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The current status of noncredit continuing engineering education is described and criticized to facilitate the planning of future activity in this field. First, in a review of the background and current nature of continuing education in general, it is shown that rapid technological change makes periodic continuing education imperative for engineers. Pertinent findings of the Joint Advisory Committee on Continuing Engineering studies, and its recommendations for future action by universities, industry, technical societies, and the Federal government, are cited. In addition, continuing education in the fields of commerce and medicine is briefly reviewed and assessed. It is concluded that future emphasis should be directed toward organization and program development at the local rather than national level, under the direction of local planning groups. Ultimate responsibility should rest with the engineering societies. (Author/ly)

AN APPRAISAL OF THE STATUS AND FUTURE OF CONTINUING EDUCATION (NON-CREDIT) FOR ENGINEERS IN THE UNITED STATES

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Summarize in fifty words or less the purpose and principal conclusions of your thesis

The current status of non-credit continuing engineering education is described and criticized to facilitate the planning of further activity in this field.

Future emphasis should be toward organization and program development at the local rather than national level, under the direction of local planning groups. Ultimate responsibility should rest with the engineering societies.

John Ohliger
Advisor's Signature

AN APPRAISAL OF THE STATUS AND FUTURE OF CONTINUING EDUCATION (NON-CREDIT) FOR ENGINEERS IN THE UNITED STATES

A Thesis

Presented in Partial Fulfillment of the Requirements for the Degree of Master of Arts

by

Richard Dempsey Frasher, B.M.E.

The Ohio State University
1969

Approved by

Adviser
Department of Adult Education

PREFACE

This paper is generally concerned with what is happening in continuing engineering education today. When I first proposed this subject and began researching the field, I was, as a practitioner, concerned with the quality and types of teachers, counseling of the "students," teaching aids, etc. However, as my work progressed, I became more concerned with the whole development. I guess my point of view changed from looking inside out to that of standing outside, looking in.

As a result, the emphasis of the paper changed to the extent that my concern lies with the future of continuing engineering education and the proper framework in which it can properly perform its intended function. This area, I feel, is of prime concern at the present time.

There is still much work to be done with teacher selection, counseling, teaching aids and others. However, these subjects are not emphasized in this paper and could well serve, together or individually, as topics for future theses or dissertations.

I wish to acknowledge my gratitude to my adviser, Dr. John Ohliger, for all his advice and counsel and to Dr. Douglas Williams for his patience in reading this thesis and his valuable suggestions. My personal thanks also are directed to Mrs. Claire Lenfest who typed this entire paper and assembled the bibliography.

Finally, I would like my wife, Gayle, to know that I truly appreciate her continued support and encouragement during the months spent preparing and writing this paper, and for the time she took to read my drafts to challenge me on expression, grammar, and sentence construction.

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CHAPTER I

A TECHNOLOGICAL EXPLOSION

The General Implications

In August 1945, the blinding flash of the havoc of an atomic bomb was perhaps one of the first and most dramatic demonstrations of the new surge of scientific development. One might well declare that at that particular point in time, modern man had become technically out-of-date.

Since that time, one hears more and more frequently the catch-phrase "obsolescence of engineers." Before proceeding, it is appropriate to establish the meaning and implication of that term.

Webster[1] defines "obsolete" as no longer in use, disused; of a type or fashion no longer current, out-of-date. However, in this paper and in engineering in general, technical obsolescence is defined as the lack of ability to understand and utilize the new developments in the scientific field. Dolan[2] writes, "The connotations of engineering as a profession are inferred by the definition adopted several years ago by the Engineers' Council for Professional Development: 'Engineering is the Profession in which a knowledge of the mathematical and natural

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[1]Webster's New Collegiate Dictionary, G. & C. Merriam Company, Springfield, Mass., 1959 edition.

[2]Thomas J. Dolan, "The Professional Approach to Engineering Education," Journal of Engineering Education, Vol. 54, March 1964, pp. 261-264.

sciences gained by study, experience, and practice is applied with judgment to develop ways to utilize, economically, the materials and forces of nature for the progressive well-being of mankind.'"

From the previous quotation, the phrase "knowledge of the mathematical and natural sciences gained by study, experience, and practice" becomes the crux of my thesis, and more specifically, the relationship of this trinity: study, experience, and practice, in light of the emerging world of science.

The lack of ability to understand and utilize the new developments in the scientific field is a problem which cannot be approached as purely internal to the profession of engineering. The engineering profession has a central role in the creation of technological changes, which have tremendous impact on every level of our society. Failure to cope with obsolescence would have repercussions that would affect the entire economy. Were we the sole occupants of this planet, perhaps we could attempt to decelerate the rate of change of technology, in order to provide a sufficient breathing span to allow our social institutions time to adjust. However, given the presence of competition from abroad and the announced intentions of the Communist Bloc, it would be economic and physical suicide to attempt to pursue a course of deceleration.

The Challenge

Every year in this country, over two million pages of scientific literature, and an equal number of scientific abstracts are published. To function, engineers should know of and use much of the technical developments written up in those mountains of paper. The engineers of today face quite a challenge. Millions of dollars have been spent to construct and furnish scientific laboratories. These laboratories have been staffed with our top scientists and engineers, who, in turn, have been equipped with the best "tools" available, and directed to find new ways of making things, and new ways of doing things. The results have been astounding! Through these technical breakthroughs and the development of the necessary instrumentation, pictures are being transmitted without wires; electricity is being generated and ships are powered by nuclear fission; a ball, some 30 inches in diameter, thousands of miles in space is being used as a repeater station for overseas communications; and man has reached and begun exploring the moon.

Mr. Alf Malmros,[3] assistant to the President, IBM Laboratories, explains: "Science and engineering in virtually all fields are driving forward at a rate that is astounding. Each year, progress seems to outstrip even the most optimistic blue sky predictions, yet the pace

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[3]Alf Malmros, "Obsolescence of Engineering and Scientific Personnel in Industry," Midwest Conference on Reducing Obsolescence of Engineering Skills. Chicago: Illinois Institute of Technology, 1963, p. 17.

seems to continue to increase. Each new discovery or practice triggers off from 10 to 100 new ones. These teriffic rates of change on all technological fronts has resulted in our living in a constant state of evolution, where almost overnight whole new technologies develop, expand, and are quickly pushed aside by newer ones."

Not too many years ago, when an industrial concern hired a newly graduated engineer, it was expected that this man was fully equipped to proceed with his career. It was at that point that the study phase of the trinity (study, experience and practice) was complete. Now the man would expand and grow through experience and practice, and thus continue to gradually expand his particular technical competence throughout his career.

Today, this no longer holds true. Continual study throughout a working lifetime is necessary for optimum development of an engineer.

Mr. Minor C. Hawk[4], speaking at an American Society of Engineering Education meeting, indicated that technically-oriented industries are finding it increasingly difficult to react to competition in this era of technological change. Many of the new aerospace developments apply directly to industrial materials, tools, and processes. Practicing engineers must keep up-to-date on aerospace research. Most space programs focus directly on engineering know-how.

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[4] Minor C. Hawk, "Aerospace Research and the NASA Program of Technology Utilization," address at the Continuing Engineering Studies Division of the American Society for Engineering Education meeting, New Orleans, November, 1967.

The presence of obsolescence is recognizable in one or more ways by management, as well as the individual engineer. Management may recognize the presence of obsolescence when:[5]

1. The main products a company makes continue to be the same over a long period of time.

2. There is an increase in technical errors in an organization.

3. Competition becomes more effective.

4. Technical output in an organization is on the conservative side.

5. Paperwork justifying projects is on the increase.

6. Few new ideas are developing.

An engineer may recognize the presence of obsolescence when:[6]

1. He is less inclined toward rigorous mathematical solutions.

2. He encounters difficulty in reading new technical papers.

3. He encounters new technical concepts which are confusing.

4. His contemporaries no longer seek his advice.

A rather concise summary of the problem is contained in a recent article by Peter Ellwood[7] in which he explains that for many years, "obsolete" used to refer to equipment, now the term applies to engineers.

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[5]Proceedings of the Midwest Conference on Reducing Obsolescence of Engineering Skills. ed. T. Paul Torda (Chicago: Illinois Institute of Technology, 1963), p. 102.

[6]Ibid

[7]Peter Ellwood, "Continuing Engineering Education," Chemical Engineering, Vol. 74, No. 9, April 24, 1967, pp. 131-134.

Speaking at an American Society of Engineering Education meeting, Ernst Weber,[8] President of Brooklyn Polytechnic Institute, presented the problem somewhat differently. He stressed that scientific and technological advances are occurring at an exponential rate. In 1900, the half-life of an engineer was approximately 30 years. By 1960, this half-life had been reduced to 10 years, and President Weber predicted that this will soon reach about 3 to 5 years, at which point, the curve will become asymptotic due to natural human inertia. He concluded by stating that engineering gets only the top 10 to 15 percent of the high school graduates and that we must make the most with what we have (italics are mine).

The problem of technical obsolescence of engineering and scientific personnel has become the concern of individuals, government agencies, institutions of higher learning, the professional societies, and industry itself.

The Consequences in Education

The consequences of this explosion of knowledge are also having considerable impact in the realm of higher education. Two distinct areas have been subjected to the "fallout" of this explosion. One area, curriculum, is rather traditional, which through the years had undergone a gradual transitional improvement. The other area, post baccalaureate formal, non-degree education is an entirely new concept in

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[8] Ernst Weber, "The Fearless and Their Trail," an address at a conference of the Continuing Engineering Studies Division of the American Society for Engineering Education, Chicago, December 1966.

engineering that has been thrust upon engineering schools by individuals, societies and by industry.

The problem centers around the need for a conservation of manpower. As stated earlier[9] engineering students come from only the top 10 to 15 percent of high school graduates. That is a very limited source of supply. Various studies conducted by The Engineering Manpower Commission of The Engineers' Joint Council in 1962,[10] The National Science Foundation in 1963,[11] and a subsequent study also by The Engineering Manpower Commission in 1966,[12] all show great concern over predictions of an increasing shortage of engineers. Also, George Hawkins, writing in the Journal of Engineering Education,[13] indicates that the needs for engineering talent extend beyond our national boundaries. In addition to the requirements of the U.S. government and industry, we must consider that elsewhere around the globe, the demand for engineers will be rising rapidly, and that American personnel will quite probably be used to meet a portion of that demand. Thus, it would seem quite clear that faced with a limited supply of "new

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[9] Ibid.

[10] "Essential Characteristics of Engineering Manpower Documented in New Report," Journal of Engineering Education LIV, No. 1, 1964, xl.

[11] "Scientists, Engineers, and Technicians in the 1960's, Requirements and Supply," National Science Foundation, NSF 63-34 (Washington D.C., 1963), pp. 34-36.

[12] John D. Alden, "Demand for Engineers and Engineering Technicians," 1966, Engineering Manpower Commission, Engineers' Joint Council.

[13] George A. Hawkins, et al, "The Engineer in Future Society," Journal of Engineering Education, Vol. 58, No.5 (January 1968), 378-381.

recruits" and a growing shortage of engineers, both in the United States and throughout the world, that we should make every possible effort to conserve our present and future "product" by maximizing their competency through continuing engineering education.

Curriculum

Traditionally, changes in engineering curriculum have first occurred at the graduate level as a result of research activities. Many of these changes then found their way into undergraduate courses. This was generally a somewhat lengthy and leisurely process.

In recent years, graduate enrollment in engineering has increased faster than undergraduate enrollment, in pace with today's emphasis on increasing knowledge. The resulting proliferation of research and applied science is generating much new knowledge and significantly altering engineering curricula at both the graduate and undergraduate levels. Subject matter previously thought appropriate only for graduate courses has now become required material for undergraduate students.

The unfortunate, but necessary, result is appropriately explained by Julian C. Smith:[14] "A practicing engineer who graduated ten, or even five years ago is often bewildered when he finds current graduates discussing, in an unfamiliar language, subjects of which he has never heard."

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[14] Julian C. Smith, "Credit-Free College Courses--An Impending Explosion," Chemical Engineering, Vol. 74, No. 9 (April 24, 1967), pp. 139-143.

These adoptions in graduate and undergraduate subject material have led to a change in formal education, emphasizing basic science and resulting in the dropping of practical courses. Mr. Harvey Brooks, writing in the IEEE Spectrum,[15] summarizes the situation excellently by stating that "science has overtaken 'art.'" Engineering has absorbed many new technologies in the past twenty years--nuclear power, solid state devices, computers, masers, lasers and cryogenics, to name a few. As a result, engineers are now being trained or educated for occupations ranging from basic scientific research and applied mathematics to systems management.

The emphasis on science has pushed many of the so-called practical, or state-of-the-art subjects, such as mechanical drawing, analytical chemistry, foundry and machine shop, either out of the curriculum altogether, or their share in the overall scope has been markedly reduced.

This evolution to the science-oriented curriculum is in many ways drawing students away from the old basic field of engineering and pushing them into careers as research scientists. Herein lies the problem associated with the knowledge explosion and decreasing half-life of an engineer. Not only are practicing engineers finding it hard to keep current with new technological developments but the entire orientation of their profession is being rotated.

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[15]Harvey Brooks, "Dilemmas of Engineering Education," IEEE Spectrum, Vol. No. 2, February 1967, pp. 89-91.

The Journal of Engineering Education presents some concern in an article by A.B. Asch,[16] which reports that the national press for an increase in the number of scientists is producing bad effects on the engineering profession. The article concludes that engineering education has reached a crossroads, and is faced with the decision of whether to return to the traditional, proven, successful route, or to continue on the current road of developing a whole new breed of highly theoretical engineers and technicians to replace our present practicing engineers.

These are the current problems of the technological explosion and its effects on individuals in the profession and education.

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[16] A.B. Asch, "Engineering Education at the Crossroads," Journal of Engineering Education, Vol. 57, No. 8, April 1967, pp. 576-578.

CONTINUING EDUCATION

History

The implied solution or answer to the problem created for the engineering profession is presented as continuing education. Dr. John T. Rettaliata,[17] President of The Illinois Institute of Technology, supports the implication as follows, ". . .But in our day the concept of continuing education has become mandatory for the man who is to remain abreast of his profession and his times."

It is appropriate at this point to examine the term "continuing education" and bring to light some of the direct and implied considerations.

Adult Education

Continuing education in the broad sense is an activity under the general umbrella of adult education. Herein lies one of the major problems to be overcome--the implications associated with the term "adult education." The educational profession is in the midst of a dilemma in attempting to define and categorize adult education and its various activities. In the Handbook of Adult Education,[18] Robert Blakely states, "Definitions of adult education in the United States are as multitudinous

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[17] Proceedings of the Midwest Conference on Reducing Obsolescence of Engineering Skills, p. 4.

[18] Robert J. Blakely, "What is Adult Education," Handbook of Adult Education in the United States, Adult Education Ass'n, Washington, D.C., 1960. pp. 3-6.

as the autumn leaves, yet nonesatisfies many persons engaged in it. The difficulties are in both the phrase and the reality.... Adult education cannot be satisfactorily defined."

Traditionally, many college educators and administrators have been unwilling to accept, and resentful of the stigma thrust upon them by outside demands for continuing education programs. Continuing education, as adult education leaves a bitter taste in many mouths and is cited as lacking the professionalism normally associated with college-level educational programs. As a result, in the majority of colleges and universities, continuing education is a marginal activity. That is to say, the activity is nearly always in a dependent position within a larger organization that is mainly concerned with other tasks.

To a degree, these persons are justified in their resentment. Until the mid 1950's, adult education was a general term referring to educational activities conducted for mature persons, or those who had at least finished high school, and generally held the implication of American citizenship courses for the foreign born, or vocational and training programs for the working man. In recent years, activities conducted under the cloak of adult education have expanded to include both credit and non-credit courses at our colleges and universities. Also included are public evening school adult programs; commercial, secretarial, and vocational courses; the technical and management institute programs; activities conducted by religious, fraternal, and public affairs organizations; Agricultural Extension programs; correspondence schools; educational TV; and even self-study.

This exponential expansion of activities, all under the guise of adult education, would naturally be of concern to college and university administrators in their desire to maintain the professional image of higher education. Thus, the term "continuing education" was born, in an attempt to identify and distinguish the university programs from those conducted through the public schools, YMCA, and community organizations, for example. Also, underlying this new term, "continuing education," more emphasis was placed on the basic philosophy that education should be a continuing thing and not something that terminates when a person leaves high school or college.

"Today many institutions of higher education use the phrase continuing education to describe their departments or divisions for adults; and with the establishment of centers of Continuing Education at major universities such as Michigan State, Georgia, Oklahoma, and Chicago, under grants from the Kellogg Foundation, and with the organization of Colleges of Continuing Education at the central campuses within statewide extension systems, the students and the faculty, as well as the administrators are beginning to think of education in a new and different way."[19] Recently, similar facilities, not utilizing Kellogg funds, have been constructed at The University of Michigan, Penn State University and The Ohio State University.

Lest the reader begin to frame the concept that the "tide has turned," contrary convictions have been expressed quite recently at a meeting of the American Society for Engineering Education. One

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[19]Jerome Ziegler, "Continuing Education in the University," Robert S. Merison, ed., The Contemporary University: USA (Boston: Houghton, Mifflin Co., 1966), pp. 135-6.

speaker[20] felt that continuing education is obscured and misunderstood, and that the professional persons working in continuing education are misunderstood by those both within and without the educational profession. Another speaker[21] affirmed that continuing education is here to stay but expressed concern over the fact that it is still regarded as a peripheral activity, a second-class expendable area and that most academicians generally look down on non-credit activities. The speaker concluded that continuing education would have to confront and conquer these problems.

Perhaps, to inject a bit of humor and also to summarize the current dilemma of continuing education, a quotation from Watson Dickerman[22] would be in order, "So, at this point, I feel a little like Margaret Fuller. Wasn't it she who, after soul-searching, announced that she accepted the universe? And wasn't it Carlyle who retorted, 'Gad, she'd better'? Yes, I accept and welcome the term 'continuing education' and all that it implies. But I have an uneasy feeling that someday I'm going to be explaining for the ten-thousandth time what it is I do for a living and the other guy will say 'Oh! you mean adult education! Well, why didn't you say so'?"

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[20] Gurth I. Abercrombie, "The Engineering Scientist and Continuing Education: Paradox-Enigma-Dilemma," address before the Continuing Engineering Studies Division of the American Society for Engineering Education, New Orleans, November, 1967.

[21] Clyde T. Hardwick, "Professional Development and Executive Development, op. cit.

[22] Watson Dickerman, "What Is This 'Continuing Education'?" Adult Education, Vol. 15 (Autumn 1964), pp. 3-9.

Analysis: Does a Need Exist?

To this point, the discussion has been addressed toward two basic concerns, the nature and effect of the explosion of knowledge, and the present stature and implications of continuing education. Now it is time to relate one to the other.

An earlier quotation in this paper (Dr. John T. Rettaliata, p. 13) indicated that continuing education is now required for a person to remain up to date in his profession. That opinion however, is far from receiving universal acceptance throughout the engineering profession. Those in opposition with the concept of universal formal continuing education maintain that only a limited number of persons in the engineering profession are in the forefront type of activities associated with research or advanced development and therefore in need of the latest scientific technology. They claim the majority of engineers are engaged in such assignments as production, technical sales, maintenance, etc., where only specific and specialized knowledge, pertinent to their current assignments is needed. In addition, this knowledge is available only as the second phase of the trinity mentioned earlier (page 2); namely, experience and practice.

An official of the General Electric Company[23] spoke out strongly against formal continuing engineering and concluded that continuing engineering studies is based on false assumptions, that the present emphasis

[23]Charles A. Church, "A Non-Academic View of Continuing Engineering Education," address at the Continuing Engineering Studies Division of the ASEE New Orleans meeting, November, 1967.

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[23] Charles A. Church, "A Non-Academic View of Continuing Engineering Education," address at the Continuing Engineering Studies Division of the ASEE New Orleans meeting, November, 1967.

by educators is nothing more than promotional, Madison Avenue advertising. The gentleman went on to state that practicing engineers resent the implication that industry is loaded with worn-out, obsolete people.

Admittedly the previous remarks represent an extreme position. The majority of those in opposition to formal continuing education agree that a goodly number of practicing engineers may indeed be somewhat obsolete in certain areas but the opposition feels that this is a problem that has been brought about by industry and a problem that can, in turn, be solved by industry through more judicious utilization of their engineers in positions and assignments.

A special report by H. M. Greenwald[24] stated, "Experts estimate conservatively that industry should have two technicians for each engineer. The reverse is now the case and the situation is not improving. Russell Beatty, President of Wentworth Institute in Boston, thinks that half the work of many engineering departments today could be done by qualified technicians."

W.H. Baldwin, in the Professional Engineer's Newsletter,[25] urges redesign of engineers' jobs to offset obsolescence and frustration. The rationale is that our educational system is now producing technicians who can perform the tasks that have been assigned to graduate engineers.

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[24] H.M. Greenwald, "What's Needed to Solve the Engineering Crisis?" Business Management, April, 1967.

[25] W.H. Baldwin, "Redesign of Engineers' Jobs," Newsletter, National Society of Professional Engineers, Vol. 14, No. 1, January, 1969.

The article goes on to estimate that nearly one-third of the non-supervisory engineers in industry today could be replaced by technicians, and claims that sixty percent of our obsolescent engineers could be salvaged by updating and re-assignment.

Yes--The Need Exists

The crux of the whole situation is contained in the previous italicized statement--obsolete engineers salvaged by updating and re-assignment. At this point it is timely to examine the situation to date. Those in general opposition to formal continuing education contend that any obsolescence among engineers has been brought about by poor management of personnel, which is true to a degree. However, to expect, in turn, that these admittedly obsolete engineers can be sufficiently updated by reassignment and on-the-job training and practice is a false assumption. Formal classroom education is required. As cited by Herbert Popper,[26] the larger companies in particular have found themselves in the education business out of necessity, for if they are to operate at the forefront of technical knowledge, they must have engineers equipped to take advantage of that knowledge. Technical obsolescence can be hidden temporarily by an aggressive sales force, patents, or lack of competition, but sooner or later--poor profits will result.

[26]Herbert Popper, "Industry's Unique Role in Continuing Education," Chemical Engineering, Vol. 74, No. 9, April 24, 1967, pp. 140-146.

Admittedly, there has been exaggeration and a fear factor involved. Many persons stand in awe of the information explosion and don't appreciate that much of this is in terms of quantities of paper and not in terms of the decreasing number of significant ideas per article.

Engineers do tend to feel fear when they continually hear that the half-life of their technical knowledge is only five to seven years. Vincent Uhl, writing in Chemical Engineering[27] deftly describes the engineer's plight by stating that too much emphasis on obsolescence has been in terms of accusing the engineer. It is not his fault that so much new technology has come forth. Too many engineers are looking over their shoulders expecting to be released.

A previous statement (p. 9) remarked that educators have the responsibility of increasing the production of qualified engineers. The key word is qualified. Higher education has changed. Technical institutes are now graduating technicians who can and are taking over many of the jobs that have been, until recently, performed by engineers. Engineering curricula now contain courses and material that were not available to engineers who completed their education as recently as ten years ago.

The emphasis in engineering education has shifted to the mathematical and natural sciences. To remain at the forefront, an engineer must undertake continual study throughout his working lifetime. He cannot hope to learn in the short span of four or five years of a

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[27]Vincent W. Uhl, "Self Education--A Mainstream Activity," Chemical Engineering, Vol. 74, No. 9 (April 24, 1967), pp. 135-8.

formal college program all that he needs to know. He will also be expected to acquire new knowledge as it comes forth, and as needs arise and his position and activities change.

Continuing engineering education is becoming a definite factor in the overall approach to education for engineers and is the challenge of the future. Comments from two engineering-oriented magazines are both timely and appropriate in summarizing and concluding this section on the need for continuing engineering studies. Julian C. Smith,[28] states, "Faculties and administrators of engineering colleges are by no means unanimous in their opinions of the future significance of continuing engineering studies. Given, however, the increased demands for assistance by industry and the profession, the trends in undergraduate and graduate programs, and the growth and success of Continuing Engineering Studies programs at major colleges and universities, it is hard to see how continuing education can fail to become a part of the practicing engineer's professional activity. He _must_ keep up; he _must_ grow. Otherwise he soon won't be an engineer, and his employer will have to find someone who can do the job he should be doing." Also, Charles H. Vervalin [29] has stated, "...without the motivation to add to technological wealth via Continuing Education, the aforementioned inclining economic growth cannot take place. This brings us to a leveling out of industrial needs, and the ensuing manpower layoffs.

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[28] Julian C. Smith, "Credit Free College Courses: An Impending Explosion," _Chemical Engineering_, Vol. 74, No. 9, April 24, 1967, pp. 139-143.

[29] Charles H. Vervalin, "What's in It for Me?" _Hydrocarbon Processing_, Vol. 46, No. 8, August 1967, pp. 89-94.

The simple truth: Engineers create and expand their own jobs. through self-renewal, and through the sheer magnitude of their own creative efforts. The status-quo lover who 'free loads' in good times may ultimately see the world pass him by!"

CHAPTER II

REPORT OF THE JOINT ADVISORY COMMITTEE ON CONTINUING ENGINEERING STUDIES

To this point the emphasis in this paper has been to lay the foundation, or to set the stage, for an appraisal of the status of continuing engineering education as it exists today. The previous chapter dealt with the steps leading to today's situation, an indication of the need for continuing education and, presented some comments about current thought toward continuing education.

A major result of all the furor concerning continuing education throughout the engineering profession was the formation in March, 1964, of a Joint Advisory Committee on Continuing Engineering Studies.[30]

The committee was composed of two representatives each from the Engineers' Council for Professional Development, The American Society for Engineering Education, the Engineers Joint Council and the National Society of Professional Engineers. In addition, two representatives from government agencies in Washington were added, in recognition of the large number of engineers employed by the government.

The formation of the Joint Advisory Committee was quite timely because the subjects of technical obsolescence, continuing education and engineering manpower shortages had become of prime concern. During the early 1960's, in conjunction with the emergence of a number of non-credit, post-graduate programs, concern had reached such a level - these

[30] Continuing Engineering Studies--A Report of the Joint Advisory Committee, Engineers' Council for Professional Development, April, 1965.

topics were among the main items of consideration at most of the major conferences and small meetings that were then occurring, and were of concern to all segments: industry, the government, educational institutions, and the engineering societies.

As indicated, numerous conferences and meetings were occurring wherein continuing education was considered either as the major topic, or present to a considerable degree in the proceedings. A paper[31] outlining the view of industry on continuing education was presented at the 1962 annual meeting of the American Society for Engineering Education. In the spring of 1963, a conference on reducing engineering obsolescence[32] was held under the auspices of the Executive Office of the President, Office of Emergency Planning. Later that year another major conference on continuing education was sponsored by the New York State Advisory Council for the Advancement of Industrial Research and Development and was held at Columbia University.[33]

During this same period a number of companies, mostly the larger ones, were actively engaged in attempting to update and upgrade their

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[31]Howard K. Nason, "Continuing (Post-Graduate) Education in Engineering--The Industrial Viewpoint." Paper presented at the Seventieth Annual Meeting of the American Society for Engineering Education, June 18, 1962, U.S. Air Force Academy, Colorado.

[32]Proceedings of the Midwest Conference on Reducing Obsolescence of Engineering Skills, ed. T. Paul Torda (Chicago: Illinois Institute of Technology, March 26-27, 1963).

[33]Continuing Education--A Stimulus for Engineering and Science, Proceedings of the conference sponsored by the New York State Advisory Council for the Advancement of Research and Development in cooperation with Columbia University, New York, Department of Commerce, Albany, N.Y. (Columbia University, November 7 and 8, 1963).

engineering staffs and technical management through various educational means and many more industries were becoming concerned about the possible threats to their technical status from their competition.

Some universities were already making significant contributions toward continuing engineering studies and an increasing number were recognizing an obligation and an opportunity.

Eric A. Walker, President of Pennsylvania State University, writing in the Engineering Education Journal in 1962 stated, "We will hear about studies on Technical Institute Education, Undergraduate Education, and Graduate Education. What about Continuing Education? ...It seems to me that we badly need a fourth study as part of the present evaluation, a study of post-graduate or continuing education."[34]

In 1961, the University of California at Los Angeles initiated a program[35] for engineering executives in industry and the military services, aimed at helping them keep current with the recent developments in science and technology.

A group from Penn State University, in 1963,[36] appraised the needs and attitudes of almost 2,100 engineers in Pennsylvania regarding continuing education through a combination of a written questionnaire and group interviews. Also, in 1964, the Engineering College Administrative Council and the Relations with Industry Division of the American Society for

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[34]Eric A. Walker, "Goals of Engineering Education--A Status Report," Journal of Engineering Education, LIII, No. 4 (1962), pp.211.

[35]"Modern Education at UCLA," Journal of Engineering Education, LV, No. 9 (1965), p. 266.

[36]Samuel E. Dubin and H. LeRoy Marlow, Highlights, A Survey of Continuing Professional Education for Engineers in Pennsylvania (College Park, Pa.: Pennsylvania State University Bulletin, 1964), 6 pages.

Engineering Education formed a joint committee[37] to appraise the expressed needs of engineers for further training after they had spent several years practicing their profession. Finally, early in 1965, from what had been the Evening Engineering Education Division of the American Society for Engineering Education was created a new Continuing Engineering Studies Division.

Thus it became more and more evident that during the early 1960's universities, industry, the government and engineering societies were becoming actively concerned with the increasing rate of technological and scientific change, and the methods that might be utilized by practicing engineers to keep abreast of all these changes.

At the time of the forming of the Joint Advisory Committee there was general concern about the possible overlapping and duplication of efforts and activities by all the various segments of the engineering profession unless some unified approach or master plan could soon be conceived.

The role of the Joint Advisory Committee then, was to study the extent of the overall situation, consider possible methods of solution to the problem, the respective roles that the universities, societies, industries, and the government should play in the solution, and finally, to make specific recommendations to implement action toward achieving the desired goals.

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[37] "Synopsis of the Joint ECAC-RWI Feedback Committee Report," Journal of Engineering Education, LV, No. 9 (1965).

The remainder of this chapter will deal with the findings of this Joint Advisory Committee and its recommendations for future action by the respective major segments of the engineering profession: universities, industry, the government, and technical societies.

The committee soon found that the different capabilities and interests of the segments composing it could be utilized to their best advantage through the formation of task forces, each of which would deal with the role of a specific major segment of the profession. Thus was created the Industry, Academic Institution, Engineering Society and Government Task Force Groups. These will each be considered in turn.

Industry Task Force

The Industry Group was immediately faced with the problem that engineers were practicing in such a variety of activities that accurate appraisal and definition of appropriate continuing education programs to satisfy all elements was extremely difficult. In addition, analysis of various surveys showed there was often a considerable gap between the personal objectives of an engineer and those of his management. The greatest discrepancy, logically, was between technical and management oriented training.

Other findings brought forth were that the current engineering graduates were more technically sophisticated and likewise, more receptive toward continuing their engineering education. Also, there was a considerable gap between the knowledge and educational incentive of a recent graduate and those of his counterpart who had graduated ten or fifteen years ago.

After considering these factors in relation to the variation in attitudes of economically related response toward continuing education by business management, and the general obsolescence that had been created by lack of educational planning in the long-range goals of many corporations, the Industry Task Force arrived at several major recommendations.

Industry should be responsible for defining a continuing education program which has specific objectives, but within which are sufficient alternatives for an individual engineer to select activities of specific interest to him.

In general, industries should look to educational institutions as the source of new knowledge and techniques and provide institutional feedback to keep the faculty current in industrial problems and engineering developments.

Finally, the continuing education programs should recognize the particular emphasis toward specific technologies within certain geographic areas and the strengths and weaknesses of the respective local educational institutions.

Academic Institution Task Force

As might be expected, the academic task force considered the problems in a completely different context. The group immediately reaffirmed that the primary role of an educational institution should be oriented toward granting various levels of academic degrees, within a scholarly atmosphere. It was recognized, however, that more and more institutions should undertake a role of relating theory to practice through continuing education activities. These activities would thereby permit the continuous exchange and feedback of new developments, techniques and technology to permit more rapid adoption within the profession and, in turn, to generate new innovations within the engineering curriculum of the institutions.

In general, the consensus of this task force was that institutions should participate in continuing education as a regular part of the institutional load, and that programs should be projected on the basis of long-range planning. The courses should be occupationally oriented, and not directed toward a particular company or organization. The subject matter should relate to the general strengths of the institution and its faculty, while recognizing the particular talents and backgrounds of the intended audience. Finally, courses should be conducted at locations and times most convenient for the participants.

There was considerable concern brought forth that the organization and operation of a continuing education activity be conducted on a high level with top teaching and administrative personnel, who were adequately compensated, rather than by parttime, volunteer, or overload persons. A major point put forward was that while worthwhile programs should eventually be self-supporting, the basic program should have a firm, broad-based budget for support, as is done for any other regular educational activity within the institution.

Finally, the group considered the question of achievement recognition and professional credit. The overall recommendation was that some form of professional credit or recognition should be established, but completely independent of formal academic credit as associated with regular degrees. The suggested solution was for the societies to develop and effect some form of professional credit as a qualification for various levels of society membership or to merely retain membership in a professionally recognized organization.

The task group concluded by suggesting studies and experiments of new teaching methods and techniques for dealing with a mature group of practicing engineers rather than a typical body of young undergraduate and graduate students.

<u>The Engineering Societies' Task Force</u> (Non-Professional)

The engineering technical societies are unique in the context of this paper in that their very reason for existence centers around the promotion, development, and dissemination of new engineering knowledge. Admittedly, the overall scope of activities undertaken by the various engineering societies, be they small or large organizations, is extremely broad. However, their common interest is a desire to solicit new engineering technology and encourage their members to avail themselves of that technology.

In general, the task force analysis was that societies were actively providing continuing educational service to their members, however, the end results were often a direct function of the organizational structure, local activity and society resources, including both members and funds.

The types of activities undertaken by the societies include the publishing of technical journals; sponsorship of local and national level meetings, conferences, workshops and short courses and self-study techniques, including programmed instruction and correspondence courses.

The conclusion of the task force was that societies should become more active in promoting the concept of continued learning and encouraging employers to provide suitable opportunities for their employees to take part in continuing education activities.

Also the task force recommended an overall strengthening of continuing education staff and committees within all societies, along with improved inter-society communications aimed at the overall development of joint national and local programs, increased experimentation with the techniques and methodology for continuing education activities and the development of continuing education activities by association with established educational institutions.

Government Task Force

The role of the U.S. Government relative to the engineering profession practically necessitated the inclusion of a government task force. As both a major employer (11%) of engineers, and supporter of technical-scientific activities which employ engineers, the government has a significant impact on all aspects of education, engineering, science and technology and is a leading patron of continuing education programs.

As has been found to be true in so many areas, the government, in its desire to maintain a strong scientific and technical work force, had the major effect on the impetus for continuing engineering education. A major contribution was the Government Employees Training Act, passed by Congress in 1958. Additional influence is evidenced by the fact that expenditures also extend beyond mere government employees to include reimbursement for all industrial employee training where government contracts are involved. As a result, opportunities for education and training have become well established fringe benefits throughout the entire technical community.

On the basis of these factors, the task force generally recommended that in addition to encouraging greater participation within its own ranks, the government should use its significant influence to work with, and encourage technical societies and educational institutions to experiment with new techniques for continuing education programs and to evaluate the effectiveness of current activities.

Conclusions and Recommendations

After assembling and considering the various task force reports, the advisory committee reached some basic conclusions and recommendations.

The group concluded that two major factors were contributing to an assured need for continuing engineering studies, namely the marked difference in preparation of the recent engineering graduates from that of their peers with degrees ten or more years earlier, and the overall dynamic character of today's science and technology. Also, while the maintenance of technical competency was the ultimate responsibility of the individual, the employers and affiliated societies had an obligation to provide the proper means for that individual to maintain his competency.

As a general recommendation, the Committee urged that a national agency of recognized competency undertake the direction of a coordinated continuing education program, utilizing, whenever possible, the assistance of eminently qualified individuals and groups, for program development, and the coincident creation of a central agency with the responsibility for developing and maintaining a national directory or reference listing of all known continuing education functions and activities. This clearinghouse would then provide such information to engineers upon request.

Finally, for implementation of a national continuing education program, the Committee had several general suggestions, including increased coordination of activities among the societies, industry, educational institutions, and government agencies, leading to regular long-range projected operation of courses and conferences with appropriate and realistic budgets; more effective motivation for engineers to continue their education and for employers to encourage that motivation.

In addition, the committee urged that program development take into consideration regional effects of industrial specialization and the specific talents of available schools--concentrating on industrial or geographic constraints.

Lastly, a cooperative program of experimentation with the various teaching methods and techniques to optimize the effectiveness of continuing education activities was put forth as a specific recommendation.

The findings and recommendations of the Joint Advisory Committee were then published and circulated among the various organizations and societies which it represented in hope that some constructive action would be forthcoming. The Committee was then dissolved.

The next chapter will consider the current state of continuing education for engineers with respect to the specific areas designated in the Committee Report: Educational Institutions, Industry, Engineering Societies and the Government.

CHAPTER III

CURRENT STATE OF CONTINUING EDUCATION

As was developed in Chapter I, the need for some means for practicing engineers to bridge the "curriculum gap," occasioned by changes in emphasis in engineering education, and to keep current with the new technological and scientific advances had become of utmost concern throughout the engineering profession. One result of that concern was the formation of a Joint Advisory Committee on Continuing Studies as discussed in Chapter II, the other, and perhaps more practical result, was the natural evolution of response to the problem through the various channels of the engineering profession. As might be expected, by nature of their vested interests, the solutions and approaches taken by the four major sectors of the profession differed to a considerable degree and again, can best be discussed according to their origin: Academic Institutions, Industry, Engineering Societies and the Government.

The overall policy and programs of each will be presented in turn.

Academic Institutions

Academic institutions are faced with a dilemma. Traditionally, their primary, and in many cases, only concern, had been with the education of an engineer to the point of his reaching his degree and becoming a practicing member of the profession. Until the early 1960's only a few schools had any recognized activity in continuing education and that was generally through evening college or university extension. However, industry soon brought a new problem to the universities, "continuing education."

The initial response to the problem of technical obsolescence had originated in industry when a few larger companies became cognizant of the need and attempted to solve the problem by in-house courses, taught by qualified employees or university specialists on a contractual basis. The Bell System, as early as 1955, initiated in-house training courses to update personnel in solid state circuitry.[38] This was the Operating Engineers Training Program, a formal in-house study activity for selected employees of the Bell-Western Electric System.

Industry soon found, however, that the scope of such programs had to continually expand. As the need for specialized training increased, the activity progressed to a point where industry turned to the universities for help. Recognizing the contribution that they could make and the obligation they had to their graduates and the profession in general, the universities undertook almost a service-oriented approach to the problem. Today, university activity in continuing engineering education seems to know no boundaries. Reference Publications,[39]

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[38]John de Butts, "Combatting Engineering Obsolescence," Proceedings: Midwest Conference on Reducing Obsolescence of Engineering Skills, Illinois Institute of Technology, Chicago, Illinois, March 26-27, 1963.

[39]Louis Monturama, Editor, Post Baccalaureate Courses for Continuing Engineering Education, June 1968 to May 1969, Reference Publications, New Providence, New Jersey, May, 1968.

an independent publisher selling a catalog of short courses for engineers and scientists, lists 580 courses offered through 52 engineering colleges for the twelve-month period, June 1968 through May 1969.

Each of the 52 separate colleges act as independent agents with little or no attempt at inter-school coordination. Each college offers what it feels the profession needs, what the profession seems to want and what each respective institution is qualified and inclined to offer. As a predictable result, there is a considerable degree of duplication and competition for "students" from the professional world.

Policy

Most of the organizations have broad-based policy statements which are, in general, all encompassing. For example, the following statements are excerpts from the objectives of continuing education contained in the 1968 Annual Report of Continuing Education at The Ohio State University.[40]

> The Ohio State University, through its Division of Continuing Education ... seeks to serve qualified adults by making the relevant research and teaching talents of the University readily available. ...
> 1. The primary objective is: To provide university-level continuing education programs, tailored to the economic, social and cultural needs of society consistant with the overall objectives, resources and unique capabilities of the University. ...

[40] Annual Report of Continuing Education at The Ohio State University: July 1, 1967 - June 30, 1968, The Ohio State University Division of Continuing Education, Columbus, Ohio, October, 1968, pp. 1-3.

> 2. More specific objectives are: To provide learning opportunities for which the University has special competence to those engaged in the various professional areas.

These statements, with minor modifications to certain words and phrases, would represent the broad policies of those educational institutions participating in continuing education activities.

Organization.--Through all of this, three basic organizational patterns have emerged. There is admittedly, considerable overlap among these, however, the general patterns are discernible. The most prevalent and perhaps traditional approach has no specific organization for continuing education. Faculty and/or departments are encouraged, with an occasional specific suggestion to organize and conduct continuing education programs, under the sponsorship of the college. Rewards, in terms of pay or honorarium are minimal, or in many cases, non-existent. The activity is considered to be a recognized function associated with a faculty position.

A second, and perhaps intermediate, organizational arrangement is illustrated by the following universities: Ohio State, Michigan, Cornell and George Washington. Under this arrangement, an engineering college has an appointed administrator of continuing engineering education who coordinates all continuing education within the college. This step perhaps would indicate a strong reaction in response to the demand from the profession. Julian Smith [41] of Cornell University writes,

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[41] Julian C. Smith, "Credit-Free College Courses: An Impending Explosion," Chemical Engineering, Vol. 74, No. 9 (April 24, 1967), pp. 139-143.

> ...I believe engineering colleges will accept this responsibility. Some have already done so and more are looking into the matter. Many now have a Director of Continuing Engineering Studies and are working closely with industrial firms, technical societies, and government agencies in developing new programs.

Under this organizational system, in most cases, faculty who participate in the continuing education programs are paid an additional wage or honorarium over and above their regular teaching salary as special recognition of and incentive for their efforts.

Citing The Ohio State University for example, a University Division of Continuing Education functions under the Vice President of Educational Services, and acts as a coordinating and service organization for the individual colleges. Primary responsibility for continuing education programs is retained by the colleges and their respective deans. Overall policy is generally formulated through a Continuing Education Advisory Committee, consisting of the Vice President and representatives from the respective colleges.

The third and perhaps highest level of organization is conducted through an independent Division of University Extension[42] under a separate Vice President or Chancellor, with individual departments serving the various professions or community groups. Some examples

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[42] University Extension Services, 1968 Annual Report of University Extension, The University of Wisconsin, Madison, Wisconsin.

of this final form of organization are found at the following universities: Wisconsin, Missouri, Kansas, and California. As described by the Chairman of the Extension Engineering Department of the University of Wisconsin,[43] "The Department is organized and staffed quite independently of the College of Engineering. In fact, the two engineering activities at the University of Wisconsin --residence and extension --are responsible to two different Chancellors in the Central Administration."

In this final type of organization, qualified teachers are employed by the Extension Department on a full or part-time basis as needed. In many cases faculty are contracted under split appointment by the College of Engineering and Extension Department of Engineering. In this type of organization the responsibility for the development and operation for continuing education programs rests solely with the University Extension.

Programs.--In recent years engineering colleges have, for the most part, been extremely active in continuing education. As discussed earlier (p. 37) 52 engineering colleges around the country offered 580 separate continuing education programs over a one-year period. In addition to the ordinary type of workshops, short courses and conferences, many different techniques and methods of knowledge dissemination are being explored, evaluated, and utilized. Among these are video tape

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[43] William W. Wuerger, "Extension Engineering Programming," a talk presented to the Central Regional Conference of The National University Extension Association, October 16-18, 1966, Madison, Wisconsin.

replay courses, programmed instruction, open and closed circuit television instruction, correspondence courses and the electronic blackboard system.

For example, Cornell University[44] presented a number of engineering courses for the Sylvania Company plant at Towanda, Pennsylvania, by the remote or electronic blackboard system in conjunction with two-way telephone conversations. The University of Florida[45] at Gainesville, utilizes a system of one-way video, two-way audio to conduct credit and non-credit continuing education courses at seven satellite campuses around the state. Twenty-five engineering professors around the country recently participated in a programmed instruction evaluation project[46] in which they wrote, experimented with and prepared a small library of programs. Correspondence courses in most major fields of engineering are available through the University of Wisconsin Extension, Department of Engineering.[47] Approximately 50 different courses are available.

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[44] Julian C. Smith, "The Electronic Blackboard--A Teaching Experiment," Address before the Continuing Engineering Studies Division of the American Society for Engineering Education. New Orleans, La., Nov. 1967.

[45] Paul D. Arthur and Richard S. Leavenworth, "Project Genesys --Short Courses," address before the Continuing Engineering Studies Division of the American Society for Engineering Education, New Orleans, La., Nov. 1967.

[46] Augustin A. Root, "Programmed Learning--The ASEE Programmed Learning Project, 1965-1967," Journal of Engineering Education, Vol. 57, No. 6, February, 1967, pp. 428-432.

[47] "Engineering Institutes and Related Programs," The University of Wisconsin, University Extension, Department of Engineering Bulletin, 1966-1967.

A most encouraging experimental program utilizing video tape replay was recently completed by Colorado State University[48] in which graduate level courses in electrical and mechanical engineering were taught to approximately 200 engineers in seven remote classrooms in industrial plants and government laboratories within a 130-mile radius of the campus. The tapes and lecture notes were delivered by messenger and student-instructor contact was maintained by individual and conference telephone calls, and with periodic visits by the instructor to the classrooms.

On a different tact, as an example of active involvement and contribution, the author participated as a member of a research team, representing the College of Engineering of The Ohio State University, which conducted an extensive appraisal of continuing education needs of approximately 4000 scientists and engineers at the Wright-Patterson Air Force Base, Dayton, Ohio.[49] The study was initiated under the Air Force program, Project Innovate, as an advance development plan initiated by the Assistant Secretary of the Air Force. The purpose of the

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[48]C. O. Neidt, Evaluation Report on Colorado State University's Research in Graduate Education--Project Colorado Surge. Human Factors Research Laboratory, College of Engineering, Colorado State University, Fort Collins, Colorado, August 1, 1968.

[49]Herman R. Weed, Marion L. Smith, Richard D. Frasher, et al, "Educational Needs to Update Air Force Scientists and Engineers at Wright-Patterson Air Force Base," The Ohio State University Research Foundation, Columbus, Ohio, Phase I: August 31, 1968; Phase II: December 31, 1968.

study was to evaluate the needs for continuing education and to develop educational programs which would assist in updating Air Force scientists and engineers, both military and civilian, working at Wright Patterson Air Force Base. The study concentrated on continuing education without academic credit rather than those which earn credit or lead to an academic degree.

Finally, a particularly innovative action was undertaken by the Center for Continuing Education at Northeastern University in offering Professional Credit, State-of-the-Art Courses for Scientists and Engineers. The catalog[50] refers to the recommendations of the Joint Advisory Committee on Continuing Engineering Studies for some type of professional credit or recognition for participation in a continuing education program.

The general policy of Northeastern is to award a certificate attesting to the completion of an organized program of continuing education to those individuals who have accumulated at least 20 professional credits within a seven-year period (such professional credits are associated only with Northeastern courses). In general, most courses are presented at the graduate level and students are assigned regular advisors to help them organize a coherent overall program which reflects their needs and objectives.

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[50]"Professional Credit, State-of-the-Art Courses for Scientists and Engineers," Northeastern University, Center for Continuing Education, Boston, Mass. Spring, 1966.

Industry

Frankly, there does not yet appear to be any overall or unified policy or approach of industry toward continuing education. The reactions vary from a flat negative response as presented by Church[51] that the present emphasis on continuing education by educators is nothing more than promotional, Madison Avenue advertising, to those who are overwhelmingly in favor and provide complete support. Such a counterview is expressed by educational programs being conducted by such companies as General Electric, Bell Telephone, Westinghouse, and International Business (IBM) which overshadow those offered in all but the largest universities. In 1967, Esso Research and Engineering Company conducted a survey[52] of twenty-five of this nation's largest industrial organizations, concerning the status of their continuing education programs. The study included nine petroleum firms, nine chemical companies, three aerospace companies, and four from the electrical communications field. Eighteen of the twenty-five companies provided on-site, non-degree, technical courses for their engineers and scientists. Thirteen of the eighteen also sponsored courses at other locations.

In all cases, however, whether in company-sponsored programs, or university or society-sponsored, all agreed that responsibility for participation in continuing education activities ultimately rests with

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[51]Charles A. Church, op. cit. address at New Orleans meeting, November, 1967.

[52]Jack Rockett, "The Industrial Survey," Chemical Engineering, Vol. 74, No. 9 (April 24, 1967), pp. 147-49.

the individual. One of the basic conclusions[53] of the Joint Advisory Committee for Continuing Engineering Studies was, "...the engineer as an individual must assume the responsibility for maintaining his competence at a maximum level." Most companies, however, recognize that it is their responsibility to encourage and aid the individual to take advantage of every opportunity to maintain and improve his competence. This viewpoint was well presented by a representative of the Sun Oil Company at the 1965 Annual ASEE Meeting[54] in stressing that industry's chief responsibility in post-college professional studies is to provide a climate which encourages continued growth.

In general, companies are engaging in, or encouraging, a variety of continuing education programs. Broadly, these encompass company-sponsored technical courses, university short courses, seminars, talks, and society meetings. It is interesting, however, to cite examples of some of the varied continuing education activities undertaken by various segments of industry.

The Bendix Corporation,[55] Instruments and Life Support Division, at Davenport, Iowa, has introduced a series of special in-house, high-level seminars of one-hour duration on a biweekly basis. The speakers

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[54] Chalmer G. Kirkbridge, "Industry's Stake in Post College Professional Studies." Paper presented at the Seventy-Third Annual Meeting of the ASEE, June 21-25, 1965, Illinois Institute of Technology, Chicago.

[55] John L. Moriarty, Vernon E. Keller, and Walter L. Dray, "A Community Effort in Continuing Education for the Development of Engineers," Journal of Engineering Education, Vol. 59, No. 9 (May 1969), pp. 1046-48.

include division personnel, other Bendix experts, contracted consultants, and university faculty. Handout reference material pertinent to the topic is distributed. Attendance of company personnel at the seminars is optional, however, reaction from both management and individual engineers has been excellent.

From the approach at Bendix, we see more formalized programs that have been and are developing throughout organized industry. Sandia Laboratories in New Mexico developed a United Science and Engineering Course[56] patterned after similar programs of UCLA and General Electric. In this case however, the course is required for all supervisors. Four groups of about 30 each are in each session, which lasts about three months. The teachers are selected experts from the Laboratory staff and sessions are held in Sandia facilities during regular working hours. Participants have no job responsibility while taking the three-month course. The Mitre Corporation and Lawrence Radiation Laboratories provide similar programs[57,58] for their engineers, but on a voluntary basis. Again, all teachers are drawn from company staff, and the curriculum is periodically modified to suit the company's related technical needs.

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[56] O.E. Jones and D.L. Hughes, "Unified Science and Engineering: An In-House Continuing Education Course," Journal of Engineering Education, Vol. 57, No. 8, April 1967, pp. 558-560.

[57] Christian Westphalen, "In-House Programs in Continuing Education," address at the Continuing Engineering Studies Division of the ASEE Chicago Meeting, December, 1966.

[58] Abe Tilles, "Mid-Career Education: In-House," address at the Continuing Engineering Studies Division of the ASEE New Orleans Meeting, November, 1967.

It is interesting to note in these latter examples, however, that while taught by company personnel, the courses themselves were designed and organized by university faculty consultants.

Some more recent developments of importance, undertaken by a few larger companies, indicate a growing trend toward more self-organized educational programs by industry with a flavor of innovativeness also. Western Electric, for example, in 1969 will dedicate a new education center at Hopewell, New Jersey. A newspaper summary[59] indicates the facility will provide advanced teaching aids and laboratory facilities which utilize the newest educational techniques. Also included are residential facilities capable of accommodating 300 students at one time. The center will maintain a permanent faculty; however, university faculty will be used to supplement the teaching activities.

A somewhat different approach is illustrated by an instructional package developed by the Training and Development Department of the Westinghouse Electric Corporation to provide their thousands of engineers with an in-depth exposure to modern statistics. The Design of Experiments Course[60] consists of thirty-two half-hour filmed lectures with a structured text that accompanies each lecture. The text is used preceding the lecture to provide the student with some insight of the lecture to follow.

[59]"Western Electric Dedicates Education Center," The Columbus Dispatch, Columbus, Ohio, June 23, 1969, pp. 20A.

[60]J.R. Van Horn, "Design of Experiments Course," address at the Continuing Engineering Studies Division of the ASEE Milwaukee meeting, November 20-22, 1968.

In addition, learning is reinforced by reference to question and answer sections to help the individual determine his mastery of the material. The design of the course is such that it can be completed entirely without reference to outside material. However, each separate program contains a detailed bibliography of standard texts which may be used for more indepth study.

The course or package of films are available to Westinghouse sites all over the country and by nature of the design can be viewed at the convenience of the engineers, individually or in various sized groups. Initial response to the course has been quite favorable.

Finally, one of the most recent and exciting developments by industry was undertaken by the RCA Corporation, Camden, New Jersey. The details of the program were presented at the 1969 Annual Meeting of ASEE.[61]

The expressed intent of the program was to bring education to the engineer regardless of their location or time schedule.

The program is fundamentally based on the use of video tape as the teaching media. Supporting textbooks are used along with study guide materials and visual aids designed specifically for television presentation. Finally, an associate instructor, located at the plant site, acts as the course coordinator and resource person.

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[61] Joseph M. Biedenbach, "Industrial Video Tape Applications to Continuing Engineering Studies Programs," a paper presented at the Seventy-Seventh Annual Meeting of the ASEE. Pennsylvania State University, State College, Pa. June 23-26, 1969.

It is particularly interesting to note that periodic quizzes are given throughout each course, along with a final comprehensi examination covering the entire course. A certificate is awarded to those, and only those, who successfully complete the course, based on requirements established by the Engineering Educational Services staff. Those who do outstanding work receive certificates bearing "with distinction" citations. The certificates awarded to individuals become permanent records in the personnel file.

As a general rule, the courses are organized and taught by faculty from nearby universities on a contractual basis. Associate instructors are selected from engineering personnel who are exceptionally knowledgable in the subject matter and have some instructional capabilities, along with a desire to help associates.

The individual courses consist of twelve two-hour weekly sessions, conducted from 4:00 to 6:00 P.M. and have been well received to date. Attendance is on a voluntary but "suggested" basis.

A "library" of taped courses is now being developed in a variety of topics recommended by individual engineers and engineering management from all divisions of the corporation. The course content will be reviewed periodically and updated or deleted as needed to coincide with changes in technology.

Indeed, the RCA program could well be utilized by other industries or by educational institutions themselves to great advantage.

Engineering Societies

Engineering (professional, technical) societies have been recognized organizations for over 100 years. The American Society of Civil Engineers, founded in 1852, and The American Institute of Mining Engineers, founded in 1871, are among the oldest. Today, more than 150 organized technical or professional societies are in operation.[62] In general, the one common denominator behind the formation of these organizations was the desire of engineers and scientists, by nature of their education, profession, employment, or interests, to seek a common ground to share their knowledge and experience with each other. Thus, one of the primary activities of these societies has been to encourage the development of new knowledge and to aid in the dissemination of that knowledge to the membership. The level and effectiveness of this activity is a direct function of the resources of the society, in terms of both membership and funds.

In consideration of the vast number and variety of organizations concerned, no attempt will be made, in the structure of this paper, to present an in-depth analysis of any one society's or organization's activities. A recent appraisal[63] of the continuing education activities

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[62]Robert H. Roy, "Proposed: A National Society for All Engineers," Journal of Engineering Education, Vol. 59, No. 4, December 1968, pp. 300-301.

[63]Monroe W. Kriegel, "The Professional Society and Continuing Engineering Studies," Chemical Engineering, Vol. 74, No. 9, April 23, 1967, pp. 150-153.

of societies in general, indicated that the most active organizations are: The American Society of Chemical Engineers, The Society of Petroleum Engineers, The American Society for Metals, and The American Society of Tool and Manufacturing Engineers.

Broadly speaking, the methods utilized by engineering societies to disseminate technical information involves any or all of the following:

1. Publications
2. Society meetings
3. Committee activities
4. Workshops, seminars, conferences
5. Sponsorship of self-study programs.

The majority of the larger organizations provide a general journal on a weekly or monthly basis, along with engineering publications concerning new developments, various reports and manuals. Society meetings are generally held on a regular basis at the national, regional, and local levels where the formats include presentation of technical papers, seminars, industry tours, discussion groups, and general conferences.

The technical committees are generally most active in specialty areas by encouraging particular emphasis for and recognition of outstanding achievement and in the organization of study courses, local seminars and specialty conferences. More recently, additional activity has occurred in the area of programmed instruction and correspondence courses.

As a whole, the societies are making a strong attempt to encourage continuing education among their membership. They are limited, however, in the degree and extent of their activities by the financial resources available to support such activities. The societies' income is derived from dues collected from their members. Any real or significant increase by these organizations in continuing education activities would necessitate a major increase in the annual dues--a step not thought to be acceptable to the society membership.

Recently, through the support of federal funds (The State Technical Services Act of 1965 will be discussed in the next section--government activities) The Engineer's Joint Council established a Learning Resources Information Center (LRIC) which acts as a clearinghouse for continuing education activities, sponsored by universities, societies, or private entrepreneurs, available for scientists, engineers and managers. At the present time, the major activity of the center is the publication of a directory, Learning Resources, of activities, and a consultation service. In the near future, the center also plans to include information about correspondence courses, programmed learning material, films, video tapes, and a selective alerting service, on specific subject matter, in answer to requests.

It is unfortunate that despite recommendations of the Joint Advisory Committee for Continuing Engineering Studies for more and better intersociety communications, very little active response has occurred by individual societies at the headquarters or local level. Each organization generally develops a continuing education program for its own people independently and, unless solicited, does not advertise its programs to other organizations.

Finally, it is disappointing to find that engineering societies have displayed very little initiative in sponsoring university programs for their members, or in recommending specific programs for universities to teach. Societies do publicize university courses extensively among their members and often utilize some university faculty to lecture in society-sponsored courses. The initiative in these areas however has, unfortunately, been relegated to the universities, and to industry.

The Government

The federal government, being the major supporter of science and engineering effort in the country, and the major employer of engineering personnel, is a leading supporter of, and subscriber to, continuing education activities. On one hand, the government shares the concern and follows the action of any private industrial corporation in developing and maintaining a competent force of engineers and scientists of its own. On the other hand, our government plays the role of a nation's leader, doing all that it can to help a significant segment of its population solve a universal problem.

In the role of a private corporation, the Government Employees Training Act of 1958 provided the bench mark for federal policy in keeping government employees abreast of the latest developments in science and technology. The government laboratories have, in a sense, become centers of excellence through both in-house continuing education programs, through arrangements with nearby universities, and attendance of personnel in outside short courses, meetings and conferences. For example, the Air Force Space Institute at the Arnold Engineering Development Center, Tullahoma, Tennessee, and The Naval Weapons Laboratory at Dahlgren, Virginia, were established by universities. At Wright-Patterson Air Force Base, Dayton, Ohio, the base training office arranges and administers a number of contract programs each year. Seventeen separate offerings were conducted annually during fiscal years 1967, 1968, and 1969.[64]

Also, as noted in records maintained by the author since 1965, government personnel have annually represented the major portion (35-40 percent) of all participants in the Engineering Summer Short Course Program of The Ohio State University.

On the other hand, in the role of the nation's leader, the government has put forth a number of programs and projects aimed at utilizing federal funds and prestige to encourage and support continuing education and the dissemination of technical knowledge. For example, the NASA Aerospace developments are being disseminated as technical briefs, reports, state-of-the-art summaries through nine regional centers under the NASA Technology Utilization Program.[65] The regional centers are identified as Aerospace Research Applications Centers (ARAC).

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[64] H.R. Weed, M.L. Smith, R.D. Frasher, et al, "Educational Program Needs to Update Air Force Scientists and Engineers at WPAFB, Phase I, The Ohio State University Research Foundation, Columbus, O., August 31, 1968.

[65] Minor C. Hawk, "Aerospace Research and the NASA Program of Technology Utilization," address at the Continuing Engineering Studies Division of the ASEE New Orleans Meeting, November, 1967.

Finally, what may be the most significant move by the federal government in support of continuing education was the passage of Public Law 89-182: The State Technical Services Act of 1965, approved September 14, 1965. The preamble to this law reads, "An Act to promote commerce and encourage economic growth by supporting state and interstate programs to place the findings of science usefully in the hands of American enterprise."

The law is administered through the Department of Commerce and was designed to promote incentive and offer assistance to individual or collective states and their appropriate institutions, for them in turn to provide a complete spectrum of technical services of maximum benefit to industry.

Basically the Law is intended as a pump-priming mechanism whereby federal funds are utilized as a subsidy to help initiate and develop technical services which are intended, through the eventual support of private industry, to become self sustaining.

In the context of this Act, the term "technical services" implies both business and scientific subject matter and encompasses three primary areas of activity. The Act provides for state and interstate technical information centers for the purpose of preparing and disseminating technical information in the form of reports, abstracts, video tapes, microfilms, etc. Secondly, the Act provides for a referral service for the purpose of identifying sources of technical expertise. Finally, the Act provides for the sponsoring of workshops, short courses, seminars, and other forms of training programs.

The following quotations from the State Technical Services Act are important in the theme of this paper, in that they deal with the overall administration of the Act:[66]

> Designated Agency--the institution or agency which has been designated as administrator of the program for any state or states under section 3 or section 7 of this Act.
>
> Qualified institution means (1) an institution of higher learning...accredited by a nationally recognized accrediting agency...; or (2) a state agency or a private nonprofit institution which meets the criteria of competence established by the Secretary of Commerce....

Thus, as briefly outlined, the Act provides for a somewhat flexible but clearly defined administrative structure.

Since the inception of the State Technical Services Act a variety of area and statewide programs have been approved and are in operation. An example of a national program, the Engineers Joint Council "Learning Resources Information Center" and the publication <u>Learning Resources</u>[67] as discussed earlier (page 52) has been established. A number of individual states have programs in effect. In Ohio, the Board of Regents is the "designated agency" with responsibility for administration of the program. Courses, workshops and conferences

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[66] Public Law 89-182, 89th Congress, S. 949, September 14, 1965.

[67] <u>Learning Resources</u>. A Directory for Engineers and Scientists and Managers, Vol. 1, No. 1, Winter 1968-1969, Engineers Joint Council, 345 East 47th Street, New York, N.Y., 10017.

are being proposed and conducted on a continuing basis by various educational institutions throughout the State. The Ohio State University was designated as the major center of direction and coordination of the operating Technical and Business Service Program and also serves as a Referral Service Network Office. Additional field offices are established at the following seven universities: Miami, Toledo, Wright State, Cleveland State, Akron, Kent State, and Ohio.[68]

This summary of the Governmental activities in the area of continuing education concludes the presentation and review of the background and status of continuing engineering studies in the United States. In the following chapter an attempt will be made to appraise and evaluate the results to date and recommend some new avenues for consideration for the future.

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[68] Annual Report of Continuing Education at The Ohio State University--July 1, 1967 to June 30, 1968, Columbus, Ohio, October, 1968.

A BRIEF SURVEY OF CONTINUING EDUCATION IN OTHER PROFESSIONS

Some of the continuing education activities in other professions will be described briefly here for comparison with that in the field of Engineering.

Commerce

The business profession operates somewhat differently in its approach to continuing education. Very few programs originate within the universities. Dr. William Hurley[69] explained that most continuing education programs in the field of business and management are initiated by the various trade and professional associations, rather than by the educational institutions. The programs are generally arranged on a contractual basis with the association underwriting the costs which are recovered as tuition fees from the participants. The schools, in turn, receive a prearranged sum for administration and teaching. The "theme" of the program is determined by the association. However, the schools generally determine the specific topics and arrange for the teachers. In general, this form of arrangement has proven quite satisfactory and overall reaction is generally favorable.

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[69] Dr. William A. Hurley, Associate Dean and Director of Continuing Education, College of Administrative Science, The Ohio State University, interview, February 17, 1969.

Medicine

The field of medicine is also extremely active in continuing education, primarily under the direction of the American Medical Association. Since 1955, when an ad-hoc Committee on Postgraduate Medical Education was formed, continuing medical education has been an emerging and expanding field. According to Dr. Robert Schweikart,[70] a program of formal accreditation, under the strict guidance of the Continuing Medical Education Division of the American Medical Association, is in effect. There is a plan of formal recognition for general physicians, who, in any 3-year period, accumulate 150 hours of continuing education credits in the approved programs at accredited centers.

A permanent record for each physician is maintained by the American Medical Association. When registering for an approved course, the physician advises the sponsor or center of his desire for continuing education credit. When he completes the course, a check-off report of completion is forwarded to the office of the American Medical Association.

The approaches taken by both business and medicine appear to be sound and workable. They would certainly bear further investigation by the engineering profession.

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[70]Dr. Robert B. Schweikart, Associate Director for Continuing Medical Education, The Ohio State University College of Medicine, an interview, April 24, 1969.

CHAPTER IV

EVALUATION AND RECOMMENDATIONS

General

In the preceding chapters, continuing engineering education was first discussed in terms of the conditions that arose to precipitate a need. These conditions were then related to the environment in which continuing engineering education developed. Next, the suggestions and recommendations for further direction of continuing education, as put forth by the profession itself, were presented. Finally, the current status of programs and activities within the profession were summarized.

Appraisal

At this point, this paper will begin an appraisal of the current status of continuing education activities of the profession and then conclude with recommendations for further action.

Throughout the previous chapter, which outlined current activities, two general points were developed. Those were: (1) the overwhelming variety and extent of continuing education activities, and (2) a general lack of coordination and direction of those activities. A rather accurate analysis is made by Peter Ellwood in <u>Chemical Engineering</u>[71]

[71]Peter Ellwood, "Continuing Engineering Education," <u>Chemical Engineering</u>, Vol. 74, No. 9, April 24, 1967, pp. 131-34.

He describes the Engineers' Joint Council Plan as an attempt to bring order out of chaos. Continuing education was presented as having no rhyme or reason with programs varying from one day to six weeks, some very important subjects not being taught while other subjects have more courses than students. Everyone is getting into the act. There are no adequate surveys of needs, and no follow-up evaluations to determine and analyze the success or failure of the programs. There is indeed a valid need for continuing education but the helter-skelter approach of the early to mid 1960's is certainly not the answer.

There is somewhat of a fear factor involved. When engineers hear that the half-life of their knowledge will soon be only five to seven years, and, for example, when a number of engineers are temporarily put out of work by the shift from airplanes to rockets, they naturally tend to become concerned and sensitive. As already mentioned in Chapter I (p. 20) many persons stand in awe of the "information explosion" but don't really appreciate that much of this explosion is measured in terms of sheer quantities of paper and not in terms of the decreasing number of significant new ideas per article.

As the furor dies down perhaps a more sensible approach can begin to emerge from the confusion. Continued, lifelong learning is not new; learning has always continued throughout life in proportion to one's desire to learn. In particular reference to engineers this has been known as "on the job" experience. This is, and will continue to be, an extremely important phase of an engineer's professional development. As presented earlier (p. 2), the trinity--study, experience and practice, are the crux of the overall development of an engineer.

In the past there had generally been a sharp line of demarcation between the study phase, which came at the close of the engineer's college program, and the experience and practice phases. Now, there can no longer be any such line. A new era--continuing or life-long formal education is upon us. In the past, the comparatively slow pace of change led to a general "laissez faire" approach toward continuing education. This has now been shown as no longer effective.

Our total technical educational system is undergoing a period of evolution. The emergence of continuing engineering education as an equal entity with undergraduate and graduate education of engineers is bringing about drastic and long overdue changes to a somewhat stodgy educational concept. The author's point is supported by several persons. Buford D. Smith, Professor of Engineering at Washington University,[72] speaking at a recent Continuing Engineering Studies meeting, emphasized that the concept of continuing education from kindergarden to retirement must be established. Professor Smith also stressed that continuing education programs and their specific curricula should be developed as carefully as is now done with credit-type undergraduate and graduate programs. This same approach was continued by Mr. R. R. O'Neill, speaking at the same meeting.[73] He re-emphasized the point

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[72]Buford D. Smith, "Relationship of Continuing Engineering Studies to Undergraduate and Graduate Studies," address at the Continuing Engineering Studies Division of the ASEE Chicago Meeting, December, 1966.

[73]R.R. O'Neill, "Program Design for Continuing Engineering Studies," address at the ASEE Chicago Meeting, December, 1966.

that program planning for continuing engineering studies should be on a par with undergraduate and graduate programs. Mr. O'Neill also suggested that good continuing education programs should be like building blocks--coherent programs of study to support and supplement experience and practice.

Continuing engineering education is faced with two general problems. One of these is "official recognition." Perhaps it was more properly described by Clyde T. Hardwick[74] in 1967 when he concluded that continuing education was still an expendable area. It was, as yet, regarded as a peripheral, second-class activity, which presenting "not-for-credit" courses, did not merit equal consideration with degree programs.

The other problem is the unwillingness of many engineering schools, or the faculty thereof, to "come down" to the level of industry and the individual engineer and find out what is really needed, by whom, and when. Many of these schools have been following a "take-it-or-leave-it" attitude and when they find that many are "leaving it," the schools blame industry for being apathetic. Charles Schaffner[75] spoke of the problem, complaining that many faculty insist on complete autonomy in organizing and teaching continuing education programs. Rather than bring in an outsider to share in the preparation and/or teaching, the

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[74]Clyde T. Hardwick, "Professional Development and Executive Development," address at the Continuing Engineering Studies Division of ASEE New Orleans Meeting, November, 1967.

[75]Charles E. Schaffner, "Institutional Committments to Continuing Engineering Studies," address at the Continuing Engineering Studies Division of ASEE Chicago Meeting, December 1966.

faculty person would prefer not to offer the course.

Coupled with this as part of the same problem has been the academic tradition of conducting programs at a time and location tailored to the convenience of the teacher. Thus, we find many practicing engineers faced with courses being offered at a time and location inconvenient for them with topics in which they have had little, if any, voice in selecting. Schools must wake up to the fact that they are not dealing with a captive audience of undergraduate students.

An illustration of these problems is shown in the following summary of the performance of engineering summer short courses at The Ohio State University. (The data are available in the author's files.)

Table I

Attendance Summary of Engineering
Summer Short Courses
The Ohio State University

Summer Courses	1964	1965	1966	1967	1968	1969*
1. Offered	9	14	22	21	23	28
2. Conducted	8	11	16	16	17	-
3. Cancelled--Low Enrollment	1	3	6	5	6	-
1. Total Attendance of Short Courses	192	313	454	407	313	-
2. Average per Course Conducted	24	28	28	25	18	-
3. Total from Ohio Industry	49	58	74	63	41	-
4. Percentage from Ohio Industry	25	18	17	15	13	-

*Data not complete at this time.

A number of interesting observations are illustrated in Table I. First, looking at the total attendance from 1964 through 1968, a rapid rise, peak, and decline can be observed. Secondly, comparing the number of offerings with attendance, the figures indicate that the solution to the reduction in attendance was to offer more courses. However, it would not appear that more courses was the solution. Complete data for 1969 are not available at the time this paper is being written. Indications to date are that an even more marked decline in attendance is occurring. Admittedly, these data represent only one institution. However, limited feedback from other continuing engineering education administators tends to generally support this trend.

A general analysis is that in response to pleas from industry for help in keeping their engineers up to date, engineering schools took up the hue and cry and began offering a variety of programs. The initial success of these prompted an expansion, not only with the original schools, but others saw the opportunity to "share the wealth." They became competitors, offering more and more programs to capture more of the"market." However, for the type of programs conducted, the market was quite stable. The average attendance declined, and now the finger of blame is pointed at industry for lack of support and at individual engineers for being apathetic. The answer is that the programs were not reaching and meeting the needs of the majority of engineers who should, or want to, participate in continuing education activities.

In the broad perspective, general industry has not actively supported the continuing education programs of universities. The bulk of registrants from industry have been from the larger corporations, who by nature of their manpower and financial resources, were better able to underwrite such activity. Smaller organizations are generally not in a position to send many of their engineers to continuing education events. The total expenses for tuition, travel, lodging and meals become significant and finally, the hidden cost of having a highly-paid productive engineer away from his desk and out of touch for a week or two at a time, is generally not justifiable.

Another factor is the problem that after participating in a course or workshop, the engineer should utilize what he has learned, otherwise the knowledge or experience will be lost. When only one man from an organization participates in a continuing education event, his associates, not being familiar with the new techniques, may not be "receptive students," or cooperative to the new ways. Thus, often, very little return on an investment is realized.

When considering some of these problems, we can appreciate that while many companies favor the concept of continuing education, they cannot afford to urge and support the participation of their engineers.

Finally, we come to the engineering societies, the representatives of the engineer, which have, in many ways as already discussed in Chapter III, fallen down on the job. These societies are in an ideal position to act as the coordinators between industry and the universities. They should have taken the lead in initiating and sponsoring continuing education programs at the universities in response to the needs of their members. The Joint Advisory Committee specifically charged the societies to improve inter-society communications and to initiate closer relationships with engineering schools, with the objectives of developing specific programs for their own and sister-society members. In this area, engineering societies have not carried through. Monroe Kriegel[76] after conducting an extensive study of society activities as a follow-up to the Advisory Committee recommendations, concluded that little had been done to improve intersociety relations and relations with universities, nor to initiate new programs.

Recommendations

After reviewing the background for continuing engineering education, presenting and criticizing the past and current activities, the area of concern at the moment is to reach the vast number of engineers who need, but are not participating, in continuing education programs and to present material which is of value to them and their employers. This can be best accomplished through schools and technical societies working together to solve problems of mutual concern. Briefly, the societies must assume more responsibility for the leadership in the planning and direction of continuing education programs. The schools,

[76] Monroe W. Kriegel," The Professional Society and Continuing Engineering Studies," Chemical Engineering, Vol. 74, No. 9 (April 23, 1967), pp. 150-53.

must develop more flexibility in, and toward, the development of programs. Too many organizations are concerned only with "doing their own thing."

In recognition of the enormous number and variety of continuing education programs being developed by industry, it is difficult to say that industry is apathetic. Perhaps it is more appropriate to relate apathy to the schools and technical societies which have not been developing and offering the types of programs most needed. Thus, industry has been faced with the need to develop its own continuing education programs.

Educational institutions will have to "tone down" their approach. Too many of them are neglecting their own area of influence. For example, referring to the summary of attendance for Ohio State Short Courses (Table I, p. 58), over the five-year span 1964 through 1968, less than one-fifth of the participants were from Ohio industry, This general pattern holds true for institutions around the country. The major effort should be directed to the local level rather than the national level. Mr. Glenn S. Jensen[77] supports this theory, "...the real hope of attaining the objectives of a truly successful and worthwhile adult education movement lies in the productivity of local groups."

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[77] Glenn S. Jensen, "Adult Education Associations and Councils," Handbook of Adult Education in the United States, M.S. Knowles, ed. Adult Education Association of U.S.A., 19th St., N.W., Washington, D.C. p. 179.

This same thought was specifically put forth in the Joint Advisory Committee Report[78] as a recommended procedure in the implementation of continuing engineering studies programs: "...programs should be tailored within the limits imposed by geographic constraints. The emphasis accorded to science and technology by different employers in different locations...must be considered."

As an example of what can and is being accomplished at the local level, The Engineers Foundation of Dayton, Ohio, in its first year of operation, using mainly qualified instructors from nearby industry, conducted 33 classes. These classes were attended by approximately 1,100 participants, representing 127 organizations within a 60 to 70 mile radius of Dayton.[79] This program is under the direction of an "Educational Coordinating Committee" representing leaders from local institutions.

Continuing education has several levels and degrees of sophistication. This point, however, has not generally been recognized to date. The speeded-up but necessary changes in educational curricula have made and will continue to make, previous graduates somewhat out-of-date relative to the newer techniques of technology. However, new

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[78] Continuing Engineering Studies--A Report of the Joint Advisory Committee, Engineers Council for Professional Development, April, 1965.

[79] Steven W. Marras, Report of the Managing Director: 1967-68 Continuing Education Program, The Engineering Foundation of Dayton, Ohio, 124 E. Monument Avenue, Dayton, O.

graduates must also be made aware of "the way things are being done in the real world."

Finally, we have the need for "new frontier" technology, which is receiving major attention today.

All of these areas are equally important and should be receiving equal attention today. For example, in a continuing education study (in which the author participated) of approximately 4,000 scientists and engineers at Wright-Patterson Air Force Base, Dayton, Ohio, a significant problem of concern, expressed by both individuals and their supervisors, was inability to communicate on a technical level between age groups and various areas of technical specialization. In this instance, the solution is not the dissemination of more "new frontier" technology, but more of the "nitty-gritty" of everyday engineering.

Conclusion

Continuing education requires a different approach in education for engineers. It must reach out to the individual at his location; it must answer his and his employer's needs and be at a level comparable to those needs. One avenue often overlooked in promoting continuing education is to emphasize that the end result of industry participation can be increased productivity and/or quality and ultimately--increased profits. The stature of continuing education needs to be raised, not as a formal academic procedure, but as an educational program with the flexibility to meet and answer the needs of our graduate engineers and their employers. It should provide them with the best educational tools and technology at hand. The traditional academic concepts of dealing with a captive audience of young undergraduate college students, of requiring their physical presence in front of a faculty instructor at his convenience, does not always appear to be the best approach in continuing education.

The proper emergence of the continuing education program would require the technical societies of the engineering profession to assume the responsibility of coordinating activities, not only between themselves, but between an educational institution and industry. The creation of programs would commence at the local level (implying city, geographical area, state, or any technical community) not on a national basis.

The universities would naturally be free to continue offering nationally advertised "frontier technology" programs. However, under this overall plan at the local level, they would act as centers of expertise (advisers and consultants) ready, where feasible, to supply knowledge, teachers, teaching aids and facilities. These institutions could administer programs similar to the approach followed with continuing education in the business profession.

Industry must take an active role in support of continuing education programs, and hopefully, minimize the further development of in-house programs. Planning committees from industry, education and society should provide the means for the creation of the desired type and quality of program, and provide criteria for evaluation of the program. This approach would end the necessity of industry funding the development of its own programs and enable them to provide additional funds which would permit the participation of more employees in continuing education programs.

This plan, local in concept, would provide continuing education programs containing specific material of concern, programmed for the benefit of the engineer and his peers.

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