degree modification. Nine respondents perceived the greatest change to be the addition of new degrees. Engineering technology predominantly was included as part of the titles for the new degrees. Four respondents in a second group indicated that revision of degrees would be the objective in their respective programs. Two respondents indicated that updating current degrees would be the goal. The final respondent reported that faculty had not reached consensus about future change.

Modifications to Concentrations/Emphases

Five categories were used to organize responses about change to concentrations/emphases. The addition of new concentrations/emphases and courses was favored by 10 respondents. Revisions and the updating of current curriculum were viewed as integral to change by seven and two respondents respectively. No consensus among faculty was a factor cited by one respondent. An "others" category contained two responses. The first was that the industrial technology program had moved to a new facility in 1989. The other respondent indicated that their program would align more closely with NAIT guidelines in the future.

Modifications to Specialized Majors

Eleven responses were organized into five categories for specialized major courses of study. Revision was the prominent theme as indicated by four respondents. Updating, adding new contemporary courses, and the dropping of specialized course work were identified by two respondents each. The final comment cited was that no consensus was evident among faculty for change. Curricula updating rather than the addition of new majors to keep up-to-date was the consensus.

Modifications for General Program

Five categories were used to organize the 16 general program change responses. The addition of new courses in math, science, computer-aided applications, other technology areas, and a new liberal arts core were identified as future changes. Revision of the core common to all industrial technology was the most notable of five responses represented in the revision category. Updating of current curriculum was cited by two respondents for this category. No consensus among faculty for change and a move to delete the concentration in secondary resources management were the other two responses.

No effect was shown for accreditation in relation to general and specialized programs of industrial technology.

It was indicated by chi square analysis in Table 19 that no difference existed.

Reasons for Changes/Additions

It was indicated by the majority of responses that modification was an ongoing task. The primary categories of action being the addition, revision, and updating of curricular components, in part or as a whole, of industrial technology programs. It was shown by the comments that industrial technology continues as a dynamic field of study.

Table 19

Chi Square for Program Type and Accreditation

	Accreditation		
Program	Technical	Nontechnical	Total
General	13	30	43
Specialized	7	10	17
Total	20	40	60

Note. Chi square = (1, N = 60) = .66, $p > .05$

It is evident from the responses of the respondents that they consider a current curriculum to be important to the vitality of their programs. The addition, revision, and updating activities for each aspect of industrial technology programs as reported by respondents is evident.

Courses of Study

The course work was divided into five discrete categories representing general education or liberal arts, mathematics, physical sciences, management, and technical course work. Since the technical coursework area was so diverse, it was further subdivided into 10 topics characteristic of industrial technology curricular content. These topics were drafting/design, construction, energy/power, graphic communications, production, material science, computer applications, aviation, work experience, and the miscellaneous topic of other specialty related.

The course work data were organized into a two row by five column matrix for analysis using the chi square statistic. The degrees of freedom were determined from the following formula: (R-1)(C-1), where R stands for Row and C stands for Column. Substituting 2 for R and 5 for C, the resultant formula became (2-1)(5-1) = (1)(4) = 4 degrees of freedom (d.f.).

General Education or Liberal Arts

The first category analyzed was General Education or Liberal Arts. Eight commonly offered course titles were identified on the survey (Appendix E). It was indicated by the data for nontechnical accredited programs shown in Table 20 that seven: economics, English, history,

Table 20

General Education or Liberal Arts Course Titles Offered in Nontechnical Accredited Programs

Course	Percentages by Year				
	1973	1978	1983	1988	1993
Economics	52.5	57.5	60	65	55
English	82.5	82.5	82.5	92.5	85
Foreign Language	5	5	5	7.5	15
History	65	67.5	67.5	75	65
Humanities	67.5	75	70	80	77.5
Psychology	62.5	65	62.5	67.5	60
Sociology	42.5	45	40	47.5	47.5
Speech	62.5	67.5	65	75	67.5
Science Electives	5	7.5	5	5	7.5
Quantitative Techniques				2.5	
Philosophy	2.5				
Literature				2.5	2.5
Bible	5	5	5	5	5
Physical Education & Health	5	5	5	5	5
Math	2.5	2.5	2.5	2.5	2.5
Technical Writing			2.5	2.5	2.5
Technology, Man, Society	2.5	2.5	2.5	2.5	
Occupational Safety		2.5	2.5	2.5	2.5
Religion	2.5	2.5	2.5	2.5	2.5
Social Science	2.5	2.5	2.5	2.5	2.5
Fine Arts	2.5	2.5	2.5	2.5	2.5
Writing Course (Jr./Sr.)	2.5	2.5	2.5	2.5	2.5
Music	2.5	2.5	2.5	2.5	2.5

Note. *n* = 40.

The percentages in the 1993 column are projections.

humanities, psychology, sociology, and speech were commonly offered. The least offered of these seven was sociology. The remaining area, foreign language, was shown to have a small percentage increase in courses offered. The course title percentages for these eight courses were shown to have a modest, yet steady increase through 1988. The same course titles for 1993 were projected to have a percentage decrease with the exception of foreign language, a percentage increase, and sociology, no percentage change. Twenty-one other courses were identified as being offered by industrial technology programs. The course offerings were diverse with only three courses receiving 5% or more of the responses; Bible studies (specific to church supported institutions), physical education and health, and science electives. The course title percentages for these courses in the general education or liberal arts category were stable as little change occurred. It was also noted that only three new course titles were added since 1983 in this category: literature, quantitative techniques, and technical writing.

The percentage increases for course titles offered in the general education or liberal arts related category were more modest as shown in Table 21. The six course titles: economics, English, history, humanities, sociology, and speech showed percentage increases through 1988. Foreign language was shown to have not changed and psychology was shown to have a percentage decrease. A percentage decrease was projected to 1993 for each of these course titles except foreign language which showed a percentage increase. The course offerings were not as diverse for the technical accredited programs. Only 10 course titles were recorded

Table 21

General Education or Liberal Arts Related Course Titles Offered in Technical Accredited Programs

Course	Percentages by Year				
	1973	1978	1983	1988	1993
Economics	60	60	60	75	60
English	95	90	90	95	85
Foreign Language			5	5	15
History	65	60	65	70	60
Humanities	90	85	85	90	75
Psychology	65	80	75	70	60
Sociology	25	30	30	35	25
Speech	60	60	60	65	50
Technical Report Writing	5	5	5	5	5
Literature	5	5	5	5	5
Biological Science	5	5	5	5	5
Physical Education & Health	5	5	5	5	5
Environment	5	5	5	5	5
Technical Writing				5	5
Cultural Pluralism				5	5
Human Understanding & Development			5	5	5
Library Science				5	5
Fine Arts	5	5	5	5	5

Note. n = 20.

The percentages in the 1993 column are projections.

in addition to the original eight identified on the survey instrument. Four new course titles had been added since 1983: cultural pluralism, human understanding and development, library science, and technical writing.

Data analysis using the chi square statistic revealed there was no significant difference in course titles between nontechnical accredited and technical accredited industrial technology programs. Chi square = (4, N = 1561) = .28, $p >$ .05 indicated no significant difference existed. An increase in total course titles offered shown in Table 22 was indicated for 1973 to 1988. The course title total projected for 1993 was projected to decrease from those offered in 1988.

Table 22

Chi Square for General Education or Liberal Arts Courses Offered by Year

	Year					
Accreditation	1973	1978	1983	1988	1993	Total
Nontechnical	190	201	196	220	206	1013
Technical	102	107	110	122	107	548
Total	292	308	306	342	313	1561

Note. Chi square = (4, N = 1561) = .28, $p >$ .05

<u>Mathematics</u>

Course work in mathematics had responses provided for twenty-eight different courses. The 10 courses identified on the survey instrument received the majority of the responses with the exception of calculus III and statistics II. The nontechnical accredited programs shown in Table 23 tended to have more diverse mathematics course work than technical accredited programs. Several course titles for the reporting periods ending in 1988 and projected to 1993 were indicated to have a percentage increase. The course titles were: analytical geometry, economic statistics, and statistics I. College algebra, college algebra II, and trigonometry were indicated to have percentage increases through 1988, but were projected to have percentage decreases in course titles by 1993. Two courses, calculus I and college algebra II, were shown to have percentage increases through 1988, but no change projected for 1993. Nine new course titles were introduced by 1988. The most prominent of these course titles was calculus II. It was the only one to be offered more than once and was projected to show an increase by 1993. No change was noted for statistics II through 1988 but was projected to have a percentage increase by 1993. Elementary analysis was projected by one respondent to be introduced as a new course title by 1993.

Table 23

Mathematics Course Titles Offered in Nontechnical Accredited Programs

Course	Percentages by Year				
	1973	1978	1983	1988	1993
Analytical Geometry . . .	12.5	15	17.5	22.5	25
Calculus I.	7.5	7.5	20	37.5	37.5
Calculus II				12.5	15
Calculus III.				2.5	2.5
College Algebra	60	60	70	72.5	65
College Algebra II. . . .	10	15	15	17.5	17.5
Economic Statistics . . .	2.5	7.5	10	12.5	15
Statistics I.	10	12.5	25	37.5	45
Statistics II	2.5	2.5	2.5	2.5	7.5
Trigonometry.	35	42.5	47.5	65	55
Basic Collegiate Math . .		2.5	2.5	2.5	2.5
Condensed Calculus. . . .		2.5	2.5	2.5	2.5
Elementary Analysis . . .					2.5
Geometry.		2.5			
Precalculus				2.5	2.5
Elements of Statistics I.				2.5	2.5
Engineering Economics . .				2.5	2.5
Boolean for Programmable Controller in Production Course.				2.5	2.5
Technical Math I.		2.5			
Technical Math II				2.5	2.5
5 hours of Math		2.5			
Calculus for Business & Life Sciences	2.5	2.5	2.5	2.5	2.5
Principles of Macro Economics				2.5	2.5
Principles of Micro Economics				2.5	2.5
College Math.	2.5	2.5	2.5	2.5	2.5

Note. *n* = 40.

The percentages in the 1993 column are projections.

Technical accredited programs in Table 24 had a less diverse grouping of courses. A slight percentage increase was shown between the reporting periods 1973 and 1988 for all course titles in this category except calculus III, statistics II, combination algebra/trigonometry, computer programming, and finance. Calculus I & III, trigonometry, analytical geometry, and computer programming had no

Table 24

Mathematics Course Titles Offered in Technical Accredited Programs

	Percentages by Year				
Course	1973	1978	1983	1988	1993
Analytical Geometry .	20	20	25	30	30
Calculus I.	25	50	60	75	75
Calculus II	5	15	15	15	20
Calculus III.	5	5	5	5	5
College Algebra . . .	70	70	75	75	65
College Algebra II. .	25	25	25	30	25
Economic Statistics .	5	10	10	10	15
Statistics I.	20	30	35	45	40
Statistics II	5	5	5	5	10
Trigonometry.	55	60	70	70	70
Combination Algebra/ Trigonometry. . . .	10	10	5	5	10
Computer Programming.	5	5	5	5	5
Finance				5	

Note. n = 20.

The percentages in the 1993 columns are projections.

percentage increase projected to 1993. Calculus II, economic statistics, and combination algebra/trigonometry were indicated to have a percentage increase projected by 1993. A slight percentage decrease was projected for college algebra, college algebra II, and statistics I by 1993.

The increase in course titles for calculus, statistics, and trigonometry for the years 1973-1988 were indicative of trends for nontechnical accredited programs. The increase in course titles for calculus and statistics courses for the years 1973-1988 were indicative of trends for technical accredited programs.

Given these slight percentage changes as shown in Table 25, no significant difference was discerned by chi square

Table 25

Chi Square for Mathematics Courses Offered by Year

	Year					
Accreditation	1973	1978	1983	1988	1993	Total
Nontechnical	58	72	87	125	127	469
Technical	54	66	73	81	77	351
Total	112	138	160	206	204	820

Note. Chi square = (4, *N* = 820) = 6.43, $p > .05$

analysis for mathematics course work between nontechnical and technical accredited industrial technology programs. Chi square (4, N = 820) = 6.43, $p > .05$ has shown that course titles have not significantly changed for either set of accredited programs. Year totals for mathematics course titles were found to have increased for each year except for the projections to 1993.

Physical Sciences

Nontechnical accredited programs were found to have more course titles in the category, physical sciences. Course titles in Table 26 that showed a slight percentage increase 1973 to 1988 were: chemistry I, chemistry II, general chemistry, introduction to physics, and physics I & III. Physics II was found to have a percentage increase through 1983 but has shown a percentage decrease projected through 1993. Likewise chemistry I and physics I are projected to have a percentage decrease by 1993. All other course titles were projected to have no change projected to 1993. Course titles added were geology and dynamics. Lab science as a course offering had shown a percentage decline.

Fewer course titles were offered by the technical accredited programs as shown in Table 27. The course titles: physics I & II, chemistry I, general chemistry, and introduction to physics were indicated to have shown percentage increases between 1973 and 1988, but are projected to have a slight percentage decrease by 1993. The

Table 26

Physical Sciences Course Titles Offered in Nontechnical Accredited Programs

Course	Year				
	1973	1978	1983	1988	1993
Chemistry I	25	35	40	55	50
Chemistry II.	12.5	12.5	15	20	20
General Chemistry	10	12.5	20	25	25
Introduction to Chemistry .	7.5	7.5	10	5	5
Introduction to Physics . .	12.5	15	15	20	20
Physical Science.	17.5	17.5	17.5	17.5	17.5
Physics I	35	47.5	60	75	72.5
Physics II.	17.5	27.5	57.5	52.5	50
Physics III	2.5	2.5	2.5	5	5
Lab Science	7.5	7.5	7.5	2.5	2.5
Geology			2.5	2.5	2.5
Biology	2.5	2.5	2.5	2.5	2.5
Materials Science					2.5
Dynamics.				2.5	2.5

Note. *n* = 40.

The percentages in the 1993 column are projections.

physical science course title was shown with an increase from 1973 but a percentage decrease projected to 1993. The other courses remained stable with the exception of introduction to chemistry and geology.

The increase in course titles for chemistry and physics courses for the years 1973-1988 were indicative of trends for nontechnical accredited programs. The increase in course titles for chemistry and physics courses for the

Table 27

Physical Sciences Course Titles Offered in Technical Accredited Programs

	Percentages by Year				
Course	1973	1978	1983	1988	1993
Chemistry I	55	55	55	65	60
Chemistry II.	10	10	10	10	10
General Chemistry	20	20	25	30	25
Introduction to Chemistry	5	5	5		
Introduction to Physics .	10	10	20	20	15
Physical Science.	15	20	25	20	15
Physics I	65	65	65	80	70
Physics II.	45	55	55	65	60
Lab Science	5	5	5	5	5
Lab Science	5	5	5	5	. 5
Computer.	5	5	5	5	
Geology				5	5

Note. $n = 20$.

The percentages in the 1993 column are projections.

years 1973-1988 were indicative of trends for technical accredited programs.

No difference was revealed in Table 28 for physical science offerings of nontechnical accredited and technical accredited programs. Chi square (4, $N = 737$) = 4.69, $p >$ .05 did not uncover any trend developing over the past fifteen years and those offerings predicted for the next five years. An increase in total course titles offered was shown for each year from 1973 through 1988. A decrease in course titles offered was projected for 1993.

Table 28

Chi Square for Physical Sciences Courses Offered by Year

	Year					
Accreditation	1973	1978	1983	1988	1993	Total
Nontechnical	60	75	100	114	111	460
Technical	49	52	56	64	56	277
Total	109	127	156	178	167	737

Note. Chi square = $(4, N = 737) = 4.69$, $p > .05$

Management

Management course work was represented in the responses by 39 different course titles. This represented an increase of 27 course titles over the original number presented to the sample. Nontechnical course titles: accounting I, businsess law, marketing, personnel management, production control, production management, supervision, and supervision and management were shown to have steadily increased between 1973 and 1988. The one exception to percentage decreases projected by 1993 for these courses was production control.

Engineering economics was indicated to show percentage decreases for 1973 through 1983, but percentage increases projected through 1993. Accounting II was shown in Table 29 to have a percentage decline since 1983. Manufacturing cost analysis was erratic a percentage decrease shown for 1978, a large percentage increase for 1988, and a small percentage decrease projected by 1993. Eight course title offerings have been added to the nontechnical accredited curricula since 1978. One course, insurance, was dropped prior to 1983. Three other courses: operations management, computer information systems, and business communications; were to be discontinued after 1988.

Several course titles offered in technical accredited programs as noted in Table 30 were shown to have experienced erratic percentage increases from 1973 through 1988. Of those with erratic percentage increases: business law, marketing, personnel management, and safety were course titles projected have no percentage increase by 1993. Accounting I and engineering economics were to continue erratic paths with projected percentage increases by 1993. Production control, production management, supervision, supervision and management, quality control, and time and motion study were courses projected by 1993 to show a percentage decrease. One course title, manufacturing cost analysis, was shown with a percentage increase for each time

Table 29

Management Course Titles Offered in Nontechnical Accredited Programs

Course	1973	1978	1983	1988	1993
	Year				
Accounting I.	20	32.5	37.5	40	17.5
Accounting II		7.5	10	5	5
Aviation Management.	2.5			2.5	2.5
Business Law.	15	20	27.5	25	20
Engineering Economics	12.5	10	5	15	17.5
Manufacturing Cost Analysis .	7.5	5	5	22.5	20
Marketing	15	20	27.5	32.5	27.5
Personnel Management.	35	35	37.5	52.5	42.5
Production Control.	17.5	20	25	40	42.5
Production Management	30	37.5	42.5	60	52.5
Supervision	12.5	10	17.5	27.5	25
Supervision and Management. .	17.5	12.5	27.5	35	30
Safety.			2.5	2.5	2.5
Decision Science.				2.5	2.5
Safety.	2.5	5	5	5	5
Occupational Safety & Hygiene Management.				2.5	2.5
Operations Management			2.5	2.5	
Principles of Management. . .	2.5	2.5	2.5	2.5	2.5
Computer Information Systems.	2.5	2.5	2.5	2.5	
Business communications . . .	2.5	2.5	2.5	2.5	
Principles of Production. . .			2.5	2.5	2.5
Channels of Management. . . .			2.5	2.5	2.5
Retailing			2.5	2.5	2.5
Personal Selling.			2.5	2.5	2.5
Advertising			2.5	2.5	2.5
Insurance	2.5	2.5			
Electronic Data Processing. .	2.5	2.5	2.5	2.5	2.5
Industrial Hygiene	2.5	2.5	2.5	2.5	2.5
Environmental Studies. . . .	2.5	2.5	2.5	2.5	2.5
Occupational Safety.	2.5	2.5	2.5	2.5	2.5
Auto & Traffic Safety. . . .	2.5	2.5	2.5	2.5	2.5

Note. n = 40.

The percentages in the 1993 column are projections.

Table 30

Management Course Titles Offered in Technical Accredited Programs

Course	Percentages by Year				
	1973	1978	1983	1988	1993
Accounting I.	20	55	45	45	65
Accounting II				10	10
Aviation Management. . . .	5	5	5	5	5
Business Law.	15	30	35	35	35
Engineering Economics . . .	25	20	20	20	30
Manufacturing Cost Analysis	5	10	15	20	25
Marketing	15	10	20	35	35
Personnel Management. . . .	40	50	50	50	50
Production Control.	25	35	40	50	45
Production Management . . .	25	35	40	45	35
Supervision	60	55	55	70	50
Supervision and Management.	20	30	35	40	35
Safety.	10	10	15	20	20
Manufacturing Policy. . . .	5	5	5	5	5
Quality Control	10	10	10	10	5
Time and Motion Study . . .	5	10	10	10	5
Industrial Accounting . . .	5	5	5	5	5
Operations Management . . .	5	5	5		
Production & Operations Management.	5	5	5	5	5
Safety & Loss Control . . .	5	5	5	5	5
Labor Economics	5	5	5	5	5
Organization Management . .		5	5	5	5
Principles of Management. .		5	5	5	5
Project Management.		5	5	5	5
Real Estate					5
Marketing Management. . . .				5	5
Finance				5	5
Maintenance Technology . .	5	5	5	5	5
OSHA	5	5	5	5	5

Note. *n* = 20.

The percentages in the 1993 column are projections.

entry point. Three course titles: organization management, principles of management, and project management were added between the years 1973 and 1988. Since 1983 marketing management, finance, and accounting II have been added. Additionally, it was projected that a course in real estate will be added by 1993 in one program. Only one course title, operations management, has been dropped since 1983.

The increase in course titles for accounting, economics related, production control, and production management courses for the years 1973-1988 were indicative of trends for nontechnical accredited programs. The increase in course titles for accounting, business law, marketing, production control, production management, and supervision and management courses for the years 1973-1988 were indicative of trends for technical accredited programs.

No significant difference was indicated in Table 31 to exist between nontechnical and technical accredited industrial technology programs for management related course titles. It was shown by statistical analysis that change was not significant as shown by chi square (4, $\underline{N}$ = 1069) = .61, $\underline{p} > .05$. The total number of management course titles offered were shown in Table 31 to have increased each reporting period through 1988. The total course titles offered are projected to decrease by 1993.

Table 31

Chi Square for Management Courses Offered by Year

	Year					
Accreditation	1973	1978	1983	1988	1993	Total
Nontechnical	84	95	122	162	145	604
Technical	68	85	94	110	108	465
Total	152	180	216	272	253	1069

Note. Chi square = (4, *N* = 1069) = .61, $p > .05$

Technical Course Work

There are nine course work areas in the technical course work category. The analyses for each area is presented in the following sections.

Design/Drafting related. Thirty-five courses were identified as being offered in the drafting/design technical course area. The nontechnical accredited course titles in Table 32 were found to be more diverse and had more numerous course titles than technical accredited programs. Ten of the most offered course titles in the design/drafting category were shown to have percentage increases for most reporting periods through 1988. Two course titles: die design and technical illustration were shown to have not changed between 1973 and 1988. The architectural drafting and technical drawing course titles were indicated to have had changeable percentages through 1988. Die design was the only course title to be indicated as having a percentage

Table 32

Drafting/Design Related Course Titles Offered in Nontechnical Accredited Programs

	Percentages by Year				
Course	1973	1978	1983	1988	1993
Architectural Drafting . . .	50	52.5	50	47.5	40
Blueprint Reading.	10	10	17.5	20	15
Construction Drafting. . . .	15	15	12.5	20	17.5
Design/Drafting.	42.5	45	47.5	52.5	47.5
Die Design	7.5	7.5	5	7.5	10
Electronic Drafting.	5	7.5	15	20	17.5
Geometric Dimensioning . . .	10	10	10	32.5	32.5
Industrial Sketching	7.5	5	10	15	15
Kinematics	2.5	5	10	12.5	12.5
Machine Design	25	25	27.5	30	27.5
Mechanical Drawing	52.5	52.5	42.5	52.5	50
Product Design and Drafting.	17.5	17.5	20	25	25
Technical Drawing.	45	50	45	52.5	47.5
Technical Illustration . . .	27.5	27.5	25	27.5	27.5
Tool Design.	5	7.5	10	15	15
Descriptive Geometry				2.5	2.5
Engineering Graphics	2.5	2.5			
Industrial Graphics.	2.5	2.5	5	2.5	2.5
Technical Graphics	2.5				
Technical Graphics Design. .	2.5				
Product Research & Development.		2.5	2.5		
Manufacturing Design Graphics		2.5	2.5		
Architecural Drafting II . .			2.5		
Computer Graphics.			2.5	2.5	2.5
Residential Planning & Specifications		2.5	5	2.5	2.5
Architectural Plans & Specifications			2.5		

Table 32 (continued)

	Percentages by Year				
Course	1973	1978	1983	1988	1993
CADD		5	7.5	10	10
Descriptive Geometry			2.5	2.5	
Technical Drawing II	2.5	5	2.5	2.5	2.5
Graphic Communication. . . .	2.5	2.5	2.5	2.5	2.5
Graphic Visualization & Analysis	2.5	2.5	2.5	2.5	2.5
Industrial Design.		2.5	2.5	2.5	2.5
Drafting Communications. . .		2.5	2.5	2.5	2.5
Technical Communication. . .		2.5			

Note. *n* = 40.

The percentages in the 1993 column are projections.

increase projected for 1993. Seven course titles: architectural drawing, blueprint reading, construction drafting, electronic drafting, machine design, mechanical drawing, and technical drawing were projected to have a percentage decrease by 1993. No percentage change was projected by 1993 for geometric dimensioning, industrial sketching, kinematics, product design and drafting, technical illustration, tool design, and CADD. The remainder of the course titles had response percentages of 5% or less. Engineering graphics, technical graphics, technical graphics design, product research and development, manufacturing design graphics, architectural drafting II, and architectural plans and specifications were courses discontinued as offerings during the first four reporting periods. Courses added to nontechnical accredited curricula

Table 33

Drafting/Design Related Course Titles Offered in Technical Accredited Programs

Course	Percentages by Year				
	1973	1978	1983	1988	1993
Architectural Drafting . . .	40	35	35	45	35
Blueprint Reading.		5	5	5	5
Construction Drafting. . . .	15	15	15	20	25
Design/Drafting.	50	45	50	55	45
Die Design	5	5	10	10	10
Electronic Drafting.	15	10	10	10	5
Geometric Dimensioning . . .	15	15	15	20	15
Industrial Sketching	15	15	20	25	25
Kinematics	10	10	15	15	15
Machine Design	15	15	15	25	20
Mechanical Drawing	20	25	25	25	25
Product Design and Drafting.	5	5	5	10	15
Technical Drawing.	50	50	50	55	45
Technical Illustration . . .	25	30	30	30	25
Tool Design.	10	10	20	25	20
Engineering Graphics	5	5	5	10	10
CADD			5	20	15
Descriptive Geometry	5	5	5	10	10
Engineering Geometry & Graphics	5	5	5	5	5
Systems Design				5	5
Industrial Communication .	5	5	5	5	5
Automotive Design.		5	5	5	5
Industrial Design.		5	5	5	5
Plastic Product Design . .				5	5

Note. *n* = 20.

The percentages in the 1993 column are projections.

since 1973 included descriptive geometry, computer graphics, residential planning and specifications, CADD, industrial design drafting communications, and technical communication.

The technical accredited responses were basically found within the original 15 identified survey items. This category represented by Table 33 had 14 course titles which were indicated to have shown either stability or a percentage increase between 1973 and 1988. Three course titles: Architectural drafting, design/drafting, and geometric dimensioning were shown to have fluctuating percentage changes between 1973 and 1988. Electronic drafting was indicated to have a percentage decrease for all reporting periods. Construction drafting and product design and drafting were projected to have percentage increases by 1993. Percentage decreases were projected for architectural drafting, design/drafting, geometric dimensioning, machine design, technical drawing, technical illustration, tool design, and CADD by 1993. No percentage change was projected for the remainder of the course titles. The only course title added in either accredited area that rated more than two responses in a year was computer-aided design/drafting (CADD). No course titles were entirely dropped from the technical accredited curricula during the reporting periods.

The increase in course titles for geometric dimensioning and CADD courses for the years 1973-1988 were indicative of trends for nontechnical accredited programs. The increase in course titles for CADD courses for the years 1973-1988 were indicative of a trend for technical accredited programs.

In final analysis of Table 34, design/drafting related course offerings were shown to be no different in relation to accredition. Statistical analysis using chi square (4, $N = 1178$) = .35, $p > .05$ has shown no difference existed for course titles. Yearly totals of course titles offered increased for each period except 1993 which was shown to have a decline.

Table 34

Chi Square for Design/Drafting Related Courses Offered by Year

	Year					
Accreditation	1973	1978	1983	1988	1993	Total
Nontechnical	136	149	158	186	173	802
Technical	63	66	73	92	82	376
Total	199	215	231	278	255	1178

Note. Chi square = (4, $N = 1178$) = .35, $p > .05$

Construction related. The construction related courses proved to be a very broad area. Thirty-five courses were identified by the respondents in addition to the 10 original survey items. The nontechnical accredited course titles displayed in Table 35 were reflective of traditional

Table 35

Construction Related Course Titles Offered in Nontechnical Accredited Programs

	Percentages by Year				
Course	1973	1978	1983	1988	1993
Advanced Woods	37.5	37.5	27.5	22.5	20
Construction Processes . .	30	32.5	42.5	45	45
Construction Technology. .	30	42.5	47.5	50	47.5
Construction Management. .	15	15	27.5	35	35
Finishing Processes. . . .	32.5	27.5	22.5	20	17.5
Project Development. . . .	10	10	5	7.5	5
Surveying.	20	22.5	25	27.5	25
Woods I.	60	50	42.5	47.5	35
Woods II	20	15	10	12.5	12.5
Woods Technology	17.5	20	22.5	22.5	20
Advanced Woods	2.5	2.5			
Wood Technology I.	2.5	2.5	2.5	2.5	
Wood Technology II	2.5	2.5	2.5		
Building Trades Mechanical	2.5				
Building Construction I. .	2.5	2.5			
Building Construction II .	2.5	2.5			
Building Construction III.	2.5	2.5			
Architectural Plans & Specifications			2.5		
Residential Construction .			2.5		
Commercial Construction. .			2.5	2.5	2.5

Table 35 (continued)

	Percentages by Year				
Course	1973	1978	1983	1988	1993
Industrial Wood Processing			5	5	5
Electrical & Mechanical Systems.			2.5	2.5	2.5
Construction Materials . .	2.5	2.5	7.5	5	5
Construction Estimating. .	5	5	5	7.5	7.5
Construction Resources . .				2.5	2.5
Construction Documents . .				2.5	2.5
Project Planning, Scheduling & Controlling			2.5	5	2.5
Construction Management & Estimating				2.5	2.5
Methods Improvement in Construction				2.5	2.5
Construction Techniques. .			2.5		
Construction Graphics. . .				2.5	
Law.	2.5	2.5	2.5	2.5	2.5
Construction Management & Controls			2.5	2.5	2.5
Construction Equipment & Methods.			2.5	2.5	2.5
Foundations & Soils. . . .			2.5	2.5	2.5
Structural Design.			2.5	2.5	2.5
Reinforced Concrete. . . .			2.5	2.5	2.5
Construction Systems . . .		2.5	2.5	2.5	2.5

Note. n = 40.

The percentages in the 1993 column are projections.

topics in their titles. The course titles: construction processes, construction technology, construction management, surveying, and wood technology were indicated to have percentage increases between 1973 and 1988. Advanced woods, finishing processes, project development, and woods I & II were shown to have a percentage decrease between 1973 and 1988. No course titles in this category were projected to have a percentage increase by 1993. Since 1973 nine course titles had been eliminated from nontechncial accredited curricula. These course titles represented either a wood technology or a building construction type course. Offsetting the decline and course elimination was the addition of 17 course titles. The majority of new course titles were offered only once during each reporting period.

Most course titles in the construction related technical accredited category shown in Table 36 were found to have construction in the title. Four courses: construction processes, construction technology, project development, and surveying were shown to have a projected percentage decline for 1993 after an indicated percentage increase in offerings through 1988. The remainder of the course titles in this category were shown to have mixed percentage changes through 1988 and were projected to have no percentage change by 1993. Courses added since 1973 included project planning, scheduling and controlling; construction techniques; law; scheduling; construction management and controls; structural systems II; construction supervision; and construction systems.

The increase in course titles for construction technology and construction management courses for the years 1973-1988 were indicative of trends for nontechnical accredited programs. The decrease in course titles for woods I & II courses for the years 1973-1988 were indicative

Table 36

Construction Related Course Titles Offered in Technical Accredited Programs

Course	Percentages by Year				
	1973	1978	1983	1988	1993
Advanced Woods	20	20	20	15	15
Construction Processes . .	25	40	35	50	35
Construction Technology. .	5	10	10	20	15
Construction Management. .	15	20	15	25	25
Finishing Processes. . . .	10	20	15	15	15
Project Development. . . .	5	15	10	20	10
Surveying.	15	20	20	35	25
Woods I.	25	25	25	25	25
Woods II	15	15	15	15	15
Woods Technology	15	20	15	10	10
Residential Construction .	5	5	5	5	5
Commercial Construction. .	5	5	5	5	5
Construction Estimating. .	5	10	10	15	15
Project Planning, Scheduling & Controlling				5	5
Construction Techniques. .				5	5
Law.		5	5	5	5
Scheduling		5	5	5	5
Construction Management & Controls			5	5	5
Legal Aspects.	5	5	5	5	5
Structural Systems II. . .					5
Construction Supervision .				5	5
Construction Systems . . .				5	5

Note. *n* = 20.

The percentages in the 1993 column are projections.

of trends for nontechnical accredited programs. The increase in course titles for construction processes and surveying courses for the years 1973-1988 were indicative of trends for technical accredited programs.

No difference in course offerings between nontechnical and technical accredited programs were indicated by course title analysis for construction related course work shown in Table 37. It was shown by chi square statistical analysis no difference existed, chi square (4, N = 882) 4.29, $p >$ .05. Total course titles offered were found to have increased for each reporting period with the exception of those projected to 1993.

Table 37

Chi Square for Construction Related Courses Offered by Year

	Year					
Accreditation	1973	1978	1983	1988	1993	Total
Nontechnical	120	120	131	140	126	637
Technical	35	49	44	62	55	245
Total	155	169	175	202	181	882

Note. Chi square (4, N = 882) = 4.29, $p > .05$

Energy and power related. The greatest array of titles was found in the energy and power related course title category. The respondents identified numerous titles in addition to those included on the survey instrument. The nontechnical accredited course title category shown in Table 38 was represented by 67 different titles. The majority of responses for both nontechnical and technical accredited programs were grouped in eight titles: electricity I & II, electronics I & II, digital electronics, instrumentation, power control, and solid state electronics. Three nontechnical accredited energy and power course titles: electricity I & II and electronics II were indicated to show a percentage decrease between 1973 and 1988. Only six courses in the nontechnical accredited category showed percentage decline projected for the next five years. Representative of these courses were electricity I & II, power control, solid state electronics, applied fluid power/industrial fluid power, and microprocessors. Of the course titles receiving responses, 24 will no longer be offered by 1993. Some of these eliminated course titles had been combined into another title. Twenty-one course titles had been added since 1973, 14 prior to 1988 and seven in 1988 or projected for 1993. Energy and power course titles identified were more diverse than in the previous categories.

Courses offered by technical accredited programs in Table 39 were not as diverse as those in nontechnical accredited programs. An increase in percentage was found

Table 38

Energy and Power Related Course Titles Offered in Nontechnical Accredited Programs

Course	Percentages by Year				
	1973	1978	1983	1988	1993
Digital Electronics.	20	25	42.5	62.5	62.5
Electricity I.	65	67.5	62.5	65	60
Electricity II	40	35	35	32.5	30
Electronics I.	55	57.5	52.5	62.5	62.5
Electronics II	27.5	25	22.5	32.5	32.5
Instrumentation.	10	17.5	17.5	27.5	30
Power Control.	15	15	20	32.5	30
Solid State Electronics. . .	10	15	32.5	40	37.5
Thermodynamics	5	2.5	5	15	17.5
Power Technology	2.5	5	5	5	5
Mechanical Power Systems . .			2.5	2.5	2.5
Electronic Applications. . .		2.5			
Electronic Communications. .	2.5	5	5	7.5	7.5
Power Systems.		2.5	2.5	2.5	
Introduction to Microcomputers			2.5	2.5	2.5
Applied Fluid Power/ Industrial Fluid Power . .	2.5	2.5	7.5	10	7.5
Power Unified Laboratory System					
PLUS Methodology			2.5		
PLUS Conceptualization . . .			2.5		
PLUS Development			2.5		
PLUS Demonstration			2.5		
PLUS Methodology & Conceptualization.				2.5	2.5
PLUS Development & Demonstration.				2.5	2.5
Automotive & Diesel Engines.	2.5	2.5			
Power Trains & Suspensions .	2.5	2.5			
Automotive Electrical & Fuel Systems.	2.5	5	2.5	2.5	
Fuel Injection Systems . . .	2.5	2.5			
Problems of Internal Combustion Engines	2.5	2.5			
Problems of Power Trains & Suspensions.	2.5	2.5			

Table 38 (continued)

Course	Percentages by Year				
	1973	1978	1983	1988	1993
AM-FM Radio.		2.5			
Guide to Automotive Fundamentals	2.5	2.5	2.5	2.5	2.5
Instrumentation.					2.5
PLC & Process Control. . . .					2.5
Electronic System Analysis .					2.5
Mechanical Contracting . . .				2.5	2.5
Construction Wiring.	2.5	2.5	2.5		
Microprocessors.		2.5	5	10	7.5
Automotive Systems	2.5	2.5	2.5	2.5	2.5
Industrial LVTS & Automation		2.5	2.5	2.5	2.5
Communications		2.5	2.5	2.5	2.5
Energy Conversion & Transmission			2.5	2.5	
Transportation Technology. .				2.5	2.5
Residential Wiring	2.5	2.5	2.5	2.5	2.5
Industrial Controls.			5	5	5
Robotic Controls				2.5	2.5
Electricity/Electronics I. .		2.5	5	5	5
Electricity/Electronics II .		2.5	5	5	5
Direct Current			2.5	2.5	
Photovoltaic & Optical . . .			2.5	2.5	
AC Principle & Circuits. . .			2.5	2.5	
Transmitter Circuits			2.5	2.5	
Logic Circuits			2.5	2.5	
Industrial Power			2.5	2.5	
Pulse Circuits			2.5	2.5	
Microwave Systems.			2.5	2.5	
Survey of Energy Sources & Power Technology	2.5	2.5	2.5	2.5	2.5
Power Transmission Principles		2.5	2.5	2.5	2.5
Power Transmission		2.5	2.5	2.5	2.5
Fluid Power I.	2.5	2.5	2.5	2.5	2.5
Fluid Power II			2.5	2.5	2.5
Fluid Logic.		2.5	2.5	2.5	2.5
Automotive/Information . . .	2.5	2.5	2.5	2.5	
Automotive Laboratory. . . .			2.5	2.5	
Hydraulics/Pneumatics. . . .				2.5	2.5
Energy/Power		2.5	2.5	2.5	2.5

Table 38 (continued)

Course	Percentages by Year				
	1973	1978	1983	1988	1993
Solar Energy		2.5	2.5	2.5	2.5
Auto Tech Sys.	2.5	2.5	2.5	2.5	2.5

Note. n = 40.

The percentages in the 1993 columns are projections.

between 1973 and 1988 for digital electronics, electricity I, electronics I & II, instrumentation, power control, and solid state electronics. Two course titles electricity II and thermodynamics were shown to have not changed through 1988. Solid state electronics and thermodynamics were projected to have a percentage increase by 1993. Three course titles: electricity I and electronics I & II were projected to have a percentage decrease by 1993. The remaining course titles were projected to have no percentage change by 1993. New course titles offered beginning in the 1978 reporting period numbered eight. Four were initiated prior to 1978, two prior to 1983, and the other two prior to 1988. One course offering, energy, had been eliminated in this category.

The increase in course titles for digital electronics, solid state electronics, and microprocessor related courses for the years 1973-1988 were indicative of trends for

Table 39

Energy and Power Related Course Titles Offered in Technical Accredited Programs

Courses	Percentages by Year				
	1973	1978	1983	1988	1993
Digital Electronics. . . .	15	35	45	45	45
Electricity I.	60	60	55	70	55
Electricity II	20	20	20	20	20
Electronics I.	30	35	40	50	45
Electronics II	15	20	25	25	20
Instrumentation.	20	30	30	30	30
Power Control.	25	30	30	35	35
Solid State Electronics. .	25	30	30	30	35
Thermodynamics	10	10	10	10	15
Power Technology				5	5
Microprocessors.			5	5	5
Communications Systems . .		5	5	5	5
Reactive Circuits.		5	5	5	5
Energy Conversion & Transmission		5	5	5	5
Transportation Technology.		5	5	5	5
Microcomputer Systems. . .			5	5	5
Industrial Electronics . .	5	5	5	5	5
Hydraulics/Pneumatics. . .				5	5
Energy				5	
Power Mechanics.	5	5	5	5	5
Power Transmission	5	5	5	5	5
Mechanical Power Systems .	5	5	5	5	5
Fluid Power Systems. . . .	5	5	5	5	5

Note. *n* = 20.

The percentages in the 1993 columns are projections.

nontechnical accredited programs. The increase in course titles for digital electronics and electronics courses for the years 1973-1988 were indicative of trends for technical accredited programs.

The statistical analysis, chi square (4, N = 1136) = 1.04, $p > .05$, indicated no significant difference in course titles between nontechnical and technical accredited programs (Table 40). The energy and power course titles have not shown enough change occur to indicate a trend for accredited programs. Total course titles offered increased for each reporting period except those projected to be offered by 1993.

Table 40

Chi Square for Energy and Power Related Courses Offered by Year

	Year					
Accreditation	1973	1978	1983	1988	1993	Total
Nontechnical	115	137	165	202	187	806
Technical	49	63	68	77	73	330
Total	164	200	233	279	260	1136

Note. Chi square = (4, N = 1136) 1.04 $p > .05$

Graphic communications related. The respondents identified 16 courses in addition to the 12 items provided on the survey. Nontechnical accredited programs, Table 41, had a wider representation of course titles than

Table 41

Graphic Communications Related Course Titles Offered in Nontechnical Accredited Programs

Course	Percentages by Year				
	1973	1978	1983	1988	1993
Advanced Photography . . .	7.5	7.5	7.5	10	10
Applied Photography. . . .	15	15	17.5	17.5	17.5
Black & White Photography.	15	17.5	17.5	15	12.5
Color Photography.	2.5	2.5	2.5	7.5	5
Communications Technology.	17.5	17.5	20	25	25
Electronic Publishing. . .	7.5	7.5	10	12.5	30
Graphics Arts Technology .	42.5	45	45	45	37.5
Industrial Photography . .	7.5	7.5	7.5	5	7.5
Lithographic Technology. .	15	20	17.5	20	20
Photographic Processes . .	17.5	15	15	20	17.5
Production Printing. . . .	17.5	22.5	22.5	20	17.5
Progressive Photographic Technology	5	2.5	2.5	2.5	2.5
Screen Printing.		2.5	5	5	5
Graphic Arts Estimating & Management				2.5	2.5
Communications Systems . .		2.5	2.5	2.5	
Advanced Graphic Arts. . .		2.5			
Printing Management. . . .	2.5	2.5	2.5	2.5	2.5
Color Separation & Reproduction				2.5	2.5
Technical Illustration . .	2.5	2.5	2.5	2.5	2.5
Advanced Technical Illustration	2.5	2.5	2.5	2.5	2.5
Printing Estimating. . . .	2.5	2.5	5	5	2.5
Creative Photography . . .	2.5	2.5	2.5	2.5	2.5
Color.	2.5	2.5	2.5	2.5	2.5
Offset Lithography	2.5	2.5	5	5	2.5
Audio-visual		2.5	2.5		
Advanced Printing.			2.5	2.5	

Note. $n = 40$

The percentages in the 1993 column are projections.

did technical accredited programs, Table 42. Graphic arts technology was projected to decline by 7.5% in times offered

Table 42

Graphic Communications Related Course Titles Offered in Technical Accredited Programs

Course	Percentages by Year 1973	1978	1983	1988	1993
Advanced Photography . . .	25	20	15	15	20
Applied Photography. . . .	15	10	10	10	20
Black & White Photography.	35	35	30	30	35
Color Photography.	20	20	30	30	35
Communications Technology.	20	15	15	15	20
Electronic Publishing. . .	5		10	10	25
Graphics Arts Technology .	30	30	30	25	30
Industrial Photography . .	10	5	5	5	15
Lithographic Technology. .	15	15	15	15	20
Photographic Processes . .	10	15	15	15	20
Production Printing. . . .	20	20	25	25	30
Progressive Photographic Technology	5	5	5	5	10
Printing Management. . . .					5
Desktop Publishing					5
Color Separation & Reproduction			5	5	5
Printing Estimating. . . .		5	5	5	5
Typography			5	5	5

Note. *n* = 20.

The percentages in the 1993 column are projections.

even though it was to remain one of the three most frequently offered courses. In addition, six other courses:

black and white photography, color photography, photographic processes, production printing, printing estimating, and offset lithograhy were projected to be offered 2.5% less by 1993. Nontechnical accredited programs had initiated seven courses since 1973, however four of those had been discontinued by 1988. Electronic publishing was projected to show the most dramatic increase in times offered with a 17.5% increase since 1988. There were eight courses that showed modest or flucuating growth through the 1988 reporting period. The remaining courses did not have a reportable percentage change in times offered.

Technical accredited programs offered fewer courses. The offerings were more uniform with the four most common being color photography, communications technology, graphic arts technology, and production printing. No course titles in this category were projected to have a percentage decrease by 1993. New courses introduced or re-introduced during the reporting period numbered six. Stability and modest growth in course offerings was shown as a characteristic of graphic arts related course titles (Table 43). The interesting development was the projected increase in course titles to be offered for the future. The courses offered in 1988 totaled 47 in technical accredited programs and 65 are planned to be offered in 1993, an increase of 18. In comparison, nine fewer courses will be offered in nontechnical accredited programs in five years.

The increase in course titles for electronic publishing courses projected by 1993 were indicative of a trend for nontechnical accredited programs. The increase in course titles for electronic publishing courses projected by 1993 were indicative of a trend for technical accredited programs.

Even though projections indicate a difference of 27 courses by 1993, no trend could be discerned for graphic arts related course titles in relation to nontechnical and technical accreditation. Statistical analysis, chi square (4, N = 688) 3.56, $p > .05$, has revealed that even given the over 38% increase in courses to be offered, there was no significant difference in course titles offered between

Table 43

Chi Square for Graphic Communications Related Courses Offered by Year

	Year					
Accreditation	1973	1978	1983	1988	1993	Total
Nontechnical	75	83	88	101	92	439
Technical	46	43	48	47	65	249
Total	121	126	136	148	157	688

Note. Chi square (4, N = 688) = 3.56, $p > .05$

nontechnical accredited and technical accredited programs as shown in Table 43. Total course titles offered were shown to have exhibited a steady increase in offerings over the four discrete reporting periods and projected to 1993.

Production related. The production related area had the second greatest number of different course titles offered. This area also had the greatest proliferation of courses of any curricular area. Nontechnical accredited programs had a more diverse offering of course work than technical accredited programs. They outnumbered the techncial accredited programs in total course titles offered. The four most offered courses in Table 44 for the nontechnical accredited programs were machine tool technology, manufacturing technology, metals I, and plastics technology. However, only three of them, machine tool technology, manufacturing technology, and plastics technology, remained in the top four by 1993. Each of them shows a potential decrease course titles offered. Robotics was projected to join the top four by 1993. Overall 10 course titles were projected to show a percentage decrease by 1993. One was projected to decrease by 10%, four were expected to decrease by 5% and five were expected a course titles offered decrease of 2.5%. The course titles to show the greatest overall percentage decrease were metals I & II. The years between 1983 and 1988 were shown to have the greatest increase in courses offered. Percentage increases of 25% were found for robotics and material handling, 20% increases were discovered for quality assurance and quality control, and 17.5 % increases for material handling and

Table 44

Production Related Course Titles Offered in Nontechnical Accredited Programs

Course	Percentages by Year				
	1973	1978	1983	1988	1993
Ceramics Processes	7.5	5	5	10	7.5
Facilities Design.	15	12.5	15	20	17.5
Machine Tool Technology. . .	47.5	52.5	55	67.5	62.5
Manufacturing Systems. . . .	15	15	32.5	47.5	47.5
Manufacturing Technology . .	22.5	27.5	37.5	62.5	60
Material Handling.	7.5	5	5	22.5	27.5
Metals I	62.5	65	57.5	60	50
Metals II.	40	42.5	35	30	25
Plant Layout	10	15	25	32.5	32.5
Plastics Technology.	45	50	47.5	55	52.5
Production Processes	17.5	17.5	27.5	37.5	42.5
Production Scheduling. . . .	7.5	7.5	7.5	20	22.5
Production Systems	15	12.5	25	42.5	45
Production Techniques. . . .	10	7.5	15	27.5	27.5
Research and Development . .	12.5	20	22.5	37.5	32.5
Quality Assurance.	7.5	12.5	20	37.5	32.5
Quality Control.	10	12.5	22.5	42.5	40
Robotics	7.5	7.5	30	55	57.5
Time and Motion Study. . . .	7.5	15	15	25	25
Plastics I	2.5	2.5	2.5	2.5	
Plastics II.	2.5	2.5			
Planning Manufacturing Systems.		2.5	2.5	2.5	2.5
Tooling Up for Manufacturing		2.5			
Material Processing Technology		2.5	5	5	2.5
Manufacturing Enterprises. .			2.5	5	2.5

Table 44 (continued)

Course	Percentages by Year				
	1973	1978	1983	1988	1993
Controlling Manufacturing Systems.			2.5	2.5	2.5
Industrial Organization & Production	2.5				
Production Systems		2.5	2.5	2.5	
Improving Manufacturing Systems.			2.5	2.5	2.5
Metalcasting Technology. . .					2.5
Machine Tools Technology . .	2.5				
Industrial Crafts.	2.5				
Methods Improvement in Construction				2.5	
Production & Inventory Control.		2.5	2.5	2.5	2.5
Manufacturing Value Control.				2.5	2.5
Welding Technology		2.5	2.5	2.5	2.5
Industrial Safety.		5	5	5	5
Operations Research.		2.5	2.5	2.5	2.5
Cellulose Materials & Processes.			2.5	2.5	
Metals Materials & Processes			2.5	2.5	
Synthetic Materials & Processes.			2.5	2.5	
Forging, Welding, Foundry. .	2.5	5	2.5	2.5	2.5
Job Analysis & Industrial Processes.			2.5	2.5	2.5
Interpreting Modern Industry	2.5	2.5	2.5	2.5	2.5
General Metals				2.5	2.5
Care & Management.				2.5	

Note. n = 40.

The percentages in the 1993 column are projections.

production systems. Four courses: production processes, production systems, production scheduling, and robotics were shown to have percentage increases for the entire reporting period. During the reporting periods 20 course titles were added and seven of these were subsequently dropped. In addition five course titles present in 1973 were dropped from course offerings by 1988. All of these courses were never offered more than one time in any reporting period.

The technical accredited programs were represented by production processes, quality control, robotics, and time and motion study as the top four titles projected to be offered for 1993. (It should be noted here that even though NAIT accreditation guidelines recognize quality control and time and motion study as managment courses, this researcher was advised by one member of the trial run panel to include the items as production technology related on the survey). A 15% decrease in times offered was projected in Table 45 for metals I. A five to 10% decrease was projected for 1993 in the offering of seven other courses. Percentage increases in course titles offered were numerous between 1978 and 1988 but not as great as for the nontechnical category. The most notable increase was for ceramics processes which showed a 45% increase from 1978 to 1983. Six courses: facilities design, material handling, plant layout, plastics technology, robotics, and time and motion study were projected to have an increase in course titles offered by 1993. The greatest increase was 15% for robotics. Eleven new courses were initiated and only two were eliminated during the reporting periods for the

Table 45

Production Related Course Titles Offered in Technical Accredited Programs

Course	1973	1978	1983	1988	1993
	Percentages by Year				
Ceramics Processes . . .			45	45	45
Facilities Design.	10	15	15	15	20
Machine Tool Technology. .	35	40	40	50	40
Manufacturing Systems. . .	15	20	20	30	25
Manufacturing Technology .	25	30	40	50	45
Material Handling.	25	25	30	30	35
Metals I	50	45	45	50	35
Metals II.	35	30	30	35	25
Plant Layout	25	25	30	35	40
Plastics Technology. . . .	15	20	20	20	25
Production Processes . . .	30	40	45	55	50
Production Scheduling. . .	10	10	25	35	35
Production Systems	10	10	15	30	20
Production Techniques. . .	10	10	10	15	10
Research and Development .	5	5	5	15	15
Quality Assurance.	15	25	30	45	45
Quality Control.	40	45	50	65	65
Robotics	20	45	40	40	55
Time and Motion Study. . .	30	50	45	45	55
Metalcasting Technology. .	5	5	5	5	5
CAM.				5	
CIM.				5	
Welding Technology	5	5	5	5	5
Applied Synthetics		5	5	5	5
Product Research & Development.				5	5
Die Design	5	5	5	5	5
Chemical Machining	5	5	5	5	5
Cellulose Materials & Processes.				5	5
Intoduction to Industry & Technology				5	5
Reinforced Plastics. . . .		5	5	5	5
Composite Plastics			5	5	5
Tooling for Plastics . . .			5	5	5
Industrial Finishing . . .	5	5	5	5	5
Welding.	5	5	5	5	5

Table 45 (continued)

Course	Percentages by Year				
	1973	1978	1983	1988	1993
Technical Experimentation.	5	5	5	5	5
Directed Studies	5	5	5	5	5
Packaging Technology . . .			5	5	5

Note. $n = 20$.

The percentages in the 1993 column are projections.

production related course title category. No percentage change was noted for the remainder of the course titles across the reporting periods. The difference between the top four course titles for each program type indicated that course titles offered in nontechnical accredited programs were more related to skill development than course titles offered in technical accredited programs.

The increase in course titles for machine tool technology, manufacturing systems, manufacturing technology, plant layout, production processes, production scheduling, production systems, research and development, quality assurance, quality control, and robotics courses for the years 1973-1988 were indicative of trends for nontechnical accredited programs. The decrease in course titles for metals I & II courses for the years 1973-1988 and projected to 1993 were indicative of trends for nontechnical accredited programs. The increase in course titles for ceramics processes, manufacturing technology, production processes, production scheduling, production systems, quality assurance, quality control, and robotics courses for the years 1973-1988 were indicative of trends for technical accredited programs.

The statistical analysis displayed in Table 46, chi square (4, N = 1775) = 3.69, $p > .05$, showed no difference in course titles between nontechnical accredited

Table 46

Chi Square for Production Related Courses Offered by Year

	Year					
Accreditation	1973	1978	1983	1988	1993	Total
Nontechnical	154	173	219	315	298	1159
Technical	91	106	121	153	145	616
Total	245	279	340	468	443	1775

Note. Chi square = (4, N = 1775) = 3.69, $p > .05$

and technical accredited programs. No trend in course title differences could be discerned for technical accredited programs. Totals for course titles offered for each reporting period were shown to increase except those projected for 1993.

Material science related. Only five titles were added to the original 10 survey titles for this course area. None of these titles identified in Table 47 were found to receive more than one response in any year. The six most offered courses in each program area had five common titles: characteristics of materials, materials I, materials testing, metallurgy, and strength of materials. The differences between the sixth of the most offered course titles were statics and strengths for nontechnical accredited programs and statics for technical accredited programs. Course titles in 1988 for material science related courses showed a marked increase over the 1983 titles for nonaccredited programs. This trend was projected to continue to 1993 for three courses. Five course titles were projected to have decreases ranging from 2.5% to 7.5% by 1993. Three new course titles were initiated and one was dropped, but re-introduced in 1988. No course titles were eliminated from the nontechnical accredited programs.

A slight increase took place (Table 48) in the number of course titles offered in 1988 as compared to 1983 for technical accredited programs. Increases for 1988 ranged from 5% to 15% in times offered for five course titles: characteristics of materials, composites, materials I, materials testing, and metallurgy. It was indicated by the 1993 projections that only one course title, strength of materials, were to be offered more while two course titles,

Table 47

Material Science Related Course Titles Offered in Nontechnical Accredited Programs

Course	Percentages by Year				
	1973	1978	1983	1988	1993
Ceramics.	2.5			5	10
Characteristics of Materials.	7.5	10	12.5	37.5	30
Composites.	2.5	5	5	17.5	20
Materials I	22.5	17.5	17.5	35	32.5
Materials II.	7.5	7.5	10	12.5	12.5
Materials Testing	15	20	25	30	35
Metallurgy.	25	22.5	22.5	32.5	25
Statics	7.5	7.5	5	20	20
Statics and Strengths	12.5	15	17.5	30	27.5
Strength of Materials	20	20	17	27.5	35
Non Destructive Testing . . .				2.5	2.5
Dynamics.			2.5	2.5	2.5
Fluid Dynamics.			2.5	2.5	2.5
Technical Development of Materials	2.5	2.5	2.5	2.5	2.5

Note. *n* = 40.

The percentages in the 1993 column are projections.

characteristics of materials and metallurgy, were to show a decline of 10%. Three courses were initiated and one was projected to be initiated during the reporting periods. Two of these, materials II and composites, were projected to be offered in 1993.

The increase in course titles for characteristics of materials courses for the years 1973-1988 were indicative of a trend for nontechnical accredited programs. The increase in course titles for characteristics of materials, materials I, and materials testing courses for the years 1973-1988 were indicative of trends for technical accredited programs.

No difference in course titles for the material science category was shown by the statistical analysis, chi square (4, N = 530) = 3.25, $p > .05$, between nontechnical and technical accredited programs in Table 49.

Table 48

Material Science Related Course Titles Offered in Technical Accredited Programs

Course	Percentages by Year				
	1973	1978	1983	1988	1993
Ceramics		5			
Characteristics of Materials	10	15	20	30	20
Composites			5	10	10
Materials I	35	45	45	55	55
Materials II					5
Materials Testing	15	20	25	35	35
Metallurgy	15	15	15	30	20
Statics	15	15	15	15	15
Statics and Strengths	5	5	10	10	10
Strength of Materials	15	30	25	25	30
Materials & Processes				5	

Note. n = 20.

The percentages in the 1993 column are projections.

No trends for accredited programs could be determined from chi square analysis. Total course titles offered were shown to have increased for the reporting periods through 1988. A very slight decline of only three courses was projected for 1993.

Table 49

Chi Square for Material Science Related Courses Offered by Year

	Year					
Accreditation	1973	1978	1983	1988	1993	Total
Nontechnical	50	51	56	103	103	363
Technical	22	30	32	43	40	167
Total	72	81	88	146	143	530

Note. Chi square = $(4, N = 530) = 3.25, p > .05$

Computer applications related. Computer applications related course work offerings for nontechnical accredited programs have expanded since 1978. Twelve of 16 course titles in Table 50 were shown to be offered 2.5% to 37.5% more often by 1983. Course titles offered by 1988 were shown to have increases of 2.5% to 42.5% for 19 of 22 course titles. Course titles that showed the greatest

Table 50

Computer Applications Related Course Titles Offered in Nontechnical Accredited Programs

Course	Percentages by Year				
	1973	1978	1983	1988	1993
Beginning Computers.	12.5	20	45	52.5	52.5
Computer-Aided Design/Drafting	5	7.5	45	87.5	82.5
Computer-Aided Machining . . .	5	5	25	47.5	47.5
Computer-Aided Manufacturing .	5	5	25	55	57.5
Computer Applications.	7.5	7.5	22.5	45	42.5
Computer Integrated Mfg. . . .	5	2.5	10	40	45
CNC Programming.	7.5	7.5	32.5	52.5	55
Computer Programming	10	10	30	35	37.5
Machine Languages.	2.5		2.5	2.5	5
Machine Vision	2.5	2.5	2.5	7.5	12.5
N/C Programming.	7.5	10	25	25	25
Programming Languages (Specify)					
m. Basic.	7.5	15	42.5	52.5	50
n. COBOL.	2.5		2.5	7.5	5
o. Fortran.	5	5	12.5	17.5	25
p. Pascal	2.5		5	15	20
t. Spread Sheet				2.5	2.5
u. Database				2.5	2.5
v. Word Processor Software.				2.5	2.5
w. BOOLEAN for Programmable Controllers.				2.5	2.5
x. Computer Graphics. . . .			2.5	2.5	2.5
y. 3-D Modeling				2.5	2.5
z. Computer-Aided Mold Design				2.5	2.5

Note. *n* = 40.

The percentages in the 1993 column are projections.

proliferation from 1978 to 1988 were computer-aided design/drafting, computer-aided manufacturing, computer-aided machining, CNC programming, and the Basic programming language. Seven new courses were added to this technical area since 1978. No courses were eliminated even though a slight percentage decrease was projected by 1993 for four course titles: computer-aided design/drafting, computer applications, and the programming languages of Basic and COBOL.

Course titles were shown in Table 51 to display 5% to 25% increases for courses offered in 14 of 15 titles between 1978 and 1983. Increases ranging from 5% to 30% for course offerings continued in 12 of 14 course titles offered in 1988. The greatest percent increases were found for computer-aided design/drafting (55%), computer-aided manufacturing (50%), computer-aided machining (45%) and basic computer programming (45%). No courses were projected to show a percentage increase by 1993. Decreases of from 5% to 20% were projected for percentages by 1993 for 10 of 14 course titles. No percentage change was projected for the remaining four course titles. Four courses were initiated during the reporting periods and one was no longer offered.

The increase in course titles for beginning computers, computer-aided design/drafting, computer-aided machining, computer-aided manufacturing, computer applications, computer integrated manufacturing, CNC programming, and the Basic and fortran programming languages courses for the years 1973-1988 were indicative of a trend for nontechnical accredited programs. The increase in course titles for beginning computers, computer-aided design/drafting, computer-aided machining, computer-aided manufacturing, computer applications, computer integrated manufacturing, CNC programming, machine languages, machine vision, N/C programming, and the Basic, fortran, and Pascal programming languages courses for the years 1973-1988 were indicative of trends for technical accredited programs.

Table 51

Computer Applications Course Titles Offered in Technical Accredited Programs

	Percentages by Year				
Course	1973	1978	1983	1988	1993
Beginning Computers.	5	15	25	35	30
Computer-Aided Design/Drafting		15	40	70	60
Computer-Aided Machining . . .	5	5	40	50	50
Computer-Aided Manufacturing .	5	5	30	55	50
Computer Applications.	10	10	30	45	45
Computer Integrated Mfg. . . .			5	25	25
CNC Programming.		15	30	50	30
Computer Programming	10	35	40	50	45
Machine Languages.		5	20	25	20
Machine Vision			5	25	20
N/C Programming.	15	15	30	40	30
Programming Languages					
Basic.		15	40	60	40
COBOL.	5	10	5		
Fortran.	20	40	55	40	20
Pascal		5	25	25	25

Note. *n* = 20.

The percentages in the 1993 column are projections.

The observations of change for this technical area were supported by statistical data as shown in Table 52. A significant difference was shown by chi square (4, *N* = 1021) = 11.22, $p < .05$ to exist in course titles between nontechnical and technical accredited programs over the designated time periods. It was indicated by statistical analysis that an emerging trend for computer applications

Table 52

Chi Square for Computer Applications Related Course Titles Offered by Year

	Year					
Accreditation	1973	1978	1983	1988	1993	Total
Nontechnical	35	39	132	224	232	662
Technical	17	38	83	119	102	359
Total	52	77	215	343	334	1021

Note. Chi square = (4, *N* = 1021) = 11.22 $p < .05$

course titles offered. Totals of course titles were shown to have increased for each reporting period through 1988. A small decrease was projected in total course titles offered for 1993.

Aviation related. The aviation related course work area was not universally offered by industrial technology programs. This observation can be supported by data in Table 53 which showed more course titles were offered in 1973 than were currently offered or projected to be offered by nontechnical accredited programs. No new course titles had been initiated and four course titles had been dropped for aviation related course work during the reporting periods. Only one of 19 course titles was shown to have a projected percentage increase in offering, while five were projected to show a decrease by 1993. Little change was shown to exist for nontechnical programs.

One course title was shown in Table 54 to have been added to aviation related course titles for technical accredited programs since 1973. The course titles for this technical area showed no change in numbers offered. All course titles were offered by 5% of the programs without exception.

It was determined that even though percentages of courses offered had declined and remained stable respectively for nontechnical accredited and technical accredited programs no significant difference was shown to exist between them. Chi square analysis (4, N = 232) = 1.95, $p > .05$ was discovered to show no difference existed for aviation related course titles as shown in Table 55. Total course titles offered were shown to have decreased

Table 53

Aviation Related Course Titles Offered in Nontechnical Accredited Programs

Course	Percentages by Year				
	1973	1978	1983	1988	1993
Aerodynamics	5	2.5	5	5	5
Aeronautics.	2.5	2.5	2.5	2.5	
Aerospace Basic Science. . . .	2.5	2.5	2.5	2.5	2.5
Aircraft Systems & Components.	7.5	5	5	5	5
Airframe Structures I.	5	5	2.5	2.5	2.5
Airframe Structures II	5	2.5	2.5	2.5	2.5
Air Transportation	2.5		2.5	7.5	5
Airport Operation.	2.5	2.5		2.5	2.5
Aviation Instructor Ground School	7.5	5	7.5	10	5
Aviation Safety.	7.5	5	5	5	7.5
Commercial Ground School . . .	2.5	2.5	2.5	2.5	2.5
Federal Aviation Regulations .	7.5	5	5	5	5
Flight Instruction I & II. . .	2.5				
Flight Instruction III	2.5				
Flight Training.	5	5	5	5	2.5
Instrument Flight.	2.5				
Instrument Ground School . . .	5	2.5	2.5	2.5	2.5
Meteorology.	2.5	2.5	5	5	5
Navigation	2.5	2.5	2.5	5	2.5
Power Plants I	2.5	2.5	2.5	5	2.5
Power Plants II.	5	2.5	2.5	2.5	2.5
Thrust Conversion.	5	2.5	2.5	2.5	2.5
GA Simmulator.	2.5	2.5	2.5	2.5	2.5

Note. _n_ = 40.

The precentages in the 1990 column are projections.

Table 54

Aviation Related Course Titles Offered in Technical Accredited Programs

Course	Percentages by Year				
	1973	1978	1983	1988	1993
Aerospace Basic Science. . . .	5	5	5	5	5
Airframe Structures I.		5	5	5	5
Airframe Structures II		5	5	5	5
Airport Operation.	5	5	5	5	5
Aviation Instructor Ground School	5	5	5	5	5
Aviation Safety.	5	5	5	5	5
Commercial Flight Instruct. I.	5	5	5	5	5
Commercial Flight Instruct. II	5	5	5	5	5
Commercial Ground School . . .	5	5	5	5	5
Federal Aviation Regulations .	5	5	5	5	5
Flight Instruction I & II. . .	5	5	5	5	5
Flight Instruction III	5	5	5	5	5
Flight Training.	5	5	5	5	5
Instrument Flight.	5	5	5	5	5
Navigation	5	5	5	5	5
Power Industries	5	5	5	5	5

Note. *n* = 20.

The percentages in the 1993 column are projections.

between 1973 and 1978 and to have increased between 1978 and 1988. A decrease of only seven courses was projected for 1993.

Table 55

Chi Square for Aviation Related Courses Offered by Year

Accreditation	Year 1973	1978	1983	1988	1993	Total
Nontechnical	38	25	27	33	27	150
Technical	15	17	17	17	16	82
Total	53	42	44	50	43	232

Note. Chi square = (4, *N* = 232) = 1.95, $p > .05$

Work experience related. Work experience related course work has steadily gained in popularity since 1973. An increase, albeit small, in titles offered was observed for the majority of the reporting time periods in Table 56 and Table 57. Each course title for nontechnical accredited programs was indicated to have a percentage increase between the years 1973 and 1988. Two course titles, field experience and practicum were projected to continue that increase through 1993. The most offered work experience related course for nontechnical programs was internship. Each course title for technical accredited programs was indicated to have a percentage increase between the years 1973 and 1988. This increase was projected to continue through 1993 for only the course title, practicum. Two course titles, cooperative education and internship were projected to not have a percentage change. Cooperative education was the most offered course title for techncial accredited programs.

The increase in course titles for internship courses for the years 1973-1988 were indicative of a trend for nontechnical accredited programs. The increase in course titles for cooperative education and internship courses for the years 1973-1988 were indicative of trends for technical accredited programs.

Table 56

Work Experience Related Course Titles Offered in Nontechnical Accredited Programs

	Percentages by Year				
Course	1973	1978	1983	1988	1993
Cooperative Education. . .	17.5	20	22.5	27.5	25
Field Experience	17.5	20	22.5	22.5	25
Internship	25	30	40	52.5	52.5
Practicum.	10	10	15	15	17.5

Note. $n = 40$.

The percentages in the 1993 column are projections.

The statistical analysis of Table 58, chi square (4, $N = 288$) = 1.46, $p > .05$, has refuted the observation that the

Table 57

Work Experience Related Course Titles Offered in Technical Accredited Programs

	Percentages by Year				
Course	1973	1978	1983	1988	1993
Cooperative Education. . .	15	40	40	55	55
Field Experience	10	15	20	25	25
Internship	20	25	30	40	35
Practicum.				5	10

Note. $n = 20$.

The percentages in the 1993 column are projections.

Table 58

Chi Square for Work Experience Related Courses Offered by Year

	Year					
Accreditation	1973	1978	1983	1988	1993	Total
Nontechnical	28	32	40	47	48	195
Technical	9	16	18	25	25	93
Total	37	48	58	72	73	288

Note. Chi square = $(4, N = 288) = 1.46$, $p > .05$

increase in course titles was significant. No difference was shown to exist between nontechnical accredited and technical accredited programs for work experience related course titles offered. The increase in total course titles offered through 1988 was indicative of a trend. A very slight increase of only one course was projected for 1993.

Other specialty technical related. The final category was designed to provide a place to identify that coursework which was unique to industrial technology programs but not reportable elsewhere on the survey instrument. The responses indicated that some respondents used this as a place of last resort. As a result, these courses were distributed by the researcher among the appropriate coursework categories. Therefore no meaningful statistical analysis was conducted for this coursework area.

Course title distribution. Shown in Figure 3 is the distribution of total courses offered per year by course work category. It is evident from the line drawing that several courses have shown a significant increase. The trend indicators are those that showed a greater than 25% increase in course titles offered since 1973 through 1988. These coursework areas are: production, computer applications, design/drafting, energy and power, management, mathematics, physical science, and material science. The increases in total course titles offered are indicative of a dynamic field.

It must be noted though that projections for total course titles to be offered in these coursework areas by 1993 also show with two exceptions, graphic communications and work experience related, that a decrease is in the offing. This decrease for whatever reason bears watching.

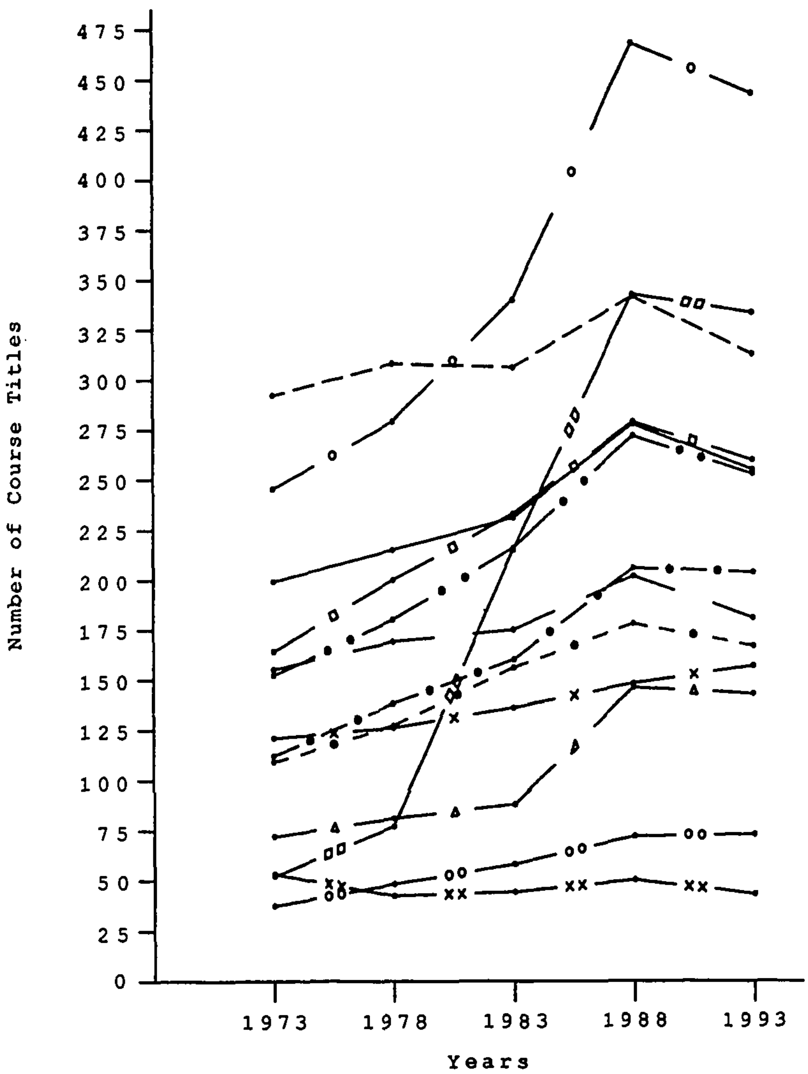
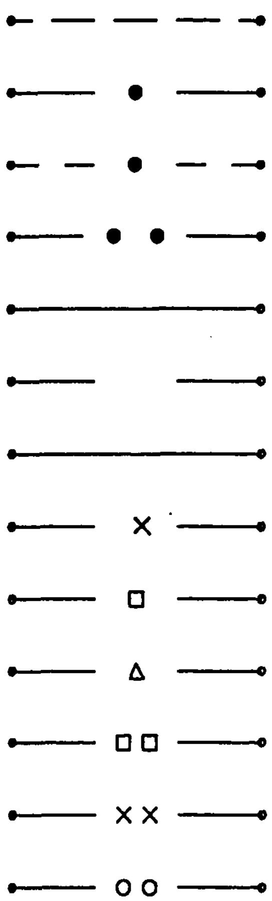


Figure 3. Total Course Titles Distributed by Year

Note. Legend of symbols for Figure 2.



General Education or Liberal Arts

Mathematics

Physical Science

Management

Design/Drafting

Construction

Energy and Power

Graphic Communications

Production

Material Science

Computer Applications

Aviation

Work Experience

CHAPTER 5

SUMMARY, RECOMMENDATIONS, AND CONCLUSIONS

The summary, conclusions, and recommendations provided here represent the professional baseline established by this study. The summary is an overview of the dissertation. The four research questions are addressed in respect to the problem of the study and the findings are presented in the conclusions. The recommendations are provided as topics for future research activities, curricular changes, and accreditation standards revisions.

Research Summary

The problem of this research was to determine curricular trends in four-year baccalaureate degree programs in industrial technology. The purpose of this study was to present implications for future curricular change in industrial technology and to provide a point of reference for future curriculum developers.

To accomplish this objective past, present, and projected future curricular change were investigated to determine trends. Four research questions were designed to guide the research. The questions were designed to determine differences in majors, concentrations/emphases, and course work areas for the determination of curricular trends. The research questions were:

1. What trends are evident in curricula of four-year baccalaureate degree programs of industrial technology?

2. What differences in curricula between technical accredited and nontechnical accredited four-year baccalaureate degree programs in industrial technology exist for majors related to: management, manufacturing, design and drafting, energy and power, graphic communications, construction, and computer applications?

3. What differences in curricula between technical accredited and nontechnical accredited four-year baccalaureate degree programs in industrial technology exist for concentrations and emphases related to: management, manufacturing, design and drafting, energy and power, graphic communications, construction, and computer applications?

4. What differences in curricula between technical accredited and nontechnical accredited four-year baccalaureate degree programs in industrial technology exist for course work areas related to: general education or liberal arts, mathematics, physical sciences, management; and the technical areas of drafting and design, construction, energy and power, graphic communications, production, material science, and computer applications?

Historical data reported in this research were indicative of industrial technology programs being a dynamic field of study. Industrial technology programs were shown to have evolved from industrial arts programs to have responded to technological change, and to be very diverse.

The research was guided by several assumptions and limitations. It was assumed that: identifiable changes had taken place, respondents were able to provide accurate data, general curricular categories were representative of most industrial technology programs, and future projections of change could be obtained. The research was limited as to: the time period for which the data were collected, qualifications of responding faculty members, industrial technology programs in the United States, industrial technology curricula, and curricular comparison with NAIT accreditation guidelines.

The literature review was designed to provide a perspective of change, curriculum development, and evolution of industrial technology programs in response to those events. Change characteristics, curriculum development strategies for industrial technology and related fields of study, accreditation activities, and industrial technology program origination were reviewed for reference in developing the questionnaire.

The method used for this research consisted of a questionnaire developed to identify curricular trends. It was submitted to a jury as part of the validation process, revised as per jury and the five member dissertation advisory committee input, approved, and submitted to the sample population.

The population of the study was identified from the National Association of Industrial Technology program directory and consisted of those programs offering a four-year industrial technology baccalaureate degree. The population for the study was comprised of 100 individuals in those programs identified by department chairs according to established criteria. The criteria was designed to identify those individuals involved with curriculum development in a program of industrial technology who could provide accurate responses.

An initial mailing and two follow-up mailings were utilized for the data collection process. A cover letter and survey instrument were sent for the the first and third mailings and a postcard reminder was used for the second mailing. The data collection process was concluded 14 days after the second follow-up mailing.

Responses were received from individuals representing 66 industrial technology programs. The final response rate was 60%, as data from six respondents were deemed unusable. The data obtained were compiled and organized for data analysis. Descriptive statistics, the chi square statistic, and the Yates correction for chi square were used to analyze the data.

Conclusions

Curricular trends were based upon consistent change during the years 1973-1988. A change during the reporting period of at least 20% was deemed significant for the identification of the following trends from the analyses of the data in Chapter 4. The trends are reflective of differences in technical and nontechnical accredited programs of industrial technology. Identified trends for industrial technology curricula are presented in the following paragraphs.

Two general trends have been identified for industrial technology baccalaureate degree programs (research question number one). These trends are:

1. Large student enrollments (400 or more) are found in technical accredited programs, while smaller (less than 400) student enrollment cluster in nontechnical accredited programs.

2. The titles of baccalaureate degree programs are being changed to industrial technology more than any other title.

Several specific trends have been identified for major courses of study (research question number two). These trends are:

1. Major courses of study are becoming more diverse.

2. New major courses of study represent a concept different from the concept of their predecessors.

3. Major courses of study are becoming more management oriented.

4. The number of baccalaureate degree major courses of study are increasing.

Specific trends have been identified for concentrations and emphases in industrial technology programs (research question number three). These trends are:

1. Concentrations and emphases are more numerous and diverse for nontechnical accredited programs.

2. Concentrations and emphases have decreased in technical accredited programs.

3. Nontechnical accredited programs of industrial technology are becoming more general type programs with concentrations or emphases offered in one industrial technology major.

4. Technical accredited programs are becoming more specialized programs with less concentrations or emphases offered and more majors offered in the industrial technology baccalaureate program.

Trends have been found in the accrediting process for industrial technology programs (research questions numbers two and three). These trends are:

1. More programs were planning accreditation by a technical accrediting agency.

2. Selection of accrediting agency is becoming more diverse.

3. Technical accreditation is not the motivating factor influencing curricular change.

4. Accrediting agencies are being selected to meet specialized needs.

Changes in course titles offered for technical accredited and nontechnical accredited programs yielded many trends (research question number four). Common general course title trends have been found in both nontechnical and technical accredited programs. These common trends are:

1. Course titles offered have increased between 1973 and 1988.

2. Course titles offered are projected to decrease by 1993.

3. The technical course work area of computer applications was shown to be significantly different.

4. Course titles have become more diverse and reflect the emerging technologies.

5. General education or liberal arts and aviation course titles exhibit stability.

6. Total course titles offered are increasing for the course work areas of production, computer applications, design/drafting, energy and power, management, mathematics, physical science, and material science.

Trends have been found in course titles for nontechnical accredited industrial technology programs (research question number four). These nontechnical accredited specific trends are:

1. Selected course titles have increased in the following course work categories: mathematics, physical sciences, management, design/drafting, construction, energy and power, graphic communications, production, material science, computer applications, and work experience related.

2. Course titles shown to have increased are: calculus, statistics, trigonometry, chemistry, physics, accounting, economics related, production control, production management, geometric dimensioning, CADD, construction technology, construction management, digital electronics, solid state electronics, microprocessor related, electronic publishing, machine tool technology, manufacturing systems, manufacturing technology, plant layout, production processes, production scheduling, production systems, research and development, quality assurance, quality control, robotics, characteristics of materials, beginning computers, computer-aided design/drafting, computer-aided machining, computer-aided manufacturing, computer applications, computer integrated manufacturing, CNC programming, and the Basic and fortran programming languages, and internship.

3. Course titles shown to have decreased are: metals I & II and woods I & II.

Trends have been found in course titles for technical accredited industrial technology programs (research question number four). These technical accredited specific trends are:

1. Selected course titles have increased in the following course work categories: mathematics, physical sciences, management, design/drafting, construction, energy and power, graphic communications, production, material science,computer applications, and work experience related.

2. Course titles shown to have increased are: calculus, statistics, chemistry, physics, accounting, business law, marketing, production control, production management, supervision and management, CADD, construction processes, surveying, digital electronics, electronics related, electronic publishing, ceramics processes, manufacturing technology, production processes, production scheduling, production systems, quality assurance, quality control, robotics, characteristics of materials, materials I, materials testing, beginning computers, computer-aided design/drafting, computer-aided machining, computer-aided manufacturing, computer applications, computer integrated manufacturing, CNC programming, machine languages, machine vision, N/C programming, basic, fortran, and Pascal programming languages, cooperative education, and internship.

Recommendations

This research has provided insights into the curricular structure of industrial technology programs over the past 15 years. The past and present have been examined as well as what is proposed for the next five years as viewed by those who are involved with the curriculum development process. It is recommended, based on the findings of this research, that curriculum developers in the profession:

1. Continue their dynamic diversity but focus substantive change.

2. Use this study as a baseline for further study and future curriculum development.

3. Develop common standards for programs with aspirations of technical accreditation by NAIT, ABET, or another technical accrediting agency to limit duplication.

4. Evaluate appropriateness of course titles, breadth and depth of course content, and develop courses reflective of technological and managerial advancements in industry.

It is recommended, based on the findings of this research that further study is needed. The following issues are recommended for further study.

1. A needs assessment survey of industry to determine what skills, knowledge, and undergraduate curricula preparations are required for entry level employment for each program type (e.g., Favre, 1988/1989).

2. Follow-up surveys of baccalaureate industrial technology programs to determine content relevancy, textbooks utilized, classroom techniques, resources, activities, topical outlines for each technical coursework area, breadth, depth, and scope of mathematics and physical science curricula.

3. Detailed studies need to be conducted to determine causes and effects of the development activities in the curriculum development process and the current content status of each curricular category of industrial technology as identified in this study.

4. A needs assessment study of past graduates of industrial technology programs should be conducted to determine entry level skills needed by future industrial technology program graduates.

5. A study of likenesses and differences between techncial accrediting agencies and the implications for those programs with plans to seek technical accreditation.

6. Given the new status of NAIT as an accrediting agency, it may be beneficial to repeat this study to determine if the baseline established by this research is impacted as a result of future changes in growth, stabilization, or decline of course work categories.

REFERENCES

Armstrong, E. W. (1958). Purpose and procedures in accreditation. In V. C. Fryklund & H. L. Helton (Eds.), The accreditation of industrial arts teacher education, 7th yearbook of the ACIATE (pp. 1-5). Bloomington, IL: McKnight & McKnight.

Arvin, G. O. (1972). Current practices and curricular comparison of industrial technology programs leading to the baccalaureate degree. (Doctoral dissertation, East Coast University, 1972). Obtained from the Historian of the National Association of Industrial Technology at Kent State University, Kent, Ohio.

Ary, D., Jacobs, L. C., & Razavieh, A. (1985). Introduction to research (3rd ed.). New York: Holt, Rinehart and Winston.

Barlow, M. L. (1967). History of industrial education in the United States. Peoria: Charles A. Bennett.

Barnhart, E. L. (November, 1963). Curriculum patterns. Paper presented at the 50th Mississippi Valley Industrial Arts Conference, Chicago.

Bawden, W. T. (1942). A tribute to a great leader. Industrial Arts and Vocational Education, 31, 291-292.

Bender, M. (1982). Technology education and traditional industrial arts. Journal of Epsilon Pi Tau, 8(2) 55-65.

Bennett, C. A. (1926). History of manual and industrial education up to 1870. Peoria: The Manual Arts Press.

Bennett, C. A. (1937). History of manual and industrial education 1870 to 1917. Peoria: The Manual Arts Press.

Betando, D. J. (1986) Where is industry? Journal of Industrial Technology, 2(3), 1, 12.

Bjorkland, L. R. (1988). Interpretation of industry approach. In W.H. Kemp & A.E. Schwaller (Eds.), Instructional strategies for technology education: 38th yearbook of the Council on Technology Teacher Education, (pp. 110-121). Mission Hills, CA: Glencoe Publishing Company.

Bjorkquist, D. C. (October, 1985). Determining IE's future course. School Shop, pp. 13-15.

Bjorkquist, D. C. (1988). Contemporary challenges for industrial education: Preparing for the future. Journal of Industrial Teacher Education, 26(2), 29-34.

Boaz, H. E. (1965). Degree-level technology programs offered in industrial education departments: Their status, accreditation and acceptance. (Doctoral dissertation, University of Missouri, 1965). Dissertation Abstracts, 27, 1583A.

Bonser, F. G., & Mossman, L. C. (1924). Industrial Arts for the elementary school. New York: MacMillan.

Brooks, W. T. (November, 1970). College level industrial arts and industrial technology program; department reorganizations; department name change; staffing and space utilization problems. Paper presented at the 57th Mississippi Valley Industrial Arts Conference, St. Louis.

Cochran, L. H. (1970). Innovative programs in industrial education. Bloomington, IL: McKnight & McKnight.

Connor, S. G. (1986). Industrial technology and industry: A derivation of subject matter from industry with implications for curricular change. (Doctoral dissertation, Kansas State University, 1986). Dissertation Abstracts International, 47/05A, 1632.

Conole, R. W. (1986). A few words on words. The Technology Teacher, 45(7), 3.

Cuban, L. (1988). A fundamental puzzle of school reform. Phi Delta Kappan, 69(5), 340-344.

Cunningham, B. M. (1969). Technological developments and industrial technology. In C.T. Dean & N.A. Hauer (Eds.), Industrial technology education, 18th yearbook of the ACIATE (pp. 13-40). Bloomington, IL: McKnight & McKnight.

Dell, S. M. (November, 1964). Program changes and placement trends in the decade 1954-1964. Paper presented at the 51st Mississippi Valley Industrial Arts Conference, St. Louis.

Dufek, D., & Gore, D. (Eds.). (1987). Industrial Technology Baccalaureate Program Directory. Ypsilanti, MI: National Association of Industrial Technology.

DuVall, J. B. (1984). High technology: Dream or reality? The Technolgoy Teacher, 44(2), 8-9.

Edgar, R. W. (1984). Setting the future agenda. The Technology Teacher, 44(1), 4-7.

Erber, E. E. (1969). Industrial technology: Implications for industrial and technical teacher education. In C.T. Dean & N.A. Hauer (Eds.), Industrial technology education: 18th yearbook of the ACIATE (now the Council on Technology Teacher Education) (pp. 41-69). Bloomington, IL: McKnight Publishing Company.

Favre, A. C. (1989). The importance of computer-based subject matter topics for graduates of an undergraduate manufacturing technology program as perceived by practicing manufacturing engineers (Doctoral dissertation, University of Northern Iowa, 1988). Dissertation Abstracts International, 49/11, 3339A.

Feirer, J. L., & Lindbeck, J. R. (1964). Industrial arts education. Washington, D.C.: The Center for Applied Research in Education, Inc.

Finch, C. R. (1983). Review and synthesis of research in trade and industrial education (3rd ed). Columbus, OH: The ERIC Clearinghouse on Adult, Career, and Vocational Education, The National Center for Research in Vocational Education.

Gavin, G. (November, 1978). How are recent changes (e.g. microprocessors) affecting industrial technology or industrial education college courses? How should they affect us? Paper presented at the 65th Mississippi Valley Industrial Teacher Education Conference, St. Louis.

Ginzberg, E. (September, 1982). The mechanization of work. Scientific American, pp.67-75.

Glazener, E. R. (November, 1959). Current status of training in industrial arts departments represented in the Mississippi Valley I.A. Conference. Paper presented at the 46th Mississippi Valley Industrial Arts Conference, Chicago.

Goetsch, D. L. (March, 1984). Meeting the high tech challenge. School Shop, pp. 17-18.

Good, C. V. (1973). Dictionary of education. New York: McGraw-Hill.

Gore, D. (Ed.). (1989). Industrial Technology Baccalaureate Program Directory. Ypsilanti, MI: National Association of Industrial Technology.

Groneman, C. H. (November, 1963). Industrial technology programs. Paper presented at the 50th Mississippi Valley Industrial Arts Conference, Chicago.

Gunderson, H. (November, 1964). Program changes and placement in the decade 1954-64. Paper presented at the 51st Mississippi Valley Industrial Arts Conference, St. Louis.

Hansen, M. E. (1964). Industrial technology and the engineering withdrawal. (Doctoral dissertation, Colorado State College, 1964). Dissertation Abstracts, 25, 188.

Harris, J. N. (1969a). Evaluation guidelines for industrial technology. In C.T. Dean & N.A. Hauer (Eds.), Industrial technology education: 18th yearbook of the ACIATE (now the Council on Technology Teacher Education) (pp. 187-199). Bloomington, IL: McKnight Publishing Company.

Harris, J. N. (1969b). Proposed criteria for self-evaluation of four-year industrial technology programs. (Doctoral dissertation, Wayne State University, 1969). Dissertation Abstracts, 31/04A, 1596.

Hauer, N. A. (November, 1957). Industrial technical training. Paper presented at the 44th Mississippi Valley Industrial Arts Conference, Chicago.

Hauer, N. A. (November, 1963). Status study industrial technology. Paper presented at the 50th Mississippi Valley Industrial Arts Conference, Chicago.

Holloway, H. D. (May, 1987). Developing high technology curriculums. Industrial Education, pp. 12-13.

Horton, G. R. (1988). Basic supervisory training: Implications for technologists. Journal of Industrial Technology, 4(4), 1-2, 18-19.

Householder, D. L. (1974). Review and evaluation of curriculum development in industrial arts education. Bloomington, IL: McKnight.

Householder, D.L. (1979). Curriculum movements of the 1960's. In G. E. Martin (Ed.), Industrial Arts Education: Retrospect, Prospect, 28th yearbook of the ACIATE (now the Council on Technology Teacher Education, CTTE) (pp. 114-131). Bloomington, IL: McKnight.

Hunter, E. M. (November, 1970). Undergraduate and graduate programs for the preparation of industrial arts teachers for the seventies. Paper presented at the 57th Mississippi Valley Industrial Arts Conference, St. Louis.

Jarvis, J. A. (November, 1959). Mathematics and science requirements for the first degree in industrial education. Paper presented at the 46th Mississippi Valley Industrial Arts Conference, Chicago.

Keil, R. L. (1966). Factors associated with the effectiveness of personnel in positions appropriate for degree-level industrial technologists (Doctoral dissertation, Michigan State University, 1966). Dissertation Abstracts, 27, 1547A.

Keith, C. W. (October, 1986). NAIT history. Ypsilanti, MI: National Association of Industrial Technology.

Kicklighter, C. E. (1985). Technology growth during static or declining university enrollments. Journal of Industrial Technology. 1(4), 1, 19.

Kicklighter, C. E. (1987). Open letter to industry. Journal of Industrial Technology, 4(1), 1, 14-17.

Kleintjes, P. L. (1969). Two-year associate degree programs compared with four-year industrial technology baccalureate degree programs. In C.T. Dean & N.A. Hauer (Eds.), Industrial technology education: 18th yearbook of the ACIATE (now the Council on Technology Teacher Education) (pp. 90-131). Bloomington, IL: McKnight Publishing Company.

Kokernak, R. P. (1987). Industrial science at Fitchburg State College: A college/industry model. Journal of Industrial Technology, 3(2), 8-9, 15-16.

Lacroix, W. J. (1983). A future in review. Journal of Epsilon Pi Tau, 9(2) 15-21.

Lauda, D. P. (1988a). Industrial teacher education 1988-2000. Industrial Teacher Education in Transition. In D. L. Householder (Ed.), 75th anniversary edition of the proceedings of the Mississippi Valley Industrial Teacher Education Conference (pp. 255-271).

Lauda, D. P. (1988b). Technology education. In W. H. Kemp, & A. E. Schwaller (Eds.), Instructional strategies for technology education, 37th yearbook of the Council on Technology Teacher Education (pp. 3-15). Mission Hills, CA: Glencoe Publishing Company.

Lemons, C. D. (1973). Technological literacy: The central focus of industrial arts education. Focus on technology, (35-40). Washington, D.C.: American Industrial Arts Association.

Lemons, C. D. (1988). Technology education: The culmination of a seventy-nine year quest. Industrial Teacher Education in Transition. In D. L. Householder (Ed.), 75th anniversary edition of the proceedings of the Mississippi Valley Industrial Teacher Education Conference (pp. 255-271).

Lewis, R., & Robinson, H. (1969). A comparison of the four-year industrial technology program with engineering and industrial arts programs. In C. T. Dean & N. A. Hauer (Eds.), Industrial technology education: Relationships of 4-year technology programs with technical training, engineering and industrial arts teacher education, 18th yearbook of the ACIATE (Now the Council on Technology Teacher Education) (pp. 70-89). Bloomington, IL: McKnight Publishing Company.

London, H. I. (1968). The phenomenon of change. The Futurist, 22(4), 64.

Lux, D. G. (November, 1967). Comparisons of theoretical bases and rationales of curricular innovations for secondary education. Paper presented at the 54th Mississippi Valley Industrial Arts Conference, Chicago.

Martin, G. E. (1983). Curriculum implications for technology education. Man Society Technology, 42,(7), 4-6.

Martin, G. E., & Luetkemeyer, J. F. (1979). The movements that led to contemporary industrial arts education. In G. E. Martin (Ed.), Industrial arts education: Retrospect, prospect, 28th yearbook of the ACIATE (Now the Council on Technology Teacher Education) (pp. 18-42). Bloomington, IL: McKnight Publishing Company.

McCrory, D. L. (1985). Technology or industry: Which shall it be? The Technology Teacher, 44(5), 2-3.

Miller, P. W. (1988). Industrial technology: A national study of curriculum changes and trends. Journal of Industrial Technology, 4(3), 18-26.

Miller, W. R. (1989). Contemporary challenges for industrial education: A reaction. Journal of Industrial Teacher Education, 26(2), 35-41.

NAIT Constitution and Bylaws. (1984). Ypsilanti, MI: National Association of Industrial Technology.

Nelson, O. (1980). Identifying and monitoring new occupations. Journal of EPT, 6(2), 40-44.

Nelson, R. A. (1973). The industrial technologies: Identification and implementation. Focus on technology, (11-14). Washington, D.C.: American Industrial Arts Association.

Olson, D. W. (1963). Industrial arts and technology. Englewood Cliffs, NJ: Prentice-Hall.

Olson, D. W. (1973). Technology, environment, and industrial arts education. In C. P. Stamm (Ed.), Technology in the classroom, (10-17). Washington, D.C.: American Industrial Arts Association.

Owens, J. R. (1988). High technology needs assessment. Journal of Industrial Technology. 4(4), 11, 21-23.

Parish, J. D. (1988). Shift from traditional industrial arts education to industrial technology. Journal of Epsilon Pi Tau, 14(2), 55-59.

Perreault, R. J., Jr. (1986). The research problems of industrial technology. Journal of Industrial Technology. 4(1), 4-5, 17.

Pickle, D. L., & Parish, J. D. (1984). High technology courses for industrial technology. Journal of Industrial Technology, 1(1), 7-8, 14.

Pinder, C. A., Bame, E. A., & Dugger, W. E. (1985). Standards for technology education: A foundation for contemporary programs. The Technology Teacher, 44(8), 4-5.

Porchia, L. J. (1975). A study to determine the general educational core curriculum needs for the baccalaureate degree industrial technology program. (Doctoral dissertation, University of Arkansas, 1975). Dissertation Abstracts, 36/03A, 3472.

Poyzer, M. F. (November, 1958). Various new curriculum patterns that have developed in colleges and universities for the preparation of industrial arts teachers. Paper presented at the 45th Mississippi Valley Industrial Arts Conference, Chicago.

Prescott, S. C. (1954). When MIT was Boston Tech 1861-1916. Cambridge, MA: The Technology Press.

Reid, D. E. (November, 1970). A report on the number of industrial arts teacher education and technology graduates -- trends, placement, and comparisons. Paper presented at the 57th Mississippi Valley Industrial Arts Conference, St. Louis.

Rowntree, D. (1981). A dictionary of education. Totowa, NJ: Barnes & Noble Books.

Russell, J.F. (January-February, 1982). Forecasting curricular needs. Voc Ed, (pp. 46-47).

Savage, E., Kruppa, R., Palumbo, A., & Schwerkolt, E. (1988). Three approaches to establishing a core curriculum for industrial technology programs. Journal of Industrial Technology, 5(1), 9-11, 23.

Savage, E., & Morris, M. (1985). Technology systems matrix: Practical application for curriculum development. The Technology Teacher, 44(7), 7-10.

Schenck, J. P. (1983). Charles A. Bennett remembered. The Technology Teacher, 43(2), 8-10.

Schilleman, J. (August,1987). Should high tech education replace more traditional IE? School Shop, pp. 28-30.

Silvius, G. H., & Curry, E. H. (1971). Managing multiple activities in industrial education. Bloomington, IL: McKnight & McKnight.

Sterry, L. (1987). A relationship between technology education and trade and industrial education. The Technology Teacher, 46(5), 11-14.

Streichler, J. (November, 1977). How do clusters affect industrial technology and industrial teacher education content? Paper presented at the 64th Mississippi Valley Industrial Teacher Education Conference, Chicago.

Streichler, J. (1980). Ideals and practice: The profession's response to technology/society. In H. A. Anderson & J. A. Benson (Eds.), Technology and society: Interfaces with industrial arts, 29th yearbook of the ACIATE (Now the Council on Technology Teacher Education (pp. 71-108). Bloomington, IL: McKnight

Streichler, J. (1988a). A step in the right direction. Journal of Epsilon Pi Tau, 14(2), 4-6.

Streichler, J. (1988b). Building a profession: More recognition for NAIT. Journal of Episilon Pi Tau, 14(2), 4.

Sutton, J. R., & Carter, L. (1986). Industrial technology education: Goal setting for success. ATEA Journal, 13(3), 12-13.

Sutton, J. R., & Kicklighter, C. E. (1987). Articulation and accreditation of two-year technology programs. Journal of Industrial Technology, 3(4), 10-11.

Swanson, R. S. (1965). Industrial arts: What is its body of knowledge. In G. S. Wall (Ed.), Approaches and Procedures in industrial arts, 14th yearbook of the ACIATE (pp. 46-59). Bloominton, IL: McKnight & McKnight.

Taba, H. (1962). Curriculum development theory and practice. New York: Harcourt, Brace & World.

Talbott, L. F. (1973). The development of four-year programs designated industrial technology by colleges and universities in the United States to 1971. (Doctoral dissertation, Utah State University, 1973). Dissertation Abstracts International, 34/05A, 598.

Talbott, L. F. (1984). A message from the president. Journal of Industrial Technology, 1, 14-15.

Talbott, L. F. (1985). President's message. Industrial technology program directory. Ypsilanti, MI: National Association of Industrial Technology.

Tuckman, B. W. (1978). Conducting educational research. (2nd ed.). New York: Harcourt Brace Jovanovich.

Tyler, R. (1950). Basic principles of curriculum and instruction: Syllabus for Education 305. Chicago: University of Chicago Press.

Vanderslice, T. A. (1984). We need a commitment to excellence and high technology. The Technology Teacher, 43(5), 4-6.

Vaughan, S.J., & Mays, A.B. (1924). Content and methods of the industrial arts. New York: The Century Co.

Van Nest, M. P. (1973). The model for technology for the urban society. Industrial arts and the challenge of an urban society, representative addresses and proceedings of the American Industrial Arts Association's 35th Annual Conference at Atlantic City, NJ, (pp. 150-151). Washington, D.C.: American Industrial Arts Association.

Warner, W. E. (1965). A curriculum to reflect technology. (Originally the feature presentation at the AIAA Convention 25 April, 1947). Columbus, OH: Epsilon Pi Tau.

Weber, E. M. (1961). A comparative study of industrial technology programs in American colleges and universities with industrial arts teacher education and technical institute programs. (Doctoral dissertation, The Pennsylvania State University, 1961). Dissertation Abstracts, 22, 2273. (University Micofilms No. 61-06, 819).

Wiens, A. E. (1987). Teaching technology as a liberal art. Journal of Industrial Teacher Education, 25(1), 7-16.

Wigen, R. A. (1958). History of accreditation. In V. C. Fryklund & H. L. Helton (Eds.), The accreditation of industrial arts teacher education, 7th yearbook of the ACIATE (pp. 6-18). Bloomington, IL: McKnight & Mcknight.

Wilber, G.O. (1948). Industrial arts in general education. Scranton, PA: International Textbook Company.

Woodward, R. L., & Decker, H. S. (1967). Industrial arts education. In F. E. Conner, & W. J. Ellena (Eds.), Curriculum handbook for school administrators (pp. 141-159). Washington, D.C.: American Association of School Administrators.

Ziegler, J. T. (1979). Industrial arts curriculum development efforts of the 1970's. In G. E. Martin (Ed.), Industrial Arts Education: Retrospect, Prospect, 28th yearbook of the ACIATE (now the Council on Technology Teacher Education, CTTE) (pp. 169-187). Bloomington, IL: McKnight.

APPENDIX A

Questionnaire Validation

1. Trial Run Participants

2. Cover Letter

Trial Run Participants

Dr. Donnell E. Cattle
Department Head, Industrial Technical Education
Wayne State College
Wayne, NE 68787

Dr. Wan-Lee Cheng
Chairman, Department of Design & Industry
1600 Holloway Avenue
San Francisco State University
San Francisco, CA 94132

Dr. Neil A. Edmunds
Coordinator of Industrial Education
Department of Practical Arts and Vocational-Technical Education
University of Missouri-Columbia
Columbia, MO 65211

Dr. William K. Hodgkinson
Assistant Professor
Department of Industrial Technology, Box 8057
University of North Dakota
Grand Forks, ND 58202

Dr. David L. Jelden
2186 McKee Hall
University of Northern Colorado
Greeley, CO 80639

Dr. John W. Sinn
Assistant Dean, College of Technology
Bowling Green State University
Bowling Green, OH 43404

UNIVERSITY OF UND NORTH DAKOTA

DEPARTMENT OF [illegible]
BOX 5057 [illegible]
GRAND FORKS [illegible]

27 July 1988

Inside address

Dear Dr. :

The enclosed questionnaire is currently being prepared for submission to representatives of four-year baccalaureate programs in industrial technology (IT). The questionnaire is designed to identify changes in industrial technology curriculum over the past fifteen (1973-88) years and to query about anticipated future changes during the upcoming five (1988-93) year period. The gathered information will be analyzed to determine trends from which implications for future IT curriculum development could take place.

Your help is requested during this trial run to validate the instrument for use on a broader scale. Please respond to the items directly on the instrument. In addition, please present comments and suggestions in regard to redundancy, explicitness, understandability, readability, and problems you had responding to the instrument.

The packages of coffee and tea are enclosed for your enjoyment while you complete the questionnaire and are making comments, notes, and suggestions pertinent to its content and design on the enclosed form. When you have completed the critique, please return the instrument and form in the enclosed stamped, addressed envelope. I would appreciate a response by August 15, 1988.

Thank you for your time and valuable input.

Sincerely,

C. Ray Diez

C. Ray Diez
Assistant Professor

APPENDIX B

Letter to Department Chairs for the Purpose of Identifying Prospective Survey Respondents

1. Letter to Department Chairs

2. Participant Identification Form

3. Follow-up Card

U N I V E R S I T Y   O F   UND   N O R T H   D A K O T A

May 29, 1988

DEPARTMENT OF INDUSTRIAL TECHNOLOGY
BOX 8057 UNIVERSITY STATION
GRAND FORKS, NORTH DAKOTA 58202

Inside address

Dear

Research is currently being conducted to identify and analyze curricular changes of baccalaureate degree programs in industrial technology. The purpose is to determine trends and identify implications for curricular development in Industrial Technology -- i.e. programs aimed at educating management-oriented technical professionals.

The study involves obtaining information from faculty members who meet the following criteria:

1) have been in residence at your institution for a minimum of ten years,
2) have received tenure and
3) have been actively involved in curriculum development for industrial technology.

This letter is to enlist your assistance in identifying at least one person from your program who meets the stated criteria. This person may be either yourself or a faculty member. Such assistance will involve identifying the qualified person(s), completing the requested address information on the enclosed identification sheet and returning it in the addressed, stamped envelope.

Your assistance will greatly enhance the success of this study of industrial technology baccalaureate degree programs. Thank you in advance for your prompt response.

Sincerely,

C. Ray Diez

C. Ray Diez
Assistant Professor

Faculty recommended for participation in curriculum study.

1st Recommendation and address.

____

____

____

____

____

2nd Recommendation and address

____

____

____

____

____

Please return in the addressed, stamped envelope to:

C. Ray Diez
Box 8057, Department of Industrial Technology
University of North Dakota
Grand Forks, ND 58202

16 June 1988

Dear

Two weeks ago you were sent a letter requesting the identification of a member of your faculty to participate in a study of curriculum change in industrial technology. My records show that you have not yet responded. Would you please take a few minutes to complete and send the identification form? Thank you. If you recently have responded to my request, thank you.

Sincerely,

C. Ray Diez
Assistant Professor, Univ. of North Dakota

APPENDIX C

Listing of Addresses for Department Chairs and the Sample Population

Chairs of industrial technology departments in the following institutions were contacted and asked to identify a person meeting the established criteria to respond to the research instrument. The addresses for these institutions follow.

(*) The asterisk is placed beside the address of the programs for which a faculty member was identified to respond to the survey. The asterisks are used to identify the sample.

* Department of Industrial Technology
Arizona State University
Tempe, AZ 85287

* Department of Industrial Technology
P.O. Box 107, University Drive
University of Arkansas at Pine Bluff
Pine Bluff, AR 71601

* Department of Technical Education
Engineering Experiment Station
University of Arkansas
Fayetteville, AR 72701

* Department of Industrial Education
University of Central Arkansas
Conway, AR 72032

Department of Industrial Technology
Industrial Technology Department
California Polytechnic St. Univ., San Luis Obispo
San Luis Obispo, CA 93407

* Department of Marine Transportation/Nautical Industrial Technology
California Maritime Academy
Vallejo, CA 94590

Department of Industrial Technology
California State University, Chico
Chico, CA 95929-0305

Department of Industrial Technology
California State University, Fresno
Fresno, CA 93740

Department of Engineering & Industrial Technology
1250 Bellflower Blvd.
California State University, Long Beach
Long Beach, CA 90840

Department of Technology
5151 State University Drive
California State University, Los Angeles
Los Angeles, CA 90032

* Department of Industrial Technology
Humboldt State University
Arcata, CA 95521

Department of Technology Education
Pacific Union College
Angwin, CA 94508

* Department of Industrial Studies
Engineering Building - 208
San Diego State University
San Diego, CA 92182-0269

* Department of Design and Industry
1600 Holloway Avenue
San Francisco State University
San Francisco, CA 94132

* Division of Technology
San Jose State University
San Jose, CA 95192-0061

* Department of Industrial Sciences
Colorado State University
Fort Collins, CO 80523

* Department of Industrial Technology
1615 Stanley Street
Central Connecticut State University
New Britain, CT 06050

Division of Graphic Arts
Florida Agricultural & Mechanical University
Tallahassee, FL 32307

School of Building Construction
College of Architecture
University of Florida
Gainesville, FL 32611

Division of Technologies Education
4567 St. Johns Bluff Road S.
University of North Florida
Jacksonville, FL 32216

* Department of Technical & Vocational Studies
Building 53
University of West Florida
Pensacola, FL 32514-5753

* Department of Industrial Education & Technology
P.O. Box 237
Berry College
Mt. Berry, GA 30149

* Department of Industrial Technology
Box 8044 Landrum Center
Georgia Southern College
Statesboro, GA 30460

* Department of Industrial Education & Technology
University of Idaho
Moscow, ID 83843

Department of Occupational Education
9500 S. King Drive
Chicago State University
Chicago, IL 60628

* Department of Industrial Technology
Applied Science Building 101
Eastern Illinois University
Charleston, IL 61920

* Department of Industrial Technology
210 Turner Hall
Illinois State University
Normal, IL 61761

Department of Technology
Technology Department SH 203
Northern Illinois University
DeKalb, IL 60115

* Department of Technology
Southern Illinois University
Carbondale, IL 62901

* Department of Industrial Education & Technology
215 Knoblauch Hall
Western Illinois University
Macomb, IL 61455

* Department of Industry and Technology
Ball State University
Muncie, IN 47306

* School of Technology
  Indiana State University
  Terre Haute, IN 47809

* Department of Industrial Technology
  Knoy Hall
  Purdue University
  West Lafayette, IN 47907

* Department of Industrial Education & Technology
  Iowa State University
  Ames, IA 50011

* Department of Industrial Technology
  University of Northern Iowa
  Cedar Falls, IA 50614-0178

* Division of Administration, Teacher Education, and Industrial Technology
  1200 Commercial, Box 17
  Emporia State University
  Emporia, KS 66801

* Department of Industrial Education
  600 Park Street
  Fort Hays State University
  Hays, KS 67601-4099

* Department of Industrial Education
  Box 1402
  McPherson College
  McPherson, KS 67460

* Department of Industrial Arts/Technology
  Pittsburgh State University
  Pittsburgh, KS 66762

* Department of Industrial Technology
  Campus Box 77
  The Wichita State University
  Wichita, KS 67208

* Department of Industrial Arts
  CPO 2313
  Berea College
  Berea, KY 40404

* Department of Industrial Education & Technology
  Fitzpatrick 307
  Eastern Kentucky University
  Richmond, KY 40475-0943

Department of Industrial Technology
Kentucky State University
Frankfort, KY 40601

* Department of Industrial Education & Technology
210 Lloyd Cassity Building
Morehead State University
Morehead, KY 40351

* Department of Industrial Education & Technology
Murray State University
Murray, KY 42071

* Department of Technology
Louie B. Nunn Drive
Northern Kentucky University
Highland Heights, KY 41076

* Department of Industrial & Engineering Technology
College of Science, Technology & Health
Western Kentucky University
Bowling Green, KY 42101

* Department of Industrial Education & Technology
P.O. Box 34
Grambling State University
Grambling, LA 71245

Department of Agricultural Engineering
E.B. Doran, Agricultural Engineering Building
Louisiana State University
Baton Rouge, LA 70803

* Department of Industrial Technology
Russell Hall
Northwestern State University
Natchitoches, LA 71497

Department of Industrial Technology
P.O. Box 847-SLU
Southeastern Louisiana University
Hammond, LA 70402

Department of Technology
400 Press Drive
Southern University of New Orleans
New Orleans, LA 70126

* Department of Industrial Technology
P.O. Box 42972
University of Southwestern Louisiana
Lafayette, LA 70504

* Department of Technology
37 College Avenue
University of Southern Maine
Gorham, ME 04038

* Department of Industrial Technology and Occupational Education
J.M. Patterson Building, Room 3216
University of Maryland
College Park, MD 20742

* Department of Industrial Education & Technology
Arts & Technologies Center, Room 110
University of Maryland, Eastern Shore
Princess Anne, MD 21853

* Department of Industrial Technology
Fitchburg State College
Fitchburg, MA 01420

Department of Industrial Technology
One University Avenue
University of Lowell
Lowell, MA 01854

* Engineering Technology
Andrews University
Berrien Springs, MI 49104

Department of Industrial & Engineering Technology
Wightman Hall 208D
Central Michigan University
Mt. Pleasant, MI 48859

* Department of Industrial Technology
118 Sill Hall
Eastern Michigan University
Ypsilanti, MI 48197

Department of Industrial
105 Swan
Ferris State College
Big Rapids, MI 49307

Department of Industrial Technology and Arts
Professional and Applied Studies
Bemidji State University
Bemidji, MN 56601

* Manufacturing Engineering Technology Department
MSU Box 48
Mankato State University
Mankato, MN 56001

* Department of Industrial Studies
Moorhead State University
Moorhead, MN 56560

* Department of Technology & Industrial Engineering
Headley Hall 216
St. Cloud State University
St. Cloud, MN 56301

Department of Industrial and Technical Studies
University of Minnesota, Duluth
Duluth, MN 55812

* Department of Industrial Education and Technology
P.O. Box 360
Alcorn State University
Lorman, MS 39096

* Department of Technology and Industrial Arts
Jackson State University
Jackson, MS 39217

* Department of Vocational Education and Technology
P.O. Box Drawer NU
Mississippi State University
Mississippi State, MS 39762

Department of Industrial Technology
P.O. Box 930
Mississippi Valley State University
Itta Bena, MS 38941

Department of Construction and Architectural Engineering
Technology
Southern State Box 5137
University of Southern Mississippi
Hattiesburg, MS 39406

* Industrial Arts and Technology
Grinstead Building
Central Missouri State University
Warrensburg, MO 64093

* Division of Industrial Science
Northeast Missouri State University
Kirksville, MO 63501

Department of Technology
Northwest Missouri State University
Maryville, MO 64468

* Department of Industrial Technology and Education
Room 203, Serena Building
Southeast Missouri State University
Cape Giradeau, MO 63701

* Department of Industrial Technology
901 S. National Avenue
Southwest Missouri State University
Springfield, MO 65804

Department of Industrial Education
The School of the Ozarks
Point Lookout, MO 65726

Department of Industrial Technology
Brockmann Center
Northern Montana College
Havre, MT 59501

* Department of Agriculture and Industrial
Technology Education
Chadron State College
Chadron, NE 69337

* Department of Industrial Technology
Otto Olsen Building
Kearney State College
Kearney, NE 68849

* Department of Science and Technology
Peru State College
Peru, NE 68421

* Department of Industrial Systems Technology
202 Engineering Building
University of Nebraska at Omaha
Omaha, NE 68182

* Department of Industrial Technical Education
Applied Science Division
Wayne State College
Wayne, NE 68787

Department of Industrial Education and Technology
Adams Technology Building
Keene State College
Keene, NH 03431

Department of Technology
Rte. 322
Glassboro State College
Glassboro, NJ 08028

* Department of Technology
Morris Avenue
Kean College of New Jersey
Union, NJ 07083

Department of Industrial Technology
Station 11
Eastern New Mexico University
Portales, NM 88130

Department of Industrial Engineering Technology
P.O. Box 3050
SUNY College of Technology
Utica, NY 13502

* Department of Engineering Technology
State University of New York at Binghamton
Binghamton, NY 13901

Department of Technology
Upton Hall 314
State University College at Buffalo
Buffalo, NY 14222

Department of Industrial Education and Technology
W. Kerr Scott Hall
Appalachian State University
Boone, NC 28608

* East Carolina University
Manufacturing
Greenville, NC 27834-4353

Department of Industrial Arts and Technology
Elizabeth City State University
Elizabeth City, NC 27909

* Department of Construction Management and Safety
North Carolina Agr. & Tech. State University
Greensboro, NC 27411

* Department of Industrial Education and Technology
Western Carolina University
Cullowhee, NC 28723

* Department of Industrial Technology
Box 8057
University of North Dakota
Grand Forks, ND 58202

* Department of Technology
Valley City State College
Valley City, ND 58072

* College of Technology
Bowling Green State University
Bowling Green, OH 43404

Department of Industrial and Technical Education
Central State University
Wilberforce, OH 45384

Department of Industrial Technology
123 Van Deusen Hall
Kent State University
Kent, OH 44242

Department of Industrial Technology
Ohio Northern University
Ada, OH 45810

Department of Industrial Technology
Room 116, Stocker Engr. Cntr.
Ohio University
Athens, OH 45701

* Industrial Technology Education
Room 200 Welding Engineering Building
The Ohio State University
Columbus, OH 43210

Industrial Technology Department
Pyle Box 1287
Wilmington College
Wilmington, OH 45177

* Department of Industrial Education
  100 University Drive
  Central State University
  Edmond, OK 73060-0185

* Department of Industrial Education & Technology
  East Central University
  Ada, OK 74820

Department of Technology
Langston University
Langston, OK 73050

Department of Industrial Education & Technology
Panhandle State University
Goodwell, OK 73939

* Department of Industrial Education
  Northeastern State University
  Tahlequah, OK 74464

Department of Technology
Station A, Box 4044
Southeastern Oklahoma State University
Durant, OK 74701

Department of Industrial Education & Technology
100 Campus Drive
Southwestern Oklahoma State University
Weatherford, OK 73096

Department of Manufacturing Engineering Tech
Oregon Institute of Technology
Klanath Falls, OR 97601

* Department of Industry and Technology
  California University of Pennsylvania
  California, PA 15419

* Department of Industry and Technology
  Osburn Hall
  Millersville University of Pennsylvania
  Millersville, PA 17551

* Department of Industrial Education & Technology
  600 St. Pleasant Avenue
  Rhode Island College
  Providence, RI 02809

* Department of Industrial Education
G-01 Tillman Hall
Clemson University
Clemson, SC 29634-0711

* Department of Industrial & Electrical Engin. Tech
Box 1735
South Caroline State College
Orangeburg, SC 29117

* Division of Industrial Technology
Black Hills State College
Spearfish, SD 57783

* Department of Industrial Technology
12th Avenue and Jay Street South
Northern State College
Aberdeen, SD 57401

Department of Industrial Technology
P.O. Box 4536
Austin Peay State University
Clarksville, TN 37044

* Department of Technology
P.O. Box 19060A
East Tennessee State University
Johnson City, TN 37614

* Department of Industrial Studies
Box 19
Middle Tennessee State University
Murfreesboro, TN 37132

Department of Industrial Arts and Technology
3500 John A. Merritt Boulevard
Tennessee State University
Nashville, TN 37203

* Department of Industrial Technology
Campus Box 5003
Tennessee Technological University
Cookeville, TN 38505

* Department of Technological & Adult Education
402 Claxton Addition
The University of Tennessee
Knoxville, TN 37996-3400

* Department of Industrial Technology
  ACU Box 8107
  Abilene Christian University
  Abilene, TX 79699

* Department of Technology
  Box 6055 Commerce
  East Texas State University
  Commerce, TX 75428

* Department of Industrial Technology
  P.O. Box 13198
  North Texas State University
  Denton, TX 76203-3198

* Department of Industrial Technology
  P.O. Box 2123
  Prairie View A&M University
  Prairie View, TX 77446

* Department of Industrial Technology
  P.O. Box 2266
  Sam Houston State University
  Huntsville, TX 77341-2266

Department of Technology
Southwest Texas State University
San Marcos, TX 78666

Department of Industrial Technology
Box 6065
Sul Ross State University
Alpine, TX 79832

Department of Industry and Technology
Box 188
Texas A & I University
Kingsville, TX 78363

* College of Technology
  Texas Southern University
  Houston, TX 77004

* Department of Technology
  3900 University Blvd. HPR 226
  The University of Texas at Tyler
  Tyler, TX 75701

Department of Industrial Technology
University Park
University of Houston
Houston, TX 77004

* Engineering Technology Department
P.O. Box 767
West Texas State University
Canyon, TX 79016

* Department of Industrial Education
Snell Building
Brigham Young University
Provo, UT 84602

Department of Industrial Education
351 West Center
Southern Utah State College
Cedar City, UT 84720

Department of Industrial Technology & Education
Utah State University
Logan, UT 84322-6000

Department of Technology
2401 Corprew Avenue
Norfolk State University
Norfolk, VA 23504

* Department of Industrial Education
Old Dominion University
Norfolk, VA 23508

* Department of Industrial and Engineering Tech
Central Washington University
Ellensburg, WA 98926

* Department of Technology
Eastern Washington University
Cheney, WA 99004

Department of Industrial Technology
306 SW 4th Street
Walla Walla College
College Place, WA 99324

* Department of Technology
Western Washington University
Bellingham, WA 98225

Division of Industry and Technology
West Virginia Institute of Technology
Montgomery, WV 25136

* Department of Industrial Technology
Campus Box 163
West Virginia State College
Institute, WV 25112

* Department of Industrial Studies
University of Wisconsin-Platteville
Platteville, WI 53818

* Department of Industrial Technology
115 Technology Wing
University of Wisconsin-Stout
Menomonie, WI 54751

* Department of Vocational Education
P.O. Box 3374, University Station
University of Wyoming
Laramie, WY 82071

APPENDIX D

Research Documents

1. Letter to Contact Persons
2. Follow-up Card to Contact Persons
3. Follow-up Letter to Contact Persons
4. Questionnaire

UNIVERSITY OF UND NORTH DAKOTA

DEPARTMENT OF INDUSTRIAL TECHNOLOGY
BOX 8057, UNIVERSITY STATION
GRAND FORKS, NORTH DAKOTA 58202
701, 777-2249

October 24, 1988

Inside Address

Dear Dr.

Research to identify and analyze changes in four-year baccalaureate programs in industrial technology programs is currently being conducted. The purpose is to determine trends and implications for future curricular development.

The study requires that certain criteria be met in regard to respondent qualifications. Your chairperson determined that you met these criteria and selected you to respond for your program.

Since it is such an important study for our field your input through response to the enclosed questionnaire is essential. The questionnaire is designed to elicit responses from checklist and limited open-ended items. The questionnaire includes a single page to be used for collecting information about each major in your program. One form for each major in your program as identified in the <u>1987-88 Industrial Technology Baccalaureate Program Directory</u> is included. If sufficient forms are not enclosed you may duplicate the form or contact me at (701) 777-2249 for additional forms.

The questionniare should take approximately 30 to 45 minutes to complete. Since it is a fairly lengthy instrument, I have enclosed packages of coffee and tea to help carry you through the task and to keep you alert while responding to this important document. In addition, I would recommend that you have a copy of the institution's 1973, 1978, 1983 and 1988 catalog available for ready reference while completing the questionnaire. Please place the completed questionnaire in the enclosed reply envelope and return by November 7, 1988.

Your participation in this study will aid greatly in future curricular improvement for four-year baccalaurate programs in industrial technology. Confidentiality is guaranteed. Your name will not be associated with your answers in any public or private report of the study's results. The requested department and university/college information in the survey instrument will be used only for follow-up mailings.

Thank you in advance for your assistance. I would be pleased to send you a summary of the study upon its completion.

Sincerely,

C. Ray Diez

C. Ray Diez
Assistant Professor

8 November 1988

Dear

As the faculty member designated as the participant from your program, you were requested to respond to a survey to identify industrial technology curricular change. The cover letter and survey instrument were mailed two weeks ago. My records show that you have yet to respond. Would you please take a few minutes to complete and return the questionnaire? Thank you. If you recently have responded to the survey, thank you.

Sincerely,

C. Ray Diez

C. Ray Diez
Assistant Professor, Univ. of North Dakota

U N I V E R S I T Y   O F   UND   N O R T H   D A K O T A

November 25, 1988

DEPARTMENT OF INDUSTRIAL TECHNOLOGY
BOX 8057, UNIVERSITY STATION
GRAND FORKS NORTH DAKOTA 58202
701 777 2249

Dear

This follow-up letter and research instrument mailing is intended to encourage your response to the questionnaire for identifying curricular changes in four-year baccalaureate programs in industrial technology. The purpose is to determine trends and implications for future curricular development.

The enclosed questionnaire is for your convenience if, by chance, the initial instrument sent you was misplaced. If you have responded to the previous mailings, Thank You. If not, please reserve some of your valuable time for responding to this survey.

Since it is an important study for our field your input through response to the enclosed questionnaire is essential. The questionnaire is designed to elicit responses from checklist and limited open-ended items. The questionnaire includes a single page to be used for collecting information about each major in your program. One form for each major in your program as identified in the 1987-88 Industrial Technology Baccalaureate Program Directory is included. If sufficient forms are not enclosed you may duplicate the form or contact me at (701) 777-2249 for additional forms.

To aid in responding, I would recommend that you have a copy of the institution's 1973, 1978, 1983 and 1988 catalog available for ready reference while completing the questionnaire. Please place the completed questionnaire in the enclosed reply envelope and return by December 12, 1988.

Your participation in this study will aid greatly in future curricular improvement for four-year baccalaurate programs in industrial technology. Confidentiality is guaranteed. Your name will not be associated with your answers in any public or private report of the study's results. The requested department and university/college information in the survey instrument will be used only for follow-up mailings.

Thank you in advance for your assistance. I would be pleased to send you a summary of the study upon its completion.

Sincerely,

C. Ray Diez

C. Ray Diez
Assistant Professor

1.

SURVEY TO IDENTIFY INDUSTRIAL TECHNOLOGY CURRICULAR CHANGE

RETURN TO: C. Ray Diez, Assistant Professor
Department of Industrial Technology
University of North Dakota
Grand Forks, North Dakota 58202

Industrial technology for this study shall mean the curricula designed to prepare professionals in the economic-enterprise system. The purpose is to see if notable changes have occurred in the curricula of four-year baccalaureate institutions offering industrial technology programs during the past fifteen years. The gathered data will be analyzed to determine trends and identify implications for future curricular development.

I. DEMOGRAPHIC INFORMATION

A. Department ______________________________

B. University/College ______________________________

C. How many students are enrolled as majors in your program? Place a check ( ) in the blank which most closely matches your enrollment.

_____ 1-99
_____ 100-199
_____ 200-299
_____ 300-399
_____ 400-499
_____ 500 and above (Approximately __________

D. Does this enrollment figure represent growth, decline, or stability for enrollment of majors since your program was identified as an industrial technology program? Circle one.

Growth Decline Stability

E. What were the name(s) of the program(s) that preceded the name of the current industrial technology program? Check ( ) all that apply.

_____ Industrial Arts
_____ Industrial Arts and Technology
_____ Industrial Education
_____ Industrial Education and Technology
_____ Applied Science
_____ Engineering Technology
_____ Other (please specify) ______________________

F. What year was the industrial technology baccalaureate degree program (nonteaching) initiated? __________

DEFINITIONS

Operational definitions are needed to promote understanding of the terminology used in this study. The following terms are defined to clarify their use.

Change: "the complete or partial alteration of an item in form, quality, or relationship;... on the whole, a characteristic of education that is dynamic rather than static" (Good, 1973, p.89).

Concentration: a series of courses within a major from which a student may choose in order to gain some degree of specialization within the major option area. For this study "concentration" may be used interchangeably with "emphasis".

Curriculum change: "an alteration of the curriculum consisting in making different or restructuring the learning opportunities provided pupils at a given time and place" (Good, 1973, p.158)

Emphasis: For this study "emphasis" may be used interchangeably with "concentration".

Industrial technology: curricula designed to prepare professionals in the economic-enterprise system.

Major: "the group of courses selected from a department's offering, and sometimes from related departments, as a requirement for specialization for ... professional preparation for graduation or certification" (Good, 1973, p.348).

Nontechnical accredited: programs that have received accreditation by an accrediting agency which accredits multidisciplinary instructional programs and institutions, such as the North Central Association (NCA).

Program: all the majors or courses of study within an academic department.

Technical accredited: programs that have received accreditation from an accrediting agency or association that has standards developed for technology programs, such as the National Association of Industrial Technology (NAIT) and Accreditation Board for Engineering and Technology (ABET).

II. INDUSTRIAL TECHNOLOGY PROGRAM MAJOR INFORMATION

Please provide the information requested below for each of your industrial technology program majors. Copies of the Industrial Technology Program Major Information form are provided for each of your program majors as identified in the 1987-88 Industrial Technology Baccalaureate Program Directory. Please use one (1) copy for each major in your program. If additional copies are needed please feel free to photocopy this form. Leave blank those items which do not pertain to the identified program major.

Program Major Information

A. Name of the major ____________________

B. Name of the degree granted ____________________

C. Year the major was approved ____________________

D. Did the major:

1. Replace a previous major? Circle one. YES NO
2. Represent a new concept? Circle one. YES NO

E. Concentration(s) or emphasis(es) within the major

____________________ ____________________

____________________ ____________________

____________________ ____________________

F. Name of accrediting agency ____________________

____

____

G. Year the program was accredited ____________________

H. If not accredited, is accreditation currently being pursued?

Please circle. YES NO Agency ____________________

____

____

I. What changes or additions are anticipated in the next five years (1993)? Circle change or addition in items below.

Change/addition of major to ____________________

Change/addition of degree to ____________________

Change/addition of concentration or emphasis to ____________________

____

Change/addition to specialized major(s) ____________________

Change/addition to general program ____________________

Accreditation by (agency) ____________________

____

____

Industrial Technology Program Major Information (continued)

J. If not accredited by a technical accrediting agency, how does your major compare to the National Association for Industrial Technology course minimum-maximum percentage guidelines shown below? Complete by circling the letter that describes the comparison to your major.

Meets	Exceeds	Below	Required Percentage	Coursework Areas
M	E	B	15-30%	General Education Humanities, English, History, Sociology, Psychology, Speech, Economics, and similar fields
M	E	B	5-15%	Mathematics Trigonometry, Analytical Geometry, Calculus, Statistics
M	E	B	5-15%	Physical Sciences Physics, Chemistry
M	E	B	10-20%	Management Production Control, Quality Control, Manufacturing Cost Analysis, Engineering Economics, Supervision, Production Management, Accounting, Business Law, Marketing, etc.
M	E	B	20-30%	Technical Plastics, Metalworking, Foundry, Welding, Electronics, Drafting, Mechanical Systems, Robotics, etc.
M	E	B	5-15%	Electives
			100%	

K. If your major is accredited by a technical agency, what factors influenced your faculty to pursue accreditation? Please check ( ) all that apply.

____ Perceived institution expectations
____ Assistance to students in gaining employment
____ Assistance in obtaining funding and resources
____ Value of a "standardized curriculum"
____ Making major more meaningful to industry
____ Strenghtening of academic standards
____ Other (comments) ______________________
____ Other (comments) ______________________

L. If your major is nontechnical accredited, what factors influence your faculty to remain unaccredited? Please check ( ) all that apply.

____ Amount of time involved
____ Amount of effort involved
____ Costs involved
____ Uncertain as to which accreditation to pursue
____ Lack of benefits to our major
____ Fear of current faculty being unqualified
____ Other (comments) ______________________
____ Other (comments) ______________________

M. Is your major designed to emphasize technology or management?

Circle one: Technology Management Equal

III. INDUSTRIAL TECHNOLOGY COURSE INFORMATION

Please respond to the items relating to course titles which were included in your department's program(s) requirements fifteen (15), ten (10), five (5) years ago and the 1987-88 program. Place a check ( ) on the line under the column for the year:

A. 1973,1978, and/or 1983 if the course was a part of your program by that year;

B. 1988 if the course is part of your program now; and

C. 1993 if you anticipate the course will continue to be offered or will be added to your program in the next five years.

You may have no checks, one check, or a check for each course/year listed.

	1973	1978	1983	1988	1993
A. General Education or Liberal Arts					
1. Economics	___	___	___	___	___
2. English	___	___	___	___	___
3. Foreign Language	___	___	___	___	___
4. History	___	___	___	___	___
5. Humanities	___	___	___	___	___
6. Psychology	___	___	___	___	___
7. Sociology	___	___	___	___	___
8. Speech	___	___	___	___	___
9. Other ______________________	___	___	___	___	___
10. Other ______________________	___	___	___	___	___
B. Mathematics					
1. Analytical Geometry	___	___	___	___	___
2. Calculus I	___	___	___	___	___
3. Calculus II	___	___	___	___	___
4. Calculus III	___	___	___	___	___
5. College Algebra	___	___	___	___	___
6. College Algebra II	___	___	___	___	___
7. Economic Statistics	___	___	___	___	___
8. Statistics I	___	___	___	___	___
9. Statistics II	___	___	___	___	___
10. Trigonometry	___	___	___	___	___
11. Other ______________________	___	___	___	___	___
12. Other ______________________	___	___	___	___	___
C. Physical Sciences					
1. Chemistry I	___	___	___	___	___
2. Chemistry II	___	___	___	___	___
3. General Chemistry	___	___	___	___	___
4. Introduction to Chemistry	___	___	___	___	___
5. Introduction to Physics	___	___	___	___	___
6. Physical Science	___	___	___	___	___
7. Physics I	___	___	___	___	___
8. Physics II	___	___	___	___	___
9. Other ______________________	___	___	___	___	___
10. Other ______________________	___	___	___	___	___

Industrial Technology Course Information (continued)

	1973	1978	1983	1988	1993
D. Management					
1. Accounting I.					
2. Accounting II					
3. Aviation Management.					
4. Business Law.					
5. Engineering Economics					
6. Manufacturing Cost Analysis . . .					
7. Marketing					
8. Personnel Management.					
9. Production Control.					
10. Production Management					
11. Supervision					
12. Supervision and Management. . . .					
13. Other ________________ . .					
14. Other ________________ . .					
E. Technical Coursework Areas					
1. Drafting/Design Related					
a. Architectural Drafting . . .					
b. Blueprint Reading.					
c. Construction Drafting. . . .					
d. Design/Drafting.					
e. Die Design					
f. Electronic Drafting.					
g. Geometric Dimensioning . . .					
h. Industrial Sketching					
i. Kinematics					
j. Machine Design					
k. Mechanical Drawing					
l. Product Design and Drafting.					
m. Technical Drawing.					
n. Technical Illustration . . .					
o. Tool Design.					
p. Other ________________ . .					
q. Other ________________ . .					
r. Other ________________ . .					
2. Construction Related					
a. Advanced Woods					
b. Construction Processes . . .					
c. Construction Technology. . .					
d. Construction Management. . .					
e. Finishing Processes.					
f. Project Development.					
g. Surveying.					
h. Woods I.					
i. Woods II					
j. Woods Technology					
k. Other ________________ . .					
l. Other ________________ . .					
m. Other ________________ . .					

7

Industrial Technology Course Information (continued)

	1973	1978	1983	1988	1993
3. Energy and Power Related					
a. Digital Electronics.					
b. Electricity I.					
c. Electricity II					
d. Electronics I.					
e. Electronics II					
f. Instrumentation.					
g. Power Control.					
h. Solid State Electronics. . .					
i. Thermodynamics					
j. Other ____________________. .					
k. Other ____________________. .					
l. Other ____________________. .					
4. Graphic Communications Related					
a. Advanced Photography					
b. Applied Photography.					
c. Black & White Photography. .					
d. Color Photography.					
e. Communications Technology. .					
f. Electronic Publishing. . . .					
g. Graphics Arts Technology . .					
h. Industrial Photography . . .					
i. Lithographic Technology. . .					
j. Photographic Processes . . .					
k. Production Printing.					
l. Progressive Photographic Tech.					
m. Other ____________________. .					
n. Other ____________________. .					
o. Other ____________________. .					
5. Production Related					
a. Ceramics Processes					
b. Facilities Design.					
c. Machine Tool Technology. . .					
d. Manufacturing Systems. . . .					
e. Manufacturing Technology . .					
f. Material Handling.					
g. Metals I					
h. Metals II.					
i. Plant Layout					
j. Plastics Technology.					
k. Production Processes					
l. Production Scheduling. . . .					
m. Production Systems					
n. Production Techniques. . . .					
o. Research and Development . .					
p. Quality Assurance.					
q. Quality Control.					
r. Robotics					
s. Time and Motion Study. . . .					
t. Other ____________________. .					
u. Other ____________________. .					
v. Other ____________________. .					

Industrial Technology Course Information (continued)

	1973	1978	1983	1988	1993
6. Material Science Related					
a. Ceramics.					
b. Characteristics of Materials.					
c. Composites					
d. Materials I.					
e. Materials II					
f. Materials Testing.					
g. Metallurgy					
h. Statics.					
i. Statics and Strengths. . . .					
j. Strength of Materials. . . .					
k. Other ______________. .					
l. Other ______________. .					
m. Other ______________. .					
7. Computer Applications Related					
a. Beginning Computers.					
b. Computer-Aided Design/Drafting					
c. Computer-Aided Machining . .					
d. Computer-Aided Manufacturing					
e. Computer Applications. . . .					
f. Computer Integrated Mfg. . .					
g. CNC Programming.					
h. Computer Programming					
i. Machine Languages.					
k. Machine Vision					
l. N/C Programming.					
Programming Languages (Specify)					
m. Basic					
n. COBOL					
o. Fortran					
p. Pascal.					
q. Other ______________. .					
r. Other ______________. .					
s. Other ______________. .					
8. Aviation Related					
a. Aerodynamics					
b. Aeronautics.					
c. Aerospace Basic Science. . .					
d. Aircraft Systems & Components					
e. Airframe Structures I. . . .					
f. Airframe Structures II . . .					
g. Air Transportaion.					
h. Airport Operation.					
i. Aviation Instructor Ground Sch					
j. Aviation Safety.					
k. Commercial Flight Instruct. I					
l. Commercial Flight Instruct. II					
m. Commercial Ground School . .					
n. Federal Aviation Regulations					
o. Flight Instruction I & II. .					
p. Flight Instruction III . . .					
q. Flight Training.					
r. Instrument Flight.					
s. Instrument Ground School . .					
t. Meteorology.					
u. Navigation					
v. Power Plants I					

Industrial Technology Course Information (continued)

		1973	1978	1983	1988	1993
	w. Power Plants II.	____	____	____	____	____
	x. Thrust Conversion.	____	____	____	____	____
	y. Other.	____	____	____	____	____
	z. Other.	____	____	____	____	____
	aa. Other.	____	____	____	____	____
9.	Work Experience Related					
	a. Cooperative Education. . . .	____	____	____	____	____
	b. Field Experience	____	____	____	____	____
	c. Internship	____	____	____	____	____
	d. Practicum.	____	____	____	____	____
	e. Other ____________________. .	____	____	____	____	____
	f. Other ____________________. .	____	____	____	____	____
10.	Other Specicalty Technical Related (Specify)					
	a. Other ____________________. .	____	____	____	____	____
	b. Other ____________________. .	____	____	____	____	____
	c. Other ____________________. .	____	____	____	____	____
	d. Other ____________________. .	____	____	____	____	____
	e. Other ____________________. .	____	____	____	____	____
	f. Other ____________________. .	____	____	____	____	____
	g. Other ____________________. .	____	____	____	____	____
	h. Other ____________________. .	____	____	____	____	____
	i. Other ____________________. .	____	____	____	____	____
	j. Other ____________________. .	____	____	____	____	____
	k. Other ____________________. .	____	____	____	____	____
	l. Other ____________________. .	____	____	____	____	____

APPENDIX E

Selected Survey Data

1. Program Name Forerunners

2. Designation of Majors

3. Concentrations/Emphases in Majors

Program Name Forerunners	
Industrial Arts	30
Industrial Arts and Technology	6
Industrial Education	12
Industrial Education and Technology	10
Applied Science	2
Engineering Technology	2
Other	16
Industrial Technology (5)	
Industrial and Technical Education (3)	
Business and Technology (1)	
Developed from a two-year program (1)	
Education for Industry (1)	
Industrial Science (1)	
New Program (1)	
Non Teaching - Industrial Arts (1)	
Practical Arts (1)	
Did Not respond (1)	
	78

Designation of Majors	
Industrial Technology	42
Industrial Management	6
Manufacturing Engineering Technology	5
Industrial Education	4
Manufacturing Technology	3
Computer Technology	2
Construction	3
Graphic Communications	2
Electrical Engineering Technology	2
Engineering Technology	2
Electronics Technology	3
General Industry and Technology	1
Energy and Power	1
Building Construction and Contracting	1
Printing Management	1
Automotive Engineering Technology	1
Interior Architecture	1
Technology Education	2
Architecture/Construction	1
Plastics	1
Manufacturing	1
Computer Aided Design	1
Computer Aided Machining	1
Occupational Safety & Hygiene Management	1
General	1
Electro-Mechanical	1
Drafting & Design Engineering Technology	1
Electronics & Computer Technology	1
Construction Engineering Technology	2
Design	1
Production	1
Industrial Distribution	1
Physical Plant Administration	1
Graphic Arts Administration	1
Construction Management	2
Industrial Science	1
Wood Technology	1
Industrial Administration and Sales	1
Automotive Technology	1
Plastics Engineering Technology	1
Mechanical Design/Drafting Engineering Technology	1
Electonics Engineering Technology	1
Production Technology	1
Visual Communications	1
Industrial Education and Technology	1
	111

Concentrations/Emphases in Majors	
Manufacturing	19
Electronics	11
Graphic Arts	8
Construction	9
Management	4
Mechanical Design	3
Production	3
Printing Management	1
Mechanical Contracting	1
Electrical	1
Design	3
Computer Integrated Design & Manufacturing	1
Visual Communications	4
Power & Energy	3
Marketing	2
Art	1
Industrial Education Technology	1
Education	1
Construction Management	3
Computer Applications	2
Robotics	1
Computer Numeric Control	1
Plastics	3
Woods	7
Metals	6
Graphics/Photography	1
Industrial Management	1
Industrial Technology	3
Mining (on hold)	1
Communications	2
Drafting	6
Electricity/Electronics	4
Power Technology	2
Industrial Materials	1
Electro-Mechanical	1
Machining	1
Architectural Design	1
Manufacturing Engineering Technology & Management	1
Industrial Electronics	1
Computer Technology	1
Communications Electronics	1
Construction Engineering, Technology & Management	1
Manufacturing Technology	3
Building Construction	1
Graphic Arts Management	1
Manufacturing Engineering	1

Mechanical Power Transmission	1
Industrial Distribution	2
Packaging	2
Quality Technology	1
Technical Sales & Service	1
Technical Communications	1
Plant Engineering	1
Product Development	1
Secondary Resources Management	1
Graphic Communications	2
Automotive	2
Materials and Processes	2
Technical Management	1
Control Systems	1
Data Communications	1
Industrial Generalist	1
Industrial Safety	1
Quality Assurance	2
Reactor Operations	1
Fuels Reprocessing Operations	1
Material Technology	1
Secondary Education	1
Product Design and Development	1
General Engineering Technology	1
Fire Science	1
Industrial Safety & Training	1
Industrial Manufacturing - Production	1
Industrial Training and Human Resources Development	1
Computer Science	1
Business Management	1
Wood Technology	1
Plastics Technology	1
Building Construction Management	1
Safety Management	1
Technical Management	1
Drafting/Design	2
Power Transmission	1
Power	1
Composites	1
Electronics Engineering Technology	1
Construction Technology	1
Graphic Arts Technology	1
Industrial Technology Education	1
Technology of Industry	1
Traffic and Safety Education	1
Occupational Safety	1
Graphic Communications and Printing	1
Energy/Power Transmission	1
Computer Electronics	2
Design & Technical Drawing	1

CAD/CAM	1
Electro/Mechanical Power Systems	1
Industrial Electronics	1
Architectural/Technical Drawing	1
Wood Products Manufacturing	1
Communications Technology	1
Energy and Power Technology	1
Production Technology	1
Technical Sales and Service	1
General Industry	1
Computing Applications	1
Planning and Design	1
Power, Energy, & Transportation	1
Service Management	1
Manufacturing Management	1
Agriculture/Heavy Equipment	1
	208

RESEARCH BUDGET

To better aid and guide the researcher as to the cost of this dissertation a budget has been prepared. The following is an outline of the budget.

Travel	$1000.00
Supplies	
Envelopes	
500 #10 24# White wove	39.40
400 Business Reply	132.00
Paper	
500 24# White Linen Letterhead	35.10
500 24# White Linen Plain	25.00
750 20# 100% Rag Content Certified Acid Free	29.55
Mailing	
250 Postcards	37.50
Envelope Posting	275.00
Duplicating	400.00
Telephone	200.00
Support Staff	50.00
Printing (University Press)	65.00
Typist/Word Processor	300.00
Data Processing (Free to UND personnel)	0.00
Final Submission	
10 duplicated copies @.05 (3000 pages)	150.00
Binding Fee	50.00
Microfilm Fee	40.00
	$2828.55

RESEARCH SCHEDULE

The procedures for the study will be identified by the following dates and activities:

May 17, 1988 -- Proposal meeting
June 1, 1988 -- Letter to department chairpersons to identify faculty at that insititution for the past fifteen years
June 16, 1988-- Follow-up card to department chairpersons
July 20, 1988-- Modified proposal and questionnaire submitted to the committee for approval
July 22, 1988-- Questionnaire sent on trial run to six selected faculty in the profession
Aug. 5,1988 -- Follow-up card to trial run participants
Aug. 21, 1988-- Questionnaire to printer for final printing
Sept. 10, 1988--1st mailing of questionnaire to the sample
Sept. 24, 1988--1st follow-up to the sample
Oct. 8, 1988 -- Final follow-up to the sample
Oct. 22, 1988-- Completion of data collection
May 10, 1990 -- Approved revised copy of dissertation submitted to the Graduate College for review prior to dissertation defense
June 1, 1990 -- Preliminary dissertation Chapter 1 Introduction, Preliminary dissertation Chapter 2 Review of Literature, Preliminary dissertation Chapter 3 Design and Procedures for the Research Preliminary dissertation Chapter 4 Findings, and Preliminary dissertation Chapter 5, Conclusions submitted to the committee
June 29, 1990-- Revised copy of dissertation submitted to the committee for review
July 23, 1990-- Defense of dissertation
July 27, 1990 -- Submit copies for duplication & binding
July 27, 1990-- Submit abstract and copy for microfilming
July 27, 1990-- Register for graduation
Aug. 3, 1990-- Graduation

VITA

Clayton Ray Diez
903 Park Drive
Grand Forks, ND 58201

(701) 772-6875 (Home)
(701) 777-2198 (Office)

PROFESSIONAL EXPERIENCES

August 1985-Present: Assistant Professor of Industrial Technology--University of North Dakota; Grand Forks, ND 58202.

August 1984-May 1985: Instructor of Industrial Technology--University of Northern Iowa; Cedar Falls, IA 50614.

June-July 1984: Instructor of Industrial Technology--University of Northern Iowa; Cedar Falls, IA 50614.

August 1982-May 1984: Graduate Assistant in Industrial Technology--University of Northern Iowa; Cedar Falls, IA 50614.

August 1975-August 1982: Instructor and Coach--Fullerton City Schools; Fullterton, NE 68638.

August 1972-August 1975: Instructor and Coach--Reinbeck Community Schools; Reinbeck, IA 50669. Committee assignments included: Steering Committee--North Central Accreditation Evaluation (1974-75).

EDUCATION

Doctor of Industrial Technology; University of Northern Iowa, Cedar Falls, IA 50614; August, 1990. Concentration: Design/Drafting and Graphic Arts.

Master of Science in Education, Wayne State College, Wayne, NE 68787; August, 1979. Applied Science Division: Industrial Education.

Bachelor of Arts in Education, Wayne State College, Wayne, NE 68787; August, 1972. Major: Industrial Education, Minor: Physical Education.

CONSULTING WORK

September 1988-Present--Technical Consultant to Center for Innovation and Business Development--University of North Dakota.

July, 1987--University of Northern Iowa--Shared High Technology Transportable Learning Modules concept with Task Force in charge of developing a Technology Loan Program for Iowa schools.

March, 1987-May, 1988--Karl's North Dakota Premium Bar-B-Que Sauce--Developed a control used to fill bottles.

February-March, 1987--Department of Health, Physical Education and Recreation for Dr. Charlotte Humphries--developed and fabricated a Linear Slide testing apparatus in conjunction with Scott Tolbert.

RESEARCH ACTIVITIES, GRANTS

Dissertation: "Curricular Trends in Four-Year Baccalaureate Degree Industrial Technology Programs".

Fall, 1989--Wrote, submitted, and was funded for an instructional development grant to attend the National Education Workshop on Material Science at NASA-Langley Research Center, Hampton, VA; and the 23rd Conference of the National Association of Industrial Technology in Indianapolis, IN.

March, 1987--Wrote, submitted and was funded for an instructional development grant to visit three industries in Iowa.

September, 1986--Reviewed and revised the Undergraduate Survey Instrument for the UND-IT undergraduate program evaluation.

CONFERENCES AND SEMINARS ATTENDED

National Profiting from Innovation Workshop in Ames, IA. September, 1989.

National Educator's Workshop on Standard Experiments in Material Science--NASA-Langley Research Center, Hampton, VA. October, 1989.

23rd Conference of the National Association of Industrial Technology, Indianapolis, IN. October, 1989.

November, 1986--5 day workshop with CUE credit--Planning for Factory Automation, University of Wisconsin-Milwaukee.

October, 1986--1 day safety workshop/seminar--Right to Know--Sponsored by North Dakota Safety Council and North Dakota Worker's Compensation Bureau.

March, 1986--2 day workshop with CUE credit--Achievable Factory Automation, University of Wisconsin-Milwaukee.

October, 1985--Industry sponsored workshops--Computer Numeric Control by Prime Computer and GM/MAP by Hewlett-Packard--1985 NAIT Conference, Indiana State University, Terre Haute, Indiana.

PROFESSIONAL AFFILIATIONS

Epsilon Pi Tau (1971-72, 1983-90), Co Trustee, Pi Chapter (1985),
Gamma Gamma Chapter (1988-Present)
American Institute of Design and Drafting (1982-85), Student Advisor
International Technology Education Association (1983-90)
Phi Delta Kappa (1983-90)
American Technical Education Association (1985-89)
National Association of Industrial Technology (1983-90), Institutional Representative

PROFESSIONAL AWARDS-HONORS RECEIVED

Spring, 1987--Nominated for Advisor of the Year.
Spring, 1990--Nominated for Advisor of the Year.

COMMITTEE ASSIGMENTS

Chair of Departmental Library Committee
Member of College for Human Resources Development Faculty Development Committee
Chair of Undergraduate Evaluation Instrument Committee
Co-Chair of Fall Technology Conference
Facilitator for High Technology Transportable Learning Modules Workshop (CNC Lathe)
Board of Directors--North Dakota Safety Council--3 year term.
Center for Innovation and Business Development--Steering Committee

PROFESSIONAL PRESENTATIONS

April 89 & 90; November 89 Guest Lecturer--Occupational Therapy 403--Physical Aspects of OT with Mature Adults: Leathercraft Fabrication.

August 1987 North Dakota All-Service Conference--Computer Integrated Manufacturing Systems.

August 1986 North Dakota All-Service Conference--High Technology Transportable Learning Modules--CNC Lathe Demonstration.

October 1985 North Dakota--Manitoba Industrial Arts Association--Computer Numerical Controlled Lathe Operations.

PUBLICATIONS

Diez, C. R. (Spring, 1990). Computer integrated manufacturing systems: An overview. T.E.A.M.

Diez, C. R., & Smart, K. (Eds.). (Fall, 1989). The Technologist. Newsletter of the Department of Industrial Technology, University of North Dakota.