A STUDY OF THE FACTORS INVOLVED IN OBTAINING AND UTILIZING AUTHENTIC PROJECTS IN AN ENGINEERING TECHNOLOGY RESEARCH AND DEVELOPMENT COURSE

By

WILLIAM P. GRIMES

Bachelor of Science

Oklahoma State University

Stillwater, Oklahoma

1966

Submitted to the Faculty of the Graduate College
of the Oklahoma State University
in partial fulfillment of the requirements
for the Degree of
MASTER OF SCIENCE
May, 1970

Thesis
1970
G96s
cop. 2

OKLAHOMA
STATE UNIVERSITY
LIBRARY
OCT 12 1970

A STUDY OF THE FACTORS INVOLVED IN OBTAINING
AND UTILIZING AUTHENTIC PROJECTS IN AN
ENGINEERING TECHNOLOGY RESEARCH
AND DEVELOPMENT COURSE

Thesis Approved:

Donald S. Phillips
Thesis Adviser

Lloyd Wiggins

D. Durham
Dean of the Graduate College

762324

ACKNOWLEDGMENT

The study was completed through the cooperation and assistance of many persons. To Dr. Maurice W. Roney for his guidance and counsel during the planning and development of the study, and helpful suggestions during the writing of the thesis, and to Dr. Donald S. Phillips and Mr. Lloyd Briggs for their constructive suggestions for the final manuscript, my sincere thanks.

The writer is grateful to those of the Oregon Technical Institute faculty and administration who gave assistance during the study, especially Mr. Gene Culver and Mr. Walter Klos, to Mr. George Range for his assistance in composition, and to Mrs. Betty Young for her typing.

And finally, I am most grateful to my wife, Avis, for her patience and cooperation over the past three years while I used my vacations and free time developing and conducting the study, and writing the thesis. I am, also, deeply grateful for her assistance in typing portions of the rough draft and for her work on the brochure.

TABLE OF CONTENTS

LIST OF TABLES

CHAPTER I

THE PROBLEM

Introduction

This study is concerned with the obtaining and utilizing of research and development projects in the learning process of students in engineering technology curriculums. Engineering colleges, in general, in the last two decades have placed more and more emphasis on the theoretical, scientific approach to engineering with few applications. The need for a concerted educational effort to meet the manpower needs in the area of applications engineering has placed new requirements on the technical education institutions of the United States. The applications engineer or engineering technician requires educational preparation that is typically more rigorous and theoretical than the vocational preparation, but more specialized and applied than the professional preparation subjects. Thus, the schools of engineering technology should keep their instructional processes oriented toward the application of theoretical knowledge to the work the graduate will be doing in industry.

Many of the engineering technology graduates obtain research and development positions with companies that expect the graduate technician to be immediately productive. Therefore, to assist the technical college in providing an immediately productive engineering technician, it appears that an efficient learning method would have the student doing just those things he will be doing in an industrial position.

> ...not as an apprenticeship but in a learning atmosphere in an educational institution with all the advantages of an up-to-date theoretical background. If the apprenticeship is served in industry, usually it is with men five to ten (or more) years out of college. Considering the half-life of an engineer to be about eight to nine years, the young engineer [engineering technician] works with a man who may himself benefit from advanced design education. (1, p. 12)

Several engineering colleges are effectively using industry-originated research and development problems on their campuses to provide the student with a real learning process. These problems do not have standard or textbook solutions nor may the solutions be provided by the instructor. They require research, planning, organization, development, collection of scientific data, decisions, and conclusions.

> Unless the situation is drawn from real life, it is almost impossible to create a design problem that has the true ring of authenticity.... Real design problems have a fascinating way of injecting considerations that seem to defy the orderly analysis of our basic courses. The traditional design courses in most of our engineering curricula are so routinely predictable that no student can learn the challenge and excitement of the actual encounters of engineers in practice. (2, p. 4, 5)

Statement of the Problem

It appears that industry-involved, challenging, unrestricted, valuable-to-the-company, on-campus research and development projects would be an advantage to the engineering technology student. The stereotyped problems have been presented and solved so often that the instructor, as well as the student, falls into an unstimulating routine. Few hypothetical problems invented by an engineering technology teacher can ever be completely satisfactory in motivating the student; imaginary or irrelevant problems can actually, in many cases, discourage the student. (3, p. 3)

The need for such authentic projects will be shown. This study will investigate in which ways they can be obtained. How can industry be interested in providing authentic, unsolved problems for on-campus research and possible solutions? If such problems are available, what are some of the advantages to be gained and the procedures necessary for making most efficient use of these problems? Since the best source of these projects appears to be the industrial firms involved in research and development, they were contacted for projects for this study.

Purpose of the Study

The purpose of this study was to investigate the availability of industry-sponsored research and development projects to Oregon Technical Institute, and, if available, to determine how they can be used within an Electronics Engineering Technology curriculum.

Definition of Terms

Authentic Projects -- These are industry-originated and industry-sponsored research and development projects. As industry-sponsored, on-campus research and development projects, they do not have ready answers, or textbook solutions. Neither may solutions be solicited from an instructor or from another student. Instead the projects require research, planning organization, development, collection of scientific data, decisions, and conclusions.

Engineering Team -- This is a concept of teamwork, developed since World War II, in which the scientist, engineer, technician, and craftsman are brought together in a productive relationship. This practice has provided the significant advantages of technology in the United States today. The scientist, engineer, technician, and craftsman working together as a team with integrated specialties and skills, transmute creative ideas from drawing board or research laboratory into machines, products, and/or structures.

> Engineering Technician -- An engineering technician is one who, in support of and under the direction of professional engineers or scientists, can carry out in a responsible manner either proven techniques, which are common knowledge among those who are technically expert in a particular technology, or those techniques especially prescribed by professional engineers.
>
> Performance as an engineering technician requires the application of principles, methods, and techniques appropriate to a field of technology, combined with practical knowledge of the construction, application, properties, operation, and limitations of engineering systems, processes, structures, machinery, devices, or materials, and, as required, related manual crafts, instrumental, mathematical, or graphic skills.
>
> Under professional direction an engineering technician analyzes and solves technological problems, prepares formal reports on experiments, tests, and other similar projects or carries out functions such as drafting, surveying, technical sales, advising consumers, technical writing, teaching or training. An engineering technician need not have an education equivalent in type, scope, and rigor to that required of an engineer; however, he must have a more theoretical education with greater mathematical depth, and experience over a broader field than is required of skilled craftsmen who often work under his supervision. (4, p. 4)
>
> Engineering Technology -- Engineering technology is that part of the engineering field which requires the application of scientific and engineering knowledge and methods combined with technical skills in support of engineering activities; it lies in the occupational area between the craftsman and the engineer.
>
> (a) Engineering technology is identified as a part of the engineering field to indicate that it does not by any means encompass the entire field and also to differentiate it from other types of technology in areas such as medicine and the biological sciences. The engineering field is viewed as a continuum, between the craftsman and the engineer and closer to the engineer than to the craftsman.
>
> (b) Engineering technology is concerned primarily with the application of established scientific and engineering knowledge and methods. Normally engineering technology is not concerned with the development

of new principles and methods.

(c) Technical skills such as drafting are characteristic of engineering technology. Engineers graduated from scientifically oriented curricula (See ASEE Report on the Evaluation of Engineering Education, 1955) may have expected to have acquired less of these skills than previously and the engineering technician will be expected to supply them.

(d) Engineering technology is concerned with the support of engineering activities whether or not the engineering technician is working under the immediate supervision of an engineer. It may well be that in a complex engineering activity he would work under the supervision of an engineer, a senior engineering technician, or a scientist. (5, p. 11, 12)

Engineering Technology Curriculum -- An engineering technology curriculum is a planned sequence of college-level courses, usually leading to an associate degree, designed to prepare students to work in the field of engineering technology.

(a) The term college-level in the definition of an engineering technology curriculum indicates the attitude with which the education is approached, the rigor, and the degree of achievement demanded, and not solely or even necessarily that the credits are transferable to baccalaureate programs.

(b) ...there are many specific branches of engineering technology in which curricula are offered. Commonly encountered are such curriculum titles as mechanical engineering technology, electronic engineering technology..... (5, p. 13)

Half-life of an Engineer -- This means that half of the knowledge acquired by an engineer in college is obsolete in eight or nine years.

Two plus Two -- This terminology, which refers to the two years in an associate degree program plus two years oriented to the academic subjects required for a baccalaureate degree, for this study defines Oregon Technical Institute's Bachelor of Technology programs which have as their prerequisites the completion of the associate degree program. If the student chooses, at the end of the basic two-year technical program, he may add a two-year upper division program leading to the Bachelor of Technology degree. Junior and Senior Research and Development Projects are included to encourage the creative abilities of the students and to develop ingenuity through projects in which the knowledge learned in the associate degree technical programs is applied to research and development problems.

Up-side-down Curricular Pattern -- For this thesis this terminology is used to describe the curriculum in which the authentic projects will be utilized. The traditional college program tends to build toward greater specialization as one moves through the lower-division years into the upper-division years. In the up-side-down curricular pattern, the student starts immediately into the technology courses in his curricular field. During the first two years the student builds toward a specialization which is not characteristic of the first two years of a traditional four-year college program. In the course of this specialization, he is introduced to concepts in science and technology that he would not, under the traditional college program, encounter until his junior or even his senior year. In order to achieve this level of specialization characteristic of the associate degree program, the program must, of necessity be narrow in scope. Consequently, in the third and fourth years (junior and senior years) the curriculum is broadened to introduce the technician to the applied social sciences, to the humanities, and to the related areas of the curriculum. These are important to the insights that must be developed by the trained technician if he is to add supervisory and managerial competencies.

Those students who, at the end of their first two years, find the attraction of employment more than they can resist, are competent to move out into the industrial world as qualified technologists, with an Associate of Engineering Degree. As they request, those students who are qualified, and who wish to prepare themselves for supervisory and administrative opportunities available to qualified technicians in industry, can do so, and can proceed without loss of time, to the orderly completion of the additional two-year program, culminating in the bachelor of technology degree. This up-side-down curriculum is, therefore, obviously suited for industry-sponsored research and development projects within a student's junior and senior years.

CHAPTER II

NEED FOR STUDY

Early in this century, one of our most famous educators, John Dewey said, "There is no such thing as genuine knowledge and fruitful understanding except as the offspring of doing." (6, p. 355) Even though Dewey's philosophy was not accepted by educators in general, many educational institutions with this philosophy have come into existence. The high school and community college vocational-technical and occupational education are examples.

The Engineering Technician

During World War II technical education also began to attain appropriate recognition. Dr. Grant Venn, author of the report by the American Council on Education, Man, Education and Work, says:

> The acute shortage of engineers in wartime industries led to the increased use of technical personnel in many areas previously considered the preserve of the professional, and the technician came to be recognized as a vital component in the engineering team. Early in the war Congress passed legislation setting up an Engineering and Management War Training Program, which after considerable debate, made technical training a function of the higher education--and not the vocational education--branch of the U. S. Office of Education. After the war the Office of Education published Vocational Education of College Grade, which sharpened the distinction between technical education and vocational education (the latter, of course, being defined by law as "of less than college grade"). About the same time the Engineers' Council for Professional Development began speaking of the "engineering team," linking the technician to the near-professional level and apart from the skilled level. These and other events that followed,

> including industry-wide recognition that differences exist between the skilled, technical, and professional work levels, have virtually completed the process of bringing recognition to the engineering technician. (7, p. 69)

To further increase the recognition of the engineering technician

> ...The National Society of Professional Engineers in 1961 authorized the establishment of an Institute for the Certification of Engineering Technicians, to function under its auspices, but concerning itself entirely with technicians who work for and under the direction of engineers. (4, p. 3)

With the increased recognition of the engineering technician the American Society for Engineering Education in 1962 published "Characteristics of Excellence in Engineering Technology Education." (5) This publication was an evaluation of Technical Institute Education and has been used as a guide in the accreditation of two-year engineering technology curriculums by the Engineers' Council for Professional Development; it has also been used nationally to establish an acceptable standard for college level engineering technology curriculums.

Several of the two and three year technical institutes and colleges of technology have added another one or two years to their curriculums and now grant a four-year baccalaureate degree. The additional years allow the student to continue his studies in a practical (doing) type of education by including in the junior and senior years courses in research and development projects.

A Practical Type of Education

This need for a practical type of education extending beyond the two-year associate in engineering degree program is emphasized in the following excerpt from a letter from an engineering manager within one of the larger, worldwide construction companies:

> In our survey of instrumentation courses available at institutions of higher learning, we have found very few that are down-to-earth sufficiently to be useful to us. Most of the graduates from these courses expect to do very sophisticated, high-level work all the time; which actually is not a major portion of our work. When these students are faced with the more routine work connected with any industrial concern, some of them are, to say the least, disappointed. We believe that proper indoctrination at the University level for these conditions is a "must" for them to be suitably adjusted to industrial life, early enough in their careers, to avoid some of the problems we have seen. (8)

Possible Advantages of Authentic Projects

A further search of the literature available on authentic projects indicates industry involvement and/or sponsorship of these projects can have the following advantages: improves student motivation; increases learning effectiveness with reduced student-staff contact hours; provides real learning situations that involve the student in conditions found in industry; enables students to experience the "real life" parameters of pressure, need, cost, labor, material availability, and manufacturing processes; acquaints students with the non-technical aspects that surround a developmental project from its inception to its culmination, including the birth of the idea, its initial development, its mock-up and proto-type stages, and its testing (possible marketing); and, finally, provides fringe benefits such as improved verbal and written communication skills resulting from the student's work with industry as well as maintenance of current, relevant instructional material for all term levels due to the latest industry practices and knowledge being made available on campus. (9, primary source)

Mr. Glenn R. Fryling, Engineering Consultant and Managing Director of Susquehanna Consulting Associates, has this to say:

> In the Foreward to the Proceedings of the Third Conference on Engineering Design Education, one may read these statements: "...design is a universal ingredient in engineering activity... design education is most effectively accomplished where students are confronted with an authentic involvement in a design experience."
>
> And a little later in the same report, P. Z. Bulkeley writes: "Education by confrontation with reality, the essential ingredient of 'authentic involvement', is a teaching method that cannot be transmitted effectively without actual experience in doing it..."
>
> All of this would seem to be in harmony with the main idea of one of the most profound books on education ever to be published: "The students are alive, and the purpose of education is to stimulate and guide their self-development. It follows from this premise, that the teachers should be alive with living thoughts...." (10, p. 8)

The review of literature and personal interviews with industrial engineers and engineering professors has emphasized not only the advantages of authentic involvement of industry in the teaching process but also the importance of incorporating it in the engineering technology curriculums, and the appropriateness of the Oregon Technical Institute staff and campus for this study.

Warnings

Newman A. Hall, Executive Director, Commission on Engineering Education, gives several warnings to those using workshop (projects) courses:

> There are certain pitfalls which must be avoided. Chief of these is the tendency to create the artificial problem. In contrast to most academicians, the engineer in his professional role must deal with situations that have a hard-headed reality. This fact must be carried into the classroom in dealing with design. Unless the situation is drawn from life, it is almost impossible to create a design problem that has the true ring of authenticity.
>
> A second danger is the tendency to retreat to the security of carefully planned analysis. Real design problems have a fascinating way of injecting considerations that seem to defy the orderly analysis of our basic courses. The traditional

> design courses in most of our engineering curricula are so routinely predictable that no student can learn the challenge and excitement of the actual encounters of engineers in practice. (2, p. 4, 5)

Even though the problem comes from industry, the company engineer may "create the artificial problem." Dr. Richard L. Lowery, after five semesters of experience in teaching a course in Authentic Involvement, gives this warning:

> There is a tendency among some practicing engineers to stereotype a design project to be similar to the previous machine design course experiences. Thus, the company engineer may tend to think in terms of the machine design problem which he worked on as a senior student, and this is usually not the type of problem which is usable in this type of program. Also, it is common for the practicing engineer to underestimate the capability of some of the more enterprising senior students. (11, p. 5)

Need

The review of the literature and the interviews of experienced personnel concerning the utilization of authentic projects for learning experiences were related to University level programs within an engineering college. (12) However, the primary purpose of this study was to investigate the possibility of making effective use of such projects within an engineering technology (doing type) curriculum. It appears that such projects would be a valuable instructional process but one in which little or no information is available.

CHAPTER III

METHODS OF STUDY

Development of an Idea

Authentic projects on the Oregon Technical Institute campus came as an idea with the development of a "two-plus-two" concept in engineering technology education. In such a program, a student may complete a two-year associate degree program in engineering technology and enter industry as an engineering technician. He may choose to continue his academic studies for another two years and receive a baccalaureate degree. This two-plus-two curriculum is "up-side-down" (see Chapter I, Definition of Terms) to the traditional engineering curriculum but is obviously suited for authentic projects in the required Research and Development courses. Upon receiving the Associate in Engineering degree, the students will have completed all the technical speciality requirements for the baccalaureate degree except for four credit hours per term in Junior and Senior Research and Development Projects with the industry-sponsored research and development projects used primarily in the senior year. However, the projects from industry could be assigned to the more capable third year students. The Associate in Engineering graduates from many colleges of technology and two-year technical institutes have had sufficient laboratory experience so that as they move into industry they are almost immediately productive for their employers. They, therefore, can be expected to make profitable use of an industry supervised research and development project in their third year.

President John F. Kennedy's message on education to the eighty-eighth Congress stated:

> There is an especially urgent need for college level training of technicians to assist scientists, engineers, and doctors. Although ideally one scientist or engineer should have the backing of two or three technicians, our institutions today are not producing even one technician for each three science and engineering graduates. This shortage results in an inefficient use of professional manpower--the occupation of critically needed time and talent to perform tasks which could be performed by others--an extravagancy which cannot be tolerated when the Nation's demand for scientists, engineers, and doctors continues to grow. Failure to give attention to this matter will impede the objectives of the graduate and post-graduate training programs. (13, p. 3)

Oregon Technical Institute, in its annual bulletin, after quoting the above message from the President of the United States, makes the following statement of objectives:

> Oregon Technical Institute, the co-educational polytechnic college in the Oregon State System of Higher Education, is dedicated to meeting the needs identified above. Specifically, it has as its objectives the following:
>
> I. To provide college-level programs designed to meet the current and emerging needs of science, business and industry....
>
> II. To provide the quality of technical and applied science programs which will enable its graduates to be immediately employable and to be advanced within the occupation....
>
> IV. To develop and administer adjunct programs and activities related to the major programs of the Institute....
>
> VII. To maintain a continuing evaluation of the curricula at OTI in recognition of the rapidly changing technologies to which they relate....
>
> VIII. To maintain a program of staff improvement which reflects the necessity for staff members to keep abreast of rapidly changing technologies to which their teaching or other professional assignment relates....
>
> IX. To maintain a continuing program of research which shall include inquiry into the use of new media and other

> potential improvements in the teaching process in technical fields....
>
> X. To provide a program of continuing education to the extent such a program is seen to be necessary....
>
> The faculty and staff at Oregon Technical Institute are enthusiastically seeking to carry out these principles as established by the Board. (13, p. 3-5)

Due to its commitment to these objectives, Oregon Technical Institute was thought to be an ideal institution for testing this concept in instructional technique and was thus selected for this study.

To supply each student or even a group of students with individual problem-solving assignments with any authenticity and motivation for the student becomes a Herculean task; but, the individual problem is a vital part of a well designed curriculum in technical education. As stated by Dr. Maurice W. Roney:

> Design courses can and should incorporate individual problem-solving assignments. Instructional material for laboratory work in advanced courses should identify only the parameters of problems, shifting to the student more of the responsibility for planning, evaluating, and summarizing the work. Further than this, however, the curriculum should include specific requirements for problems which require investigating, planning, designing, and reporting functions.... In a course of this type the student should be responsible for the selection of a problem, a review of relevant published materials, and a well-organized report of the work done and the results achieved in the solution of the problem. In a very real way, the performance of students in this course can serve to evaluate both the student and the instructional program. (14, p. 8)

The Electronics Engineering Technology faculty at Oregon Technical Institute could see no other solution to this problem than to resort to contacting the research and development companies for authentic projects to provide the real-life situations.

Method of Obtaining Projects

As a preliminary survey, two faculty members visited the San Francisco Bay area in the spring of 1967. That same year two other faculty members attended a National Science Foundation sponsored Summer Institute at Oklahoma State University on Teaching Authentic Design Engineering. Dr. Lee Harrisburger, Dr. Richard Lowery, and other faculty members of Oaklahoma State University with a working knowledge of authentic projects were interviewed to obtain all the information possible. They were questioned concerning their experiences in their ME4F3, Engineering Design II courses, and the methods used in obtaining and utilizing industry originated and sponsored research and development projects.

Returning to the Oregon Technical Institute campus for the fall term, 1967, the two faculty members from the Summer Institute approached the administration with the idea of industry-sponsored research and development projects on campus and the need for patent and proprietary agreements between the student(s) and the company, and the college and the company. The idea was received very enthusiastically by the administration and work on the agreements was begun. These agreements (Appendix A) were developed by the attorney for the State System of Higher Education, the college administration, and the company planning to sponsor a research and development project on campus.

Company personnel recruiters were interviewed as they arrived on campus and the need for a descriptive brochure became very evident. Such a brochure had been recommended by Dr. Lowery. A brochure was developed in the summer of 1968 and was finally approved and printed during the winter term of 1969. (Appendix B) The time lag is indicated to show developmental processes within a large state system.

During the week of Spring Break, 1969, personal visits and telephone calls were made in the San Francisco Bay area to follow-up an earlier letter-brochure mailing. (Appendix C) In addition a four-day field trip to the Portland, Oregon area was used to make company contacts by personal visits and as follow-up of an earlier letter-brochure mailing.

Faculty-Student Orientation

Two company conducted research and development seminars were held on campus during the 1968-1969 academic year. These seminars were used for faculty and student orientation to possible projects on campus, and to the nature of the projects. The seminars included the following outline for discussion:

1. Organization within the company.
   The relationship of research and development to engineering and production.

2. Research problem definition.
   How the problems are originated and the source of research and development topics within the company.

3. Organizing, planning, scheduling and budgeting of the research and development.

4. The philosophy of research for production.
   A typical research effort was described with emphasis on data collection from production environment.

5. The results of research.
   The methods for disseminating and implementing improvement into production.

Ideas for Utilization

The most profitable source of information on the utilization of authentic projects on campus was the National Science Foundation Summer Institute on Teaching Authentic Involvement in Engineering Design at

Oklahoma State University, 1967. The faculty members from engineering schools across the country actually experienced the student's position as a design engineer working on an industry design problem on the university campus. Five different companies presented problems on the opening day of the Institute with four-man teams assigned to each problem. Daily "brainstorming" (idea exchange) meetings were held with all five teams involved.

Guest lecturers and seminars were used effectively in helping the student to recognize more than just the technological design problems. The seminar, "Creativity, the psychology of creative people, the politics of groups, and related areas" by Dr. J. H. McPherson, psychologist, Dow Chemical Company, (11, p. 16) presented the thinking of creative people and how an idea could become a usable item. Professor Jay Doblin, head of the Institute of Design, Illinois Institute of Technology and Vice President of Unimark, Inc., "was concerned with the humanistic side of design and engineering, although he spent some time explaining psychological factors in design such as symbolism, utility, and aesthetics." (11, p. 16) On the negative side of humanistic design was Dr. Charles Mischke, Professor of Mechanical Engineering, Iowa State University with a seminar on "computer aided design." (11, p. 16)

In addition to the guest lecturers, several other specialists conducted seminars at the Summer Institute, including a patent attorney, a consulting engineer, and faculty members in such specialties as computer graphics, fluidics, and computerized design.

Method of Utilization

Oregon Technical Institute's facilities will be used for the research and development work, because its four year engineering technology curriculums, which are actually up-side-down, appeared to be an advantageous factor. The differing complexity of the project problems that could be available requires a supply of students on different term levels. The two-plus-two up-side-down curriculum, with two, three and four year degrees available, provides that broad range of term levels.

To determine the assignment of projects to students in the appropriate term level, a personal visit by a company representative was considered necessary. The representative then becomes acquainted with the college's available equipment and facilities and with the competency of the faculty as consultants to the student(s). Any industrial firm indicating an interest in sponsoring a research and development project on campus was invited to visit the campus to present the problem for research. The decision concerning the complexity of the problem and the academic level of application within the technology was made during the company representative's stay on campus. The faculty members involved, the company representative(s), and the interested students determined the student(s) to be assigned to the project. The student then acted as an employee of the company, responsible to the appointed company supervisor, but working in relevant academic surroundings with a competent faculty, a research library, evaluation equipment, and computer facilities.

CHAPTER IV

RESULTS AND ANALYSIS OF STUDY

An effective method of obtaining names, titles, addresses, and telephone numbers for contacts within the companies that might sponsor projects was by personal interviews with personnel recruiters as they came on campus. The brochure and the model agreements were needed for an effective presentation at the interviews. Forty-three electronics oriented research and development firms in the San Francisco Bay area were contacted by letter-brochure (Appendix B, C) with a follow-up either by telephone or by personal visit. For the personal visit, especially, and for most effectiveness from the letter-brochure mailing, a name of one particular person within the company was needed. The Portland, Oregon area was surveyed in the same manner. Five days in the San Francisco Bay area and three days in the Portland area was insufficient time for personal visits to all interested firms or even for making telephone calls to all companies to which brochures had been mailed.

As a result of the letter-brochure mailing, however, one company in the San Francisco Bay area telephoned immediately on receipt of the letter requesting a visit for further explanation. Representatives from this company visited the campus, hired two students for summer and two graduates for full-time employment. The company is now sponsoring seven projects. Two electronic projects and one mechanical project were also obtained by the Bay area and Portland visits. Several companies are looking seriously at their manpower needs and the availability of an engineer to supervise an on-campus research and development project. The numerical tabulation of mailings, telephone calls, personal visits, and number and types of responses is shown in Table I. (15 through 27)

TABLE I

NUMERICAL TABULATION OF CONTACT METHODS AND TYPES OF RESPONSES

CONTACT METHOD	IN PROCESS			PROMISED			POSSIBLES			FOLLOW-UP			FUTURE			DEAD			**
	L	M	S	L	M	S	L	M	S	L	M	S	L	M	S	L	M	S	
LETTER		1	1	3			4		1	5		26	2		1		2	4	50
PHONE		1	1	2			3		1	5	1	9			1		1	1	26
RECRUITER	1			1			4	1		9	5		3			1			25
PERSONAL VISIT	1	1	1	3			3			4		3	2				1		19
COMPANY ON CAMPUS	1		1			1	1		1										5
TOTAL* COMPANIES		3			3			8			43			12			7		76

*Several contact methods per company **Total company contacts per method

L = Larger companies, over 1,000 employees
M = Medium companies, 100 to 1,000 employees
S = Small companies, less than 100 employees
In Process = Companies with projects in the developmental stage to be brought on campus this fall for students in the Research and Development course (1969)
Promised = Companies with promised projects for this fall term but not yet assigned or identified specifically (1969)
Possibles = Companies seriously looking for developmental ideas for which they can write the specifications for assignment to students on campus
Follow-up = Companies with which some initial contact has been made but no specific answer has been received
Future = Companies which have encouraged a future contact but which are still in organizational throes, or which can see no application at present, or which appear to be good contacts for the future
Dead = Companies with which no further contact would be of any value (no research and development, defunct, moving, too remote a location from Oregon Technical Institute), or companies which could not be located in the telephone book or at the street address given.

From the tabulated data and from experience with the telephone conversations and personal interviews, some interpretations seem justified:

(1) The "In Process" and "Promised" columns indicate the time lag in the larger companies between first contact and actual company involvement on campus. Experience has indicated that the smaller the company the quicker the action on implementing on-campus projects. The large company with a project in process involved over a year of development work before the project was started on campus in the fall of 1968. In contrast the one small company has seven projects progressing very rapidly since the first contact five months ago. Progress is being made with the medium sized company with two projects for the fall term 1969 but the organizational process is much slower. Four larger companies have promised at least one or more projects for the fall term, but it appears now that the assignments cannot be made until well into the fall term with work commencing even later. All initial contacts were made within a period of less than a month.

An interesting contact was made with Oregon Technical Products, a subsidiary of Textron Incorporated, when the company's program manager made a personal visit to the campus. He called to make an appointment to visit the campus and talk over the possibilities of sponsoring one or more projects. He has promised to write specifications for at least one on-campus project. The program manager had been instructed to contact Oregon Technical Institute as a result of an earlier visit by an Oregon Technical Institute faculty member to a subsidiary of Textron in the San Francisco Bay area.

(2) The "Possibles" are predominantly in the larger company area, once again indicating the slower action of larger companies. Personal

visits are almost a necessity to route properly the information to the person within the company who will be able to be the most effective in obtaining industry involvement on campus. Where a personal visit was made these companies indicated an interest but needed time to find the manpower to write the project specifications and supervise the project while on campus. The need for a personal visit is further indicated in the "Follow-up" column.

(3) In the "Follow-up" column not many personal visits are indicated but this is the follow-up that is needed. The four personal visits with the extremely large companies produced interviews with men who were too far removed from the research and development areas of the companies to be of any help in obtaining projects except to introduce the interviewer to someone in a position of providing a project. These interviews took a full half day and were profitable in company-college relations but not in obtaining projects. The twenty-six small companies contacted by letter would probably give a negative or affirmative answer with a personal contact by telephone or visit.

(4) The "Future" column is made up of those companies which are interested but not ready to make a decision at this time. One small company was placed in this column even though it was not interested in talking further. The company representative said they had had a "sad experience" with one of the larger engineering colleges in an on-campus project and the company was not prepared to go through another such experience. It was placed in the future column for contact after Oregon Technical Institute was able to offer some successful examples. Four companies in this column show no contacts but have been recommended by factory representatives for future contact.

(5) Those companies listed in the "Dead" column need no further contact because it would be a waste of time to pursue them further in any way. One of these companies was not interested even though it could, no doubt, provide research projects that required highly specialized test equipment in the microwave areas. Another company felt it should help Bay area schools before going to a distant school like Oregon Technical Institute. An Oregon paper mill (a typical Union Shop type of operation) was interested only in hiring electricians and wanted to leave the research and development to other companies. One company was moving to San Diego, two were out of business, and one could not be located.

Analysis of Industry Responses

Thirty-four out of the seventy-six companies shown in Table I have been contacted by a telephone call or a personal visit so their response is known. Forty-two or fifty-five percent of the companies have not been contacted other than by letter or with the company recruiter and, therefore, have not given any specific answer to whether they are interested in sponsoring a project on the Oregon Technical Institute campus. These companies will be contacted as time becomes available. Using only the thirty-four companies that have given answers as to their interest, the following is an analysis of Table I:

A. Eleven on-campus projects are in process with at least four more promised, for a total of fifteen projects from the thirty-four companies contacted. These fifteen projects, representing six (6/34 = 0.18 or 18%) of the companies, were provided as a result of the initial personal contact. However, the six companies provided fifteen projects, increasing the ratio of projects to initial company contacts to .44 (15/34 = .44 or a percentage of 44%). This encouraging percentage indicates the number of projects which are available for on-campus research and development.

B. Another eight companies have indicated an interest, and are taking a serious look at their manpower availability for supervising an on-campus project. Twenty-four percent (8/34 = 0.235) of the companies find the proposal of sufficient merit to warrant further investigation.

C. Fifteen of the forty-three companies in the "Follow-up" column have been contacted by telephone and/or visits and have shown sufficient interest to make further contact of possible value. Forty-four percent (15/34 = 0.44) of the companies having a personal contact are interested but need more time to evaluate the possibilities for their companies.

D. The three companies having personal contacts in the "Future" column, nine percent (3/34 = .09) of the companies, are interested but not ready to take positive action at this time.

E. Two companies or only six percent (2/34 = .06) of those companies in a position of furnishing on-campus projects gave a "no" answer.

The above percentages would indicate that there are authentic projects available to the technical institute and college of technology. Industry can be interested in providing authentic, unsolved problems for on-campus research. Finally, the "how to obtain" question has been at least partially answered.

One of the more significant aspects of the personal interviews with company engineers was the availability of project possibilities. Almost unanimously they agreed that there were ideas and/or problems available. Engineers or physicists in the smaller companies were, in many cases, the president or manager of the company; and in this position they could implement their ideas when manpower was provided by an organization such as Oregon Technical Institute. Since authentic projects on the college campus were a partial answer to their manpower needs, the smaller companies appear to be the primary source of authentic projects. The larger companies, however, have the engineers with the ideas for research and development projects but are not as free to develop specifications for presentation to the student on a college campus. Within the larger companies the engineering time was not available for supervision of an on-campus project. However, the larger company vice-presidents or engineering managers promised to consider seriously the possibilities. As rapport is developed more projects will become available from the larger companies which appear to be not only a more steady source of projects but also financially able to supply test equipment to the college. (16, 17, 19, 24, 27)

Another factor that should not be overlooked, in the faculty-company interviews and on-campus project contributors, was the development of good public relations. One of the largest world-wide construction companies was just developing a technician classification within its organization. The two faculty members, in their visit to this large company, were able to establish excellent placement possibilities for both the two year and four year engineering technology graduates. (27) Those company engineers visiting the Oregon Technical Institute campus were most favorably impressed with the faculty, facilities, and equipment available for research and development projects. These visits were also a real assistance in locating future employment possibilities with the company for the Oregon Technical Institute graduates.

Utilization Results

Oregon Technical Institute was obviously suited for the utilization of industry-sponsored research and development projects for the student on campus with its two, three and four year degree programs. The authentic projects are utilized in the Research and Development Projects courses required in the third and fourth years (24 credits). When the company indicated an interest in sponsoring a project, the company engineering representative was invited on campus, at his expense, to present the problem to the students in the Research and Development courses.

After faculty, student, and company discussion, the student(s) interested were assigned to the project. From that time on the student(s) were working for the company with the faculty member acting only as an advisor. The student(s) do their own organizing, planning of procedure, research, development, gathering of scientific data, making decisions, drawing conclusions, and writing a formal report. The faculty is used for consultation as needed and close liaison is maintained with the company engineering supervisor. As stated in the agreement with the company, the company accepts at least one collect telephone call a week from the student(s).

A documented log book is kept by the student in the form required by the company and faculty advisor. Mid-term and end-of-the-term typed reports are required by the faculty advisor. Periodic oral reports to the class and interested faculty are given within the limits of the proprietary information agreement.

At the conclusion of the project the students prepare a formal written report for the company. Also they are taken to the company, at the company expense, for an oral presentation of the results of their research and a discussion of their written report and log books. The sponsoring company agrees to reimburse the college for expenditures directly attributable to the project and essential to its accomplishment, such as duplicating services and film, and to make available specialized test equipment or components as required for the project.

The use of seminars, specialists on the faculty, visiting industry specialists, and guest speakers has proven valuable. Oral progress reports and student conducted seminars are used effectively with periodic "brainstorming" sessions.

Two seminars, one by Boeing of Seattle, Washington, representing a large company, and the other by Cintra of Mountain View, California (40 employees), representing a small company, helped increase the enthusiasm of the faculty for industry involved projects and brought staff comments favoring more such seminars. These seminars were also used effectively in the utilization of authentic projects.

One problem appeared; no company supervision was given to the design engineering student while the engineering technology student would require more company engineering staff involvement and supervision. This increased the challenge of the study but has slowed the process of obtaining authentic projects.

An Ideal Project

One project, as of this writing, has been on campus for the last academic year. The design critique from the company on the original design by the students states briefly: This design is good, and it is probably the most economical system that could be designed today using standard procedures and components and still meet specifications, but it costs too much (only $200.00 under the lowest $800.00 similar unit now on the market); it should now be redesigned using new concepts to reduce costs. The students redesigned with the following results:

> (1) There are at least three, probably more, ideas that are worthy of patent search, (2) the students are to provide (the company) with working drawings of their design so that over the summer (the company) can build the components needed to test the design, (3) (the company) will attempt to supply test equipment to run a full test program next year (fall, 1969)--about $40,000.00 worth.... There are branching ideas that have come up that could lead to new projects.... (28, p. 1, 2)

The supervising professor reported:

> The authentic involvement method of teaching design seems to be working very well. The students are motivated far more than ever before. They are learning how to learn on their own thru independent study and research and finding it can be a very rewarding experience. (28, p. 2)

To reinforce the supervising professor's statements, the two company supervisors stated repeatedly,

> that the students knew more about (their research and development project design) than eighty percent of the engineers at (the company) with twenty years of experience. They are also learning to work with each other and with others thru letters, telephone calls, etc., experiences they would never have had in conventional design projects. (28, p. 2)

New Projects and Developments

The ten projects being developed for the beginning of fall term, 1969, were obtained (as indicated in Chapter II) through letter-brochure contacts, personal visits to the companies at their request, and then their visit to campus. Instead of the students choosing the projects the three staff members involved with the students in earlier laboratory courses--so they knew their capabilities--chose four students to participate. These four students worked at two companies as engineering technicians through the summer months and brought the problems on campus this fall for research and development. Both companies requested this method of orienting the students to the problem so they could more intelligently develop a solution.

A recent visit with the president of the small company sponsoring seven of the above projects indicated the practicality of the two-year graduate's readiness to utilize an authentic project on campus. As company president and head of research and development for the company he was well pleased with the work done by the students during the summer and was confident the on-campus projects would prove valuable to the company. He gave a "100% endorsement of the plan." (29)

Of further advantage to the student is the fact that he receives four credit hours for his summer's work by enrolling in a projects class. The school requires that he send his supervising professor a weekly report, a midsummer summary report, and a final report for which he receives a grade. These reports not only earn the student credits but they also prove to be a valuable help to the instructional staff in seeing the needs of the graduate for job entry and updating instructional material.

As a final analysis of the results of a year's concentrated study of authentic projects, it appears that the time for the initial contacts with the companies should be in early September in preparation for projects to be brought on campus a year later at the beginning of the school year. The students should be assigned to the company before the end of the spring term so that they can develop the problem during the summer and be prepared for immediate research as they return to campus in the fall. The time from February on, for most electronic and electronic related firms, is devoted to preparing for the IEEE Show in New York, new consumer models, conventions, and the WESCON show in August. Since the engineering personnel are heavily involved during this time, contacts and follow-up by personal interviews need to be made prior to the first of February to be most effective. For the larger companies the time involved between initial contact and project implementation on campus is much greater; a year or more is indicated from Table I.

Sufficient information has been obtained to justify the continuation of authentic projects on the Oregon Technical Institute campus and from this presentation to aid other technical institutes and colleges of technology.

CHAPTER V

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

The purpose of this study was to investigate the availability of industry-sponsored research and development projects for students on the Oregon Technical Institute campus and if available to determine how they can be used within an Electronics Engineering Technology curriculum. Since several engineering colleges have been involved in this type of design problems, their experiences were used as examples to implement such projects on the Oregon Technical Institute campus. Very little information was available on how to obtain authentic projects from industry, thereby further justifying this study to meet a need for authentic, unsolved problems for research and development within an Engineering Technology curriculum. What are the factors involved in obtaining and utilizing authentic projects within an engineering technology learning process? For this study a descriptive brochure, "Technology Projects," was designed and printed, patent and proprietary agreements were developed, and letters of introduction were composed.

From a list of seventy-six companies, seventy-two have been contacted in some manner--letter-brochure, personnel recruiter, telephone call, or personal visit. Of these seventy-two, thirty-four have been contacted personally by telephone or visit to the company. Only two companies (6%) out of the thirty-four have indicated no interest in authentic projects. Although projects from the larger companies are slower in materializing, these projects which were promised by the larger companies are included in this year's study and increases the number to fifteen projects from six companies. In other words, eighteen percent of the thirty-four companies have made projects available with the initial personal contact. Another eight companies (24%) are taking a "serious look" at their manpower availabilities for supervising on-campus projects. Fifteen companies (44%) have indicated an interest but want more time to evaluate. And three companies have indicated they might be interested in the future. All companies indicated there were ideas and/or problems available so the source is unlimited. However, the obtaining of such projects is limited by lack of travel funds and time for the company-faculty interviews, by company problems in creating interest among their engineers to supervise a project on campus, and by the time and effort necessary for the company engineers to write specifications for the problem.

Findings

Three questions were asked in the Statement of the Problem. First, "Are authentic projects available and in what ways can they be obtained?" Second, "How can industry be interested in providing authentic, unsolved problems for on-campus research and possible solutions?" Third, "If such problems are available, what are some of the advantages and the procedures necessary for making the most efficient use of such projects?"

In answer to the first question, this study indicates there are authentic projects available and the method used was effective in obtaining projects for on-campus research and development. A descriptive brochure of authentic projects was used as well as patent and proprietary agreements. Personal visits to the companies were required for all projects obtained to route the information to personnel within the company who would be directly involved with the projects and to determine the interest of the company in sponsoring authentic on-campus projects. The brochure was more effective if made available to interested personnel prior to a personal visit.

The second question was answered by the method used in this study but a further study may indicate more effective methods of interesting companies in providing authentic, unsolved problems for on-campus research and possible solution. The need now is for several successfully completed projects to use as examples for the questioning companies.

Since problems are available, the answer to the first part of question three gives the following advantages:

(1) For the student

- (a) improved motivation
- (b) increased learning effectiveness through real learning situations
- (c) experiencing of real life parameters--pressures of need and time, test equipment needs, material costs and availability, manufacturing processes
- (d) experiencing administrative research procedures
- (e) improved verbal and written communication through application under working conditions
- (f) learning teamwork
- (g) aided in choosing their position of employment on graduation
- (h) for some, prior to graduation work experiences adding maturity to their continued learning process

(2) For the company

- (a) technician manpower for research and development
- (b) faculty consultation
- (c) technician recruiting advantages

(3) For the college

- (a) improved relevancy of instruction
- (b) company specialists on campus for seminars or guest lectures
- (c) improved company-college relations
- (d) improved student placement
- (e) specialized test equipment made available to the college

Two methods could be used in answer to the last part of question three; if no course existed for the application of authentic projects it would have to be implemented within the curriculum. For this study Oregon Technical Institute used its junior and senior Research and Development Projects courses required for all engineering technology baccalaureate degree graduates. The industry-sponsored authentic projects were the fulfillment of a need in these courses and for this study provided the procedures for the utilization of authentic projects.

Conclusions

Industry-sponsored authentic projects are available for on-campus research and development. The brochure "Technology Projects" appears to be the most effective presentation to the companies, whether by letter or in personal interviews, or with the on-campus recruiters. Personal visits to the companies are necessary but should be planned to avoid conflict with annual conventions, industry shows, and new model introductions. For greater effectiveness the company engineering supervisor for the project should visit the campus so he is familiar with the facilities available. A campus project coordinator and a research committee representing all areas of instruction are also desirable to provide organization of effort in all curricula on campus and assurance of continuation of the program.

The advantages of authentic projects are sufficient to warrant the development of courses within a curriculum to utilize such projects; the instructional staff and students will find a challenging and effective teaching and learning process.

This study did not include the application of authentic projects on campus to the last term of the two year curriculum, but it is anticipated that these projects could be used effectively. The faculty involved with the second year students would have to be selective in the students chosen to participate in such projects. Using a laboratory projects course which meets ten clock hours per week and is required in the 6th term of the curriculum, the authentic project could be used if it became available. The problem appears to be that of obtaining projects that could be completed in one term.

Recommendations

Several companies lacked interest in sponsoring any type of on-campus projects due to "sad experiences" with previous college-company relationships. A continuing study needs to be made of the effectiveness of on-campus authentic projects in providing technical research manpower, recruiting advantages, faculty consultation advantages, and actual problem solutions of value to the company.

The limited experience in the utilization of projects on campus indicates that a further study of the advantages claimed for the student should be made. Since not all graduates will have the advantage of authentic on-campus projects, a study of the graduates as they enter industry and as they progress in industry would be of real value in any evaluation of the effectiveness of these projects. There may be better procedures indicated by such a study.

The present study should be continued to include the additional forty-two companies with which no personal contact has been made and from this a more accurate evaluation could be obtained. The spin-off from this study has indicated there are other disciplines than electronics technology for which projects are available and the possibilities should be investigated. There are many other areas of the United States in which research and development work is being conducted and where further studies could be made. Further studies and the utilization of on-campus authentic projects could prove profitable to other technical institutes and colleges of technology.

A SELECTED BIBLIOGRAPHY

(1) Benner, Russell E. "The Master of Science Degree Program in Mechanical Engineering Design at Lehigh University." Proceedings of the Fourth National Conference on Engineering Design and Design Education, 1967.

(2) Hall, Newman A. "The Workshop Program in Retrospect." Proceedings of the Fourth National Conference on Engineering Design and Design Education, 1967.

(3) Lowery, Richard L. "Authentic Involvement: A Vehicle for Teaching Creative Design." Proceedings of the Fourth National Conference on Engineering Design and Design Education, 1967.

(4) Institute for the Certification of Engineering Technicians. The Certification of Engineering Technicians, National Society of Professional Engineers Publication No. 2601, 1967.

(5) American Society for Engineering Education. Characteristics of Excellence in Engineering Education, Final Report of the Evaluation of Technical Institute Education, James L. McGraw, project director, Urbana, Illinois, 1962.

(6) Williams, Lloyd P. "The Struggle for Balance--Vocational Education in the Western World." Phi Delta Kappan, XLVI, #8, April, 1965, p. 355.

(7) Venn, Grant. Man Education and Work, Post Secondary Vocational and Technical Education, Washington, D. C., 1964.

(8) Pardo, V. A. Letter to Oregon Technical Institute, April 22, 1969.

(9) Proceedings: Fourth National Conference on Engineering Design and Design Education, July 17-18, 1967, Thayer School of Engineering, Dartmouth College, Hanover, New Hampshire, 1967.

(10) Fryling, Glenn R. "Innovations in Boiler Design in Historical Perspective--Some Implications for Undergraduate Engineering Education." Proceedings of the Fourth National Conference on Engineering Design and Design Education, 1967.

(11) Lowery, Richard L. "The Summer Design Workshop at Oklahoma State University." Proceedings of the Fourth National Conference on Engineering Design and Design Education, 1967.

(12) Lowery, Richard L. Personal Interviews, Summer 1967, Summer 1968.

(13) Bulletin of Oregon Technical Institute, 1969-1970 Catalog, Oregon State System of Higher Education. Eugene, Oregon.

(14) Roney, Maurice W. "Curriculum Design in Technical Education." Hand-out sheet in Tech Ed 423, Program Planning in Technical Education, Fall Semester, Oklahoma State University, 1965.

(15) Johnson, Ronald A. Personal Visit, January 24, 1969.

(16) Dzugan, Walter and Clifford Skoog. Personal Interview, March 4, 1969 and March 25, 1969.

(17) Ammendolia, G. Joe, William H. Appleton, Gordon T. Longerbeam, John M. Muldoon, Charles F. Miller, Howard G. Patton, Maurice Zaslawsky. Personal Interviews, March 25, 1969.

(18) Muray, Julius J., Irwin Wunderman, John Haynes. Personal Interviews, March 26, 1969.

(19) Young, John. Personal Interview, March 27, 1969.

(20) Renton, William L. Personal Interview, April 3, 1969.

(21) Johnston, George. Personal Interview, April 15, 1969.

(22) Rockwood, Lawrence, Dale Lockhart, A. Grossenbacher, Frank Hovanic, Jack Henderson. Personal Interviews, April 16, 1969.

(23) Stevens, Kenneth E., Evans Davis, Mr. Goodwin, Joe T. Lienert. Personal Interview, April 17, 1969.

(24) Collier, Warren, and Jack Millay. Personal Interview, April 18, 1969.

(25) Richardson, George E., and John Haynes. Personal Interview, May 27, 1969.

(26) Webber, Melvin M. Personal Interview, June 4, 1969.

(27) Rush, David R., H. J. Glenn, V. A. Pardo, Clyde Mitchell. Personal Interview, March 26, 1969.

(28) Culver, G. Gene. Interim Report: (Name of Company, Type of) Project, (Confidential Information, not for publication) as sent to Dr. Purvine, President of Oregon Technical Institute, April 1, 1969.

(29) Wunderman, Irwin. Personal Interview, August 23, 1969.

APPENDIX A

OREGON STATE BOARD OF HIGHER EDUCATION

OREGON TECHNICAL INSTITUTE

PROJECT AGREEMENT

This agreement, dated as of , 19 , between the OREGON STATE BOARD OF HIGHER EDUCATION, on behalf of OREGON TECHNICAL INSTITUTE, hereinafter referred to as the INSTITUTE, and , hereinafter referred to as COMPANY, is intended to provide students with research and development projects in connection with course work as described in the current INSTITUTE catalog.

The agreement is to enable industry to participate with the INSTITUTE in the development of projects that will be relevant for both industry and student participants. The projects are to qualify as junior and senior research and development projects that will provide educational experience for students pursuing a baccalaureate degree. The following items constitute the agreement:

1. COMPANY will send its designated project leader to INSTITUTE to present a project problem to the student(s) assigned to the project.
2. Student(s) assigned to work on the problem and to endeavor to solve the problem will function <u>freely</u> and work <u>independently</u> under the direction of the INSTITUTE faculty member in charge. A written report will be submitted to COMPANY'S project leader by the student(s) prior to the end of each school term or earlier should a report be required by COMPANY. Upon completion of the project the student(s) will prepare a written and an oral report for COMPANY'S project leader. The project will involve approximately 125 clock hours per student per term.
3. It is mutually understood and agreed that no principal-agent, employer-employe, master-servant or other relationship exists between the parties, nor between the participating student(s) and the INSTITUTE, by virtue of this agreement other than as explicitly set forth herein.

4. The COMPANY will advise INSTITUTE in writing of proprietary information disclosures which it intends to make to faculty of the INSTITUTE. The INSTITUTE shall then exercise reasonable care in protecting said proprietary information, both during the term of this agreement and thereafter.
5. The student(s) will prepare a formal presentation with visual aids, such as slides, charts and/or drawings for presentation to the COMPANY at the end of the term. The COMPANY agrees to provide transportation for earlier plant visits in the event it is mutually agreeable between it and the student(s) that such a visit will be of value to the student effort.
6. COMPANY agrees to reimburse INSTITUTE for the modest costs of long distance telephone calls, postage, reproduced copies of the report, slides, and supplies which may be used in the completion of the project; either during the term of the contract or thereafter. These costs will be controlled by the supervising faculty member involved in leading the project. Neither the COMPANY or the INSTITUTE will be obligated in any way to supply equipment either on a loan or donated basis to complete the development project. Overhead costs such as faculty salaries, heat, lights, water, gas, etc., will be borne by the INSTITUTE.
7. This agreement shall extend for five years from the effective date hereof. This agreement shall terminate at the conclusion of the project if only one in number, or at the comclusion of all of the projects if there were more than one. The agreement may also be terminated at any time on a mutually satisfactory basis; also either party may cancel the agreement by giving thirty day's advance notice in writing to the other party.

-3-

This document sets forth the entire agreement between the parties as to the subject matter of this agreement and merges all prior discussions between them.

STATE OF OREGON ACTING BY AND THROUGH
THE STATE BOARD OF HIGHER EDUCATION
ON BEHALF OF OREGON TECHNICAL INSTITUTE

BY______________________	BY______________________ H. A. Bork, Vice Chancellor for Business Affairs
BY______________________	BY______________________ R. L. Collins, Secretary
DATE______________________	DATE______________________

OREGON TECHNICAL INSTITUTE

STUDENT PROJECT AGREEMENT

The purpose of this agreement is to enable Oregon Technical Institute to assign meaningful junior and senior projects to students pursuing a baccalaureate degree. Current industrial problems assigned through this project are beneficial to industry, students and faculty. The agreement endeavors to provide all parties with maximum flexibility in pursuing a project and to protect all parties to the agreement. Students participating in the project are working toward a degree and will be receiving credit and a grade should they perform acceptably to the supervising faculty member. The fact that a student's efforts may or may not result in a patentable item will not determine his grade. All parties should bear in mind that the student is a student first and then a participant in a project leading to a conclusion, hopefully useful in industry.

The following items constitute the terms of the agreement between the student(s) and the company.

1. ______________________ will send its designated project leader to Oregon Technical Institute to present a project problem to the student(s) signing this agreement.
2. Student(s) assigned to work on the problem and to endeavor to solve the problem will function <u>freely</u> and work <u>independently</u> under the direction of a faculty member in charge. A written report will be submitted to ______________________'s project leader by the student(s) prior to the end of each school term or earlier should a report be required by ________________. Upon completion of the project the student(s) will prepare a written and an oral report for ____________________'s project leader. The project will involve approximately 125 clock hours per student per term.

3. It is mutually understood and agreed that no principle-agent, employer-employe, master-servant or other relationship exists between the parties hereto by virtue of this agreement other than as explicitly set forth herein.
4. Participating student(s) will take reasonable care to protect proprietary information supplied by ____________________.
5. The student(s) assign inventions arising out of the project and gives ____________________ a royalty free license to make, use and sell anything communicated to ____________________ in connection with the project, except where the student actually reduced an invention to practice prior to the project and identified the invention for ____________________ at the time it was communicated to the company. The student(s) agree(s) to assign to ____________________, its successors and assigns his (their) entire right, title and interest in all inventions arising out of the project problem and all applications for letter patents thereon which may be filed. The student(s) also agree(s) at ____________________'s request, that he (they) will, without further consideration, apply for letters patent for any or all of such inventions in all countries desired by ____________________, but at the expense of ____________________, and will sign any and all papers, take all lawful oaths and do all lawful acts required on or concerning such application and/or divisions, continuations or re-issues thereof.
6. ____________________ agrees that in the event the student(s) develop(s) an invention during the course of solving the problem relating to the problem, upon which a patent application is filed, to pay to the

Oregon Technical Institute Development Fund the amount of $__________ at such time as each application is filed and an additional $__________ for each patent as may issue from each such application.

7. If an invention is made, the student(s) will not, during or after the agreement, publish or discuss without __________________'s written consent any information concerning the invention or improvements, or proprietary information he obtains from ______________________.

8. ____________________________is free to discuss all information supplied to it by the student(s) and to use such information in any way not prevented by valid patents or inventions which did not arise out of the project.

9. ___________________ agrees to accept at least one collect call from the student(s) each week.

10. ___________________________ agrees to provide transportation for the student(s) working on the project to visit ________________________'s plant at the end of the term to present a formal oral report of his (their) work on the project problem to _______ __________'s personnel. The company also agrees to provide transportation for earlier plant visits in the event it is mutually agreeable between ______________________ and the student(s) that such a visit will be of value to the student effort.

11. The student(s) will prepare a formal presentation with visual aids, such as slides, charts and/or drawings.

12. It is mutually agreed that this agreement shall terminate at the conclusion of the project or when mutually agreed upon by the ______________________ company and the supervising faculty member signing this agreement with the exception of the terms set forth in paragraphs 5, 6, 7, and 8. It is mutually

agreed that either party may cancel the agreement without forfeit, with notice in writing, to the other party in thirty (30) days, upon receipt of said notice.

This document sets forth the entire agreement and understanding between the parties as to the subject matter of this Agreement and merges all prior discussions between them, and none of the parties shall be bound by any conditions, definitions, warranties or representations with respect to the subject matter of this Agreement, or as duly set forth on or subsequent to the date hereof in writing and signed by an authorized person, or of officer, of the party to be bound thereby.

FOR OREGON TECHNICAL INSTITUTE

Accepted and agreed to this ___________ day of ____________________

Oregon Technical Institute

By____, Supervising Faculty Member.

________________________________Student ________________________________,Student

________________________________Student ________________________________,Student

________________________________Student ________________________________,Student

________________________________Student ________________________________,Student

FOR THE COMPANY

Accepted and agreed to this _______________ day of __________________________

By____

APPENDIX B

OBJECTIVE:

The purpose of this brochure is to interest:

- Industrial Firms
- Research and/or Development Organizations
- Educational Institutions
- Governmental Agencies (Federal-State-Local) in providing research or development projects for students at Oregon Technical Institute—the solving of which will be mutually beneficial to the sponsor, the student, and the college.

ADVANTAGES TO THE SPONSOR:

1. A potential for having a development or modification accomplished or a problem solved.
2. An unusual opportunity for pre-recruitment selection.
3. Students who have had project experiences become productive at a faster rate in subsequent employment situations.

ADVANTAGES TO THE STUDENT:

1. An opportunity to develop initiative, ingenuity, and educational experiences in solving a real and useful problem.
2. An opportunity to work in association with professional specialists from technological fields prior to the actual employment situation.
3. Project experiences develop self confidence and good employment attitudes.

ADVANTAGES TO THE COLLEGE:

1. An opportunity to keep the educational programs of the college abreast of recent technological advancements.
2. An opportunity to increase the effectiveness of on-campus programs through the involvement of scientists, engineers, and other persons from the professions.

THE "PROJECTS" IDEA:

1. Students—especially during the junior and senior years—enroll in "projects" classes intended to provide research, development, and problem solving experiences.
2. Authentic industry-sponsored projects are more meaningful and challenging to students than simulated projects.
3. Projects are selected which demand student participation from original planning through culmination.
4. Gathering of scientific data—or other appropriate research—is involved in project organization and development.
5. The student tends to become highly motivated when the sponsoring organization has a keen interest in the outcome of the project. (The professional person representing the organization is primarily responsible for judging the success of the project.)

PROJECTS:

A suitable project may be:

- The development of a new instrument
- The accomplishment of a modification of an existing system or process
- The solving of any specified problem in an area of a technology
- The exploration of existing patents for marketable products.

SPONSOR PARTICIPATION:

The sponsoring organization agrees to:
Send a representative to the Klamath Falls campus to discuss the proposed problem with the projects class and the appropriate faculty member.
Accept authorized collect telephone calls from the college as necessary while work is being done on the project.

Reimburse the college for expenditures directly attributable to the project and essential to its accomplishment.

Make available specialized test equipment or components as required for the project.

Assign a project monitor who is knowledgeable concerning the problem, and who will supply technical advice.

Facilitate transportation for the student(s) to the location of the sponsoring organization at the end of the project for personal presentation of the final report.

STUDENT PARTICIPATION:

The student agrees to:

Spend a minimum of one hundred twenty-five hours per term on the project.

Keep detailed, dated log books.

Submit written progress reports as required by the sponsor, faculty member, or both.

Prepare a detailed, written, final report.

Support the written report with an oral presention to the sponsor when the project is terminated.

PATENTS & PROPRIETARY INFORMATION

Oregon Technical Institute, its faculty, and participating students, agree to exercise all reasonable care in protecting proprietary information supplied by a sponsor.

A patent arising from the investigations of a student will be signed over to the appropriate company at the request of an authorized officer.

Personnel at the college are concerned primarily with the timeliness and importance of the problems.

ADDITIONAL INFORMATION:

If your organization is interested in participating in this program, write to:

William P. Grimes, Projects Director
Oregon Technical Institute
Klamath Falls, Oregon 97601

Phone: 503-832-6321

Published by the Oregon State System of Higher Education

OREGON TECHNICAL INSTITUTE:

Oregon Technical Institute is the Coeducational Polytechnic College in Oregon's State System of Higher Education.

Oregon Tech moved in 1964 to a new campus within the northern city limits of the City of Klamath Falls. The 158 acre campus overlooks Upper Klamath Lake and its mountain background. The eight major structures on the new campus are the Classroom, Laboratory, Instructional Shops, Library-Commons, Administration, Residence Hall, Physical Education, and Physical Plant buildings. All buildings are heated by natural hot water wells located on the campus.

TWO PLUS TWO:

"Two Plus Two" alludes to Oregon Tech's two-year lower division programs which lead to associate degrees and two-year upper-division programs which lead to baccalaureate degrees. Students who have earned associate degrees at Oregon Tech or a Community College with a gpa of 2.25 or higher in the same or related technologies may enter Oregon Tech's Bachelor of Technology degree programs.

DEGREES AND PROGRAMS:

Bachelor of Technology degrees are awarded in: Civil Engineering Technology, Mechanical Engineering Technology, Electrical Engineering Technology, Medical Laboratory Technology, and Auto-Diesel Technology.

Associate of Engineering or Associate of Applied Sciences degrees are awarded in: Electronics Engineering Technology, Electro-Mechanical Engineering Technology, Engineering Drafting Technology, Highway Engineering Technology, Mechanical Engineering Technology, Structural Engineering Technology, Surveying Engineering Technology, Accounting Technology, Automotive Technology, Automotive Tune-Up and Instrumentation Technology, Dental Assistant Technology, Diesel Technology, Environmental Health Technology, Machining Processes Technology, Medical Radiologic Technology, Secretarial Science Technology, Small-Arms Processing Technology, Physical Science Technology, Radiologic Electronics Technology and Arc Welding Processes Technology.

ACCREDITATION:

The college is accredited by the Higher Commission of the Northwest Association of Secondary and Higher Schools. Electronics Engineering Technology, Mechanical Engineering Technology, Highway Engineering Technology, Structural Engineering Technology, and Engineering Drafting Technology are accredited by the Engineers' Council for Professional Development as Engineering Technology programs.

The Dental Assistant Technology curriculum is approved by the Council on Dental Education of the American Dental Association.

The Medical Laboratory Technology program is approved by the American Society of Clinical Pathologists.

Medical Radiologic Technology is approved by the Council on Medical Education of the American Medical Association.

TECHNOLOGY PROJECTS

Oregon Technical Institute

Klamath Falls, Oregon

APPENDIX C

OREGON TECHNICAL INSTITUTE
KLAMATH FALLS, OREGON 97601

March 11, 1969

Dear Sir:

Oregon's Polytechnic College, under the State System of Higher Education, is embarking on a unique method of instruction for Engineering Technicians. The enclosed brochure gives a description of this approach which, it is deemed, will improve the transition of the student from school to industry.

The 2 + 2 curriculum of Oregon Technical Institute makes such a plan feasible, since in two years the student has completed his course work in a technical specialty with an Associate Degree in Engineering Technology. He is ready for employment at that time as an Engineering Technician in research and development. His second two years, for the baccalaureate degree, concentrate on supervisory (middle management) type training with 4 credit hours (12 hours per week) devoted to a development projects class in his technical specialty area.

With this type of curriculum, the student, especially in his senior year, is ready for industry involved problems. It is anticipated that these problems, requiring a solution by industry, would be undertaken by the student on campus, under the direction of an industry appointed supervisor. The student would be responsible to this appointed supervisor but working in an academic atmosphere with the very latest test equipment and a computer available to him on campus.

My colleague and I plan a trip into your area during our term break the week of March 24, 1969. We would appreciate the opportunity of talking with a representative of your organization in order that ideas may be exchanged.

If you feel that we may be able to help your organization in this regard, please let us know of your interest and whom we should contact for an appointment.

Very truly yours,

William P. Grimes
Associate Professor
Project Coordinator

WPG:bmb

OREGON TECHNICAL INSTITUTE
KLAMATH FALLS, OREGON 97601

March 11, 1969

Dear Sir:

Oregon's Polytechnic College, under the State System of Higher Education, is embarking on a unique method of instruction for Engineering Technicians. The enclosed brochure gives a description of this approach which, it is deemed, will improve the transition of the student from school to industry.

The 2 + 2 curriculum of Oregon Technical Institute makes such a plan feasible, since in two years the student has completed his course work in a technical specialty with an Associate Degree in Engineering Technology. He is ready for employment at that time as an Engineering Technician in research and development. His second two years, for the baccalaureate degree, concentrate on supervisory (middle management) type training with 4 credit hours (12 hours per week) devoted to a development projects class in his technical specialty area.

With this type of curriculum, the student, especially in his senior year, is ready for industry involved problems. It is anticipated that these problems, requiring a solution by industry, would be undertaken by the student on campus, under the direction of an industry appointed supervisor. The student would be responsible to this appointed supervisor but working in an academic atmosphere with the very latest test equipment and a computer available to him on campus.

I will be in the Portland area April 16-19, 1969, and would appreciate the opportunity of talking with a representative of your organization in order that ideas may be exchanged.

If you feel that we may be able to help your organization in this regard, please let us know of your interest and whom we should contact for an appointment. I will be with the Oregon Tech group when they visit your organization for a field trip.

Very truly yours,

William P. Grimes
Associate Professor
Project Coordinator

WPG:bmb

VITA

William P. Grimes

Candidate for the Degree of

Master of Science

Thesis: A STUDY OF THE FACTORS INVOLVED IN OBTAINING AND UTILIZING AUTHENTIC PROJECTS IN AN ENGINEERING TECHNOLOGY RESEARCH AND DEVELOPMENT COURSE

Major Field: Technical Education

Biographical:

Personal Data: Born at Wichita, Kansas, August 8, 1919, the son of Lewis and Louise Grimes.

Education: Graduated from high school in Central Point, Oregon, 1937; graduated from National Schools of Los Angeles in Broadcast Radio, 1940; Capital Radio Engineering Institute, Washington, D.C., correspondence school, 1943-1949; U. S. Navy Radio Materiel School, Treasure Island, California, 1944; attended summer sessions at Oregon State University, University of Houston, Southern Oregon College, University of Illinois, took additional courses at Oregon Technical Institute and under the Department of Continuing Education, and received the Bachelor of Science degree from Oklahoma State University in 1966, with a major in Technical Education.

Professional Experience: Radio technician-announcer, KFJI Radio, 1940-1943; U. S. Navy Radio Technician, 1943-1945; Chief Engineer KFJI Radio, Klamath Falls, Oregon, 1945-1950; U. S. Navy Electronics Technician, 1950-1951; Chief Engineer KFJI Radio, 1951-1953; Chief Engineer KFLW Radio-TV, KCNO Radio, 1953-1957; Associate Professor, Curriculum Chairman, Electronics Engineering Technology, Project Coordinator, Oregon Technical Institute, 1957- . Commercial radio engineering consultant, 1957- .

Professional Organizations: Member, Institute of Electrical and Electronic Engineers; Member, American Society of Certified Engineering Technicians, Vice-President, Western Region; Evaluator for Engineering Technician certification for The Institute for the Certification of Engineering Technicians; Certified Senior Engineering Technician; Vice-Chairman, Hydro-Electric Commission of Oregon; Member, American Society for Engineering Education; Member, Phi Delta Kappa.