THE YOUNG ENGINEER
A PROFESSIONAL GUIDE

MANUAL ON PROFESSIONAL DEVELOPMENT

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This pamphlet was prepared by the Development of Young Engineers Committee of the Engineers' Council for Professional Development in cooperation with representatives from the Societies listed below:

American Institute of Aeronautics and Astronautics, Inc. (AIAA)
American Institute of Chemical Engineers (AIChE)
American Institute of Industrial Engineers, Inc. (AIIE)
American Institute of Mining, Metallurgical and Petroleum Engineers (AIME)
American Nuclear Society (ANS)
American Society of Agricultural Engineers (ASAE)
American Society of Civil Engineers (ASCE)
American Society for Engineering Education (ASEE)
The American Society of Mechanical Engineering (ASME)
The Institute of Electrical and Electronics Engineers, Inc. (IEEE)
National Council of Engineering Examiners (NCEE)
National Institute of Ceramic Engineers (NICE)
National Society of Professional Engineers (NSPE)
Society of Automotive Engineers (SAE)
Society of Manufacturing Engineers (SME)

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Your Transition From Student To Graduate

You are about to do it! To make the move from the life of a college student into professional life. You are emerging from the relative warmth and security of a well-defined area into an area where you once again must establish yourself. What a fantastic opportunity lies before you. The opportunity to exercise initiative and enthusiasm and to establish your identity as an individual. You really can't ask for much more.

The purpose of this booklet is to bring into focus some of the challenges and concepts you will be facing in the coming years.

In an engineering education, the fundamental purpose of the college years is to enable you in a short period of time, to learn of, and to profit by, the experiences, discoveries, and interpretations of the thousands who have gone before you in the application of nature's laws and material for the use of mankind. For you, an engineering graduate at the threshold of a professional career, your total education has only begun. Education in its broadest sense is an orderly accumulation of factual knowledge and progressive ability to interpret and apply that knowledge to human needs. It is the sum of all indelible impressions left upon the human being by life. These thoughts are particularly applicable to the engineer, who has contributed so much to the creation, development, building, installation, and operation of the physical elements important to modern life.

What is Required of You as an Engineer?

You must consciously develop some very specific and basic qualities. Professor William Wickenden, in his booklet, " A Professional Guide for Young Engineers," presents them as follows:

1. **Courage and integrity** are prime requisites for a successful engineer. Do not continue in engineering if you are afraid to take calculated risks and to make decisions on the basis of available information; very seldom will you know in advance the certain answer to any major engineering problem. You must be willing to live up to an inflexible code of integrity and honesty. The habit of straight thinking and honest action is just as important to an engineer as is the habit of cleanliness to a surgeon.
2. **A thirst for knowledge** is an attribute you must possess if you hope to succeed in professional life. The engineer must have the native inclination to delve into the fundamental truths of mathematics, physics, and chemistry.

3. **Imagination** is a factor vital to successful engineering. Every engineering product, be it great or small, is someone's mental picture that has become a reality. If you find it difficult to see things in your mind's eye as they would be in actuality, you should re-examine your motives for entering engineering.
4. **Sound judgment** is a requisite for the successful engineer. You must be able to see all aspects of a question or problem and place a proper value on each phase of a situation and to foresee and estimate the consequences likely to result from each step taken in the solution of the problem or project.
5. **Accuracy** in thought and action is essential if you are to be a successful engineer. It must be cultivated if you hope to succeed in technical pursuits.
6. **An instinct for economy,** the economical use of manpower, energy, and materials in producing the most effective results is most important.
7. **An aptitude for leadership** is very important to the individual engineer's professional advancement in this modern civilization. You have a challenging opportunity to constructively lead as an engineer and as a private citizen in the field of civic and social problems. If humanity is to receive the maximum benefit of the engineer's work, then you, as an engineer, must assume interest and responsibility for applying your accomplishments most effectively for the welfare of humanity.
8. **Ingenuity,** the ability to be creative, is another essential ingredient for a successful engineer. The engineer who can take commonplace situations and apply imagination of conception and creativity to produce and improve results will contribute the greatest benefit to mankind.
9. **Hard work** is essential to give strength and vigor to the intellect and to give it the dimension of depth. Intelligence is necessary to give effectiveness, honor, and dignity to labor.
10. **The ability to communicate effectively** can enhance every other quality which the engineer possesses. And without it, all other qualities are shadowed. Especially as a young engineer, you will do well to emphasize this phase of your education.

Four things you, as an engineer, must have—

- **a mastery of applied science**
- **the power to visualize your ideas by imagination**
- **the power to express your ideas clearly to others in speech or writing or drawings**
- **an instinct for economy of effort and of cost**

As engineers mature, three-quarters of them take on executive responsibilities and many become executives. Only rarely does an engineer get far without a good understanding of human nature and the art of managing people.

A Career of Human Significance

Are there opportunities in the technical professions for the youth of today? Be assured that the young engineer, chemist, or physicist who wants to do something that will count in terms of human welfare and advancement has a great opportunity. All mankind faces a future of uncertainty. But many of the "ifs" of life are influenced greatly by scientists and engineers. If your community is to be prosperous; if America is to provide jobs for all who seek them; if our people are to be safe and free from disease; if they are to live in comfortable homes; if they are to enjoy time-saving transportation; if they are to live in the open and not huddled in slums; if the news and the culture and entertainment of the world are to be brought to them by radio and television; if we are to continue to grow and prosper as a people when our resources dwindle; if our soil is to be kept fertile and not washed away; if America is to assist developing nations through technical cooperation and sound financing; if *any* of these real feats are to be accomplished, men and women of science and technology have a vast and challenging job to do. They cannot do it alone, of course, and people of goodwill in every calling and profession will have to lend a hand. But without the future engineers, chemists, physicists, and metallurgists it could never be done at all. The foundation would be lacking and the new world of men's dreams would only be words.

The Engineering Graduate

Important Choices and Decisions upon Graduation

For the majority of engineering school graduates one of the important decisions to be made is "*which job opportunity shall I take?"* Consider some of the alternatives:

Should it be a large organization or a small organization?

When all of the issues are considered, the advantages and disadvantages are surprisingly even between the large and the small organization. Normally the large organization will have a wider range of jobs but the jobs may require greater specialization. The top of the ladder may be higher, but early progress may be more routine and less individual in its considerations. Large organizations most often will have a well-developed program of research, offering greater opportunities for those interested in research.

Some of the greatest opportunities for the young engineer lie in those small organizations where little use has been made of engineering talent. Usually these opportunities are not covered by any systematic plan of recruitment and must be sought out. Such work opportunities involve many uncertainties but offer much latitude for individual initiative. Frequently there are no specific plans for recognition of professional training and status, but once the young engineer has become established within the organization, there may be little or no competition.

Within each area there are different functions which demand distinct types of individual interest and capacity. As an example, one may concentrate on investigation — experimental, analytical, or economic; or on design and development; on planning the programs of instruction; on supervision of operations; on the application of products or services; or on the closer related selling of goods and services.

Whatever the situation, the young engineering graduate would do well to look carefully over the field with an open mind. Each opportunity will have to be evaluated on its own merit. Matching the available position with the needs, background, education and experience of the individual applicant requires careful analysis.

A Good Job Opportunity Must Offer Two Ingredients for Personal Development

First: experience, though varied, must be cumulative. It must add up progressively to something that is coherent and must rise continually in the amount of responsibility required.

Second: the work must not be allowed to bog down in routine. Whether these things happen is most often your direct responsibility, rather than that of your employer. Any job is just about whatever you want to make of it. Work is a powerful molding influence, and you will do well to ask yourself what will a given type of work make of me in a given time period, say, fifteen years.

Although technical qualifications are important in an engineering position, it is the composite of personal traits and characteristics defined by the term "personality" that determine which young engineering candidate will be selected for the best position.

Work in engineering differs widely; some engineers work mostly with materials, some mostly with machines, some mostly with money, and some mostly with people. Your individual characteristics, interests, and inclinations will, in a significant way, determine in which of these areas you will eventually concentrate your efforts. You must choose among job opportunities. Your employer must choose among other applicants. From a recent survey of a representative group of industrial employers, the American Association of Engineering Societies established the points of consideration which carry the most weight in selecting a candidate for an engineering position. These characteristics, ranked in order of their importance are as follows:

1. personality
2. scholastic record and indicated promise of development
3. experience
4. ability to cooperate with others
5. recommendations from qualified persons
6. indicated promise for executive development
7. standing of the college from which the candidate was graduated, and
8. salary requested

Beginning the Professional Practice

Your first few years in the engineering profession can be among the most important in your life.

Up until now, you have been receiving an education based upon the experiences and discoveries of others. From now on, you are expected to use your knowledge and ability to produce results. You paid to learn, now you must produce to earn.

Up until graduation, the work that you did was regulated, programmed, and graded. In the future, it will also be regulated, programmed, and graded, but not in the same way. The regulations are a combination of policy, professional ethics, law, and unwritten law. Programming is usually informal, but in every company tradition or experience governs the initial assignment for an engineer, and establishes what is expected in the way of performance. *The grading consists of first impressions, constant appraisal, and your record of accomplishment.*

Most engineers are highly motivated, or they would have picked a career which requires less rigorous preparation than a degree in engineering. You probably have some objective which you consider success — some level of responsibility, some salary, some contribution to mankind, country, profession, or employer. Whatever that objective, it is important for you to realize that you are in competition with all of your fellow engineers. Promotions are not likely just because people think that you are a nice person. Selecting people for advancement is like "choosing up sides" for a softball game. The manager making the selection wants to choose the winners.

Responsibilities

Progress — even existence — as an engineer requires recognition of an acceptance of responsibilities to your employers, to society, to your profession, and to yourself and your family. Your employer is paying you to do the job and accomplish the results which they have a right to expect from an engineer. You have a responsibility to your employer to do that job as best you can. You have a responsibility to work with the organization, to communicate with the people, to do your full share of the work.

Your responsibilities to society are becoming more widely recognized, as we learn more about the conflict between technological development and the environment. Safety of employees, consumers, and of future generations must be considered, as well as cost and utility, in arriving at recommendations.

You are a representative of the engineering profession. Your conduct and your performance, both on and off the job, reflect on engineers in general and upon your associates in particular. You have an obligation to try to make your profession better than it is — more enlightened, more concerned, more effective, more deserving of the respect of other people.

Above all, you have responsibilities to your family and to yourself. The needs of your family and concern for your own mental and physical health are as deserving of attention as the other responsibilities which demand your time.

Unwritten Laws of Engineering

Success in engineering depends upon a lot more than technical skill. The chief obstacles to success are likely to be of a personal and administrative nature, rather than technical. A commentary on this was written by W. J. King, Professor of Engineering, University of California at Los Angeles, entitled "The Unwritten Laws of Engineering." This publication is available from the American Society of Mechanical Engineers and from the Accreditation Board for Engineering and Technology, and we recommend that you read it. Some of these "laws" are so basic that they are being quoted or paraphrased below without elaboration.

However menial and trivial your early assignments may appear, give them your best efforts.

There is always a premium upon the ability to get things done, and this requires energy, resourcefulness, and persistence.

Before asking for approval of any major action, have a definite plan and program worked out to support it.

Strive for conciseness and clarity in oral or written reports.

Be extremely careful of the accuracy of your statements.

One of the first things you owe your boss is to keep him informed of all significant developments.

Whenever your work affects another department or another employee, make sure they know what you are doing, and why.

Get the facts, make an analysis, apply judgment, and make a decision; do not vacillate.

Be interested in the people who work with or for you, and treat them as you would want to be treated.

Regard your personal integrity as one of your most important assets.

Be careful of your personal appearance; if you would be an executive, look the part.

Many additional "laws" could be added to the list. You should make an effort to learn what is expected of you in *your* job. Realize this: people *do* form first impressions of you; people *do* appraise your appearance, the way you conduct yourself, and your ability to accomplish assigned tasks; and these evaluations are being made *all the time.*

Personal Development

Engineering can be a challenging and rewarding profession. Your personal goals should be ambitious enough to be challenging, but realistic enough to avoid frustration. Continued education is a must, if you are to avoid technical obsolescence. It can be formal, in graduate school or in training programs, or informal, through reading and self-study. Seek to develop yourself so that you are ready for the next job, but realize that you are most likely to get a chance at the next job if you do an excellent job of the one you have now.

A study of those whose names are remembered for significant achievement reveals one trait almost universal - the practice of doing more than was required, specified, or paid, for. A career of distinction results from something more than eight-to-five performance; rather, it is the result of a whole-hearted commitment to perform at one's best no matter how unappreciated such effort may appear to be. Out of such effort comes the type of work that attracts attention for its excellence, and the internal satisfaction that gives one the confidence to take on a more difficult challenge when it is presented.

LICENSE

Registration

Registration is the legal recognition of the Professional Engineer

Registration certifies that the engineer has demonstrated technical competence and has met certain prescribed qualifications. In the eyes of the public, registration is assurance that one can be entrusted with the work involved in the practice of engineering… thus, the legal ground for registration: "to safeguard life, health, and property and to promote the public welfare."

For some engineers, registration is required by law.

For others, registration is a symbol of achievement which affords professional recognition among associates and professional identification to the public.

Should the young college graduate plan on obtaining registration?

Frequently, the answer is yes, for registration is one way to protect your investment in an engineering education. If the recent rapid growth in registration continues, the practice may soon be virtually universal. You will want to have a new and definite goal to strive for, one that will bring you a sense of achievement and the recognition of your associates and friends now that your college degree is safely won. *You will want to keep all doors of opportunity open to you until you are firmly settled in your career*. In fact, there are some you cannot enter without the license as a key. You will want to share all possible gains in recognition which engineers may enjoy, and the license may be increasingly important to that end. You will want to assure yourself of full professional recognition by any court or legislative body or regulatory commission before which you may one day appear. You will want to have your professional status recognized in any other state or country to which your work may take you.

These are weighty practical considerations. Unless you are clearly destined for a business career, or for a long postgraduate training in research or pure science, enlightened self-interest and a sense of professional citizenship will lead you to consider registration as soon as possible.

Professionalism and Unionism

An understanding of professionalism and the impact of union activity on professional engineers will assist you in future decisions involving these issues.

No attempt is made to represent unionization as being advisable or as being out of the realm of the professional engineer in practice. Rather the issue is presented so the young engineer can be mindful of the problems encountered and weigh the concepts of professionalism and unionism.

What does it mean to be a member of a "profession"?

Volumes have been written by engineers and scholars in an attempt to define what constitutes a profession. Dictionary definitions are inadequate; legal definitions, such as those in the Taft-Hartley Act, are cold and vague. There have been numerous attempts to put both the letter and the spirit together to define a profession. The following points will serve as an outline of the major attributes of the engineering profession:

1. The engineering profession satisfies an indispensable and beneficial social need.
2. The profession requires the exercise of discretion and judgment and is not subject to standardization.
3. It is a type of activity conducted upon a high intellectual plane with knowledge and skills not common to the general public.

4. It has as an objective the promotion of knowledge and professional ideals for rendering social services.
5. It has a legal status and requires well-formulated standards of admission.

This description does an excellent job of covering the intellectual and legal requirements of the profession but does little to expand upon the ethical responsibilities of the professional. Most technical societies, as well as NSPE and the Engineers' Council for Professional Development, have adopted codes of ethics. These codes serve as a framework within which the professional may define the limits of right and wrong in the practices of the profession. These ethical considerations are tied closely to the professional's responsibility to provide for the health, safety, and welfare of the general public. It is important that you take the time to reflect upon the higher and broader definition of a profession as it applies to the true professional.

When considering the alternatives for employment, one of your most important considerations should be the prospective employer's attitude toward professionalism and his commitment to provide a professional atmosphere in which to work.

Lack of this professional atmosphere, coupled with economic factors, has led to unionization among some professional engineers. This unionizing effort can be traced back to 1918, when the International Federation of Draftsmen Union, later known as the American Federation of Technical Engineers, was chartered. Although other attempts at organizing engineers were made, none achieved any measure of success until the post-war recession years of the early 1950s.

The Taft-Hartley Act, passed in 1947, attempted to define professional and non-professional employees and allowed professional employees to vote separately on the question of union representation. Under this Act, there were attempts to organize professional engineers as separate groups throughout the nation and by the early 1950s there were 17 engineering unions of various sizes in existence. These 17 unions formed a federation know as "Engineers and Scientists of America" (ESA) with the purpose of promoting the economic, professional, and social welfare of engineering and scientific employees. Approximately 5% of the total engineering population supported this federation. ESA collapsed in the 1960s for various reasons, the primary one being the strong demand for engineers and scientists during this period. When the economy weakened in the early 1970s, the demand for engineers and scientists plummeted. Since that time, engineers in both the public and private sector have shown growing interest in the promise of economic gain through collective bargaining. The situation is not unique to the engineering profession: the medical and legal professions are both experiencing similar trends.

The basic issue involved here is whether or not collective bargaining for wages and working conditions is compatible with the professional practice of engineering.

Many engineers find it difficult to imagine a member of one of the "learned professions" engaged in the activities associated with a union. This question has caused serious problems among professional engineers. Many engineers have found themselves in situations where they felt need for a voice stronger than that of the individual engineer. Yet, they had serious difficulties in imaging themselves as union members. The National Society of Professional Engineers has been active in studying this problem and in formulating alternatives to unionism. The concept of collective action, rather than collective bargaining, has been developed as an alternative, making it possible for engineers to work together with the management of the company, institution, or government agency, to solve the problems confronting the engineer. This approach contrasts with the collective bargaining approach, where the paid union negotiator, representing the employee, sits across the bargaining table from management's representative, making demands and backing up the demands with threats of economic actions, such as strikes, boycotts, and slow-downs.

As an engineer entering the profession, you are certain to be faced sometime during your career with the question of unionism and collective bargaining as solutions to your job-related problems. There are many papers and discussions which outline the history of this subject and go into great depth concerning the legal and ethical considerations involved. The question is a serious one, but one you must answer for yourself. Several readings are suggested in the following bibliography.

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The Engineer's Heritage

As an engineer, you are a member of a great profession, long an art and now a science. Your heritage dates back to the discovery of the lever, the wheel, and the screw, the great Roman road builders, and the discoverers of electrical energy. It accelerates through the industrial revolution, and encompasses the dramatic endeavors the profession has made to serve man and improve his environment and quality of life.

Today, more than ever before, engineering progress depends on the organized efforts of highly trained and competent people.

By instinct and tradition, engineers tend to be collaborators, most successful when getting things done by team effort. Science progressed slowly until observers began to preserve detailed records and to pool their observations and submit their discoveries to critical scrutiny. This exchange of information is formalized today in the meetings and publications of the engineering societies.

The Birth of the Engineering Societies

Engineering flowered in Britain during the industrial revolution…while the British educational system neglected scientific training and stressed apprenticeship. The first organization of engineers, The Institution of Civil Engineers, was established in 1818 by eight machine builders to supplement the apprenticeship system. They chose the title "Civil Engineers" simply to distinguish themselves from military engineers, but the Institution gradually developed its primary interest in fixed construction. George Stephenson, a self-taught master of the principles of mechanics, who gained great fame as the father of the steam locomotive, found the interests of the Institution less than relevant, and he helped found a new British society, the Institution of Mechanical Engineers. Thus began the movement which has resulted in the specific engineering societies available to you today.

Your engineering society provides strong encouragement to the free exchange of experience and the wide publication of knowledge.

It is not an exclusive caste, but an organization very much interested in young engineers like you, who are trying to become established in the profession. You will find unusual profit, inspiration, and enjoyment in this organized professional life which helps establish the integrity of the profession. It is an important part of your heritage.

The Establishment of Scientific Management

The engineer's role in industry has been conspicuous and dynamic: creator of structures, materials, machines, electronics, and technical services; but he has also been conspicuous as the developer of scientific management, organizing the work of others, thus taking the guess-work not only out of processes and products, but also out of every element from financing to research.

Your heritage of leadership is a reflection of the needs of our civilization which cannot be maintained or defended without engineering.

For example, fewer than one tenth of the world's people produce enough food to feed all mankind. If all are to enjoy a high standard of living, the rest must live by industry, trade, personal service, and the work of government. As our endowment of natural wealth shrinks, it must be replaced by wealth originating in the laboratories of science. As an engineer, you are the indispensable executor of science in an industrial society.

A few individuals like Edison, Watt, or Roebling have had great influence on the development of the profession, but in general, engineering has grown through the contributions of thousands who have found a sense of fulfillment in the making of a great civilization.

As a young engineer today, your opportunity to contribute to this growing heritage is almost limitless.