Chapter 2:

The Field of Engineering Technology

From *Studying Engineering Technology: A Blueprint for Success*

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Introduction

The purpose of this chapter is to introduce you to the field of engineering technology and to the many functions, opportunities, and career paths it offers.

We will start with a brief overview of the field in order to concentrate on the **rewards and opportunities** that will come to you when you are successful in graduating with your A.S. or B.S. degree in engineering technology. Having a clear picture of the payoff will be a major factor in motivating you to make the personal sacrifice and put in the hard work required to succeed in such a challenging and demanding field of study.

Next, we will answer the question:

What will I do as a technician or technologist?

We will do this by focusing on the **technological spectrum** and the place of engineering technology within this spectrum. We will then discuss the various **engineering technology disciplines** and the **job functions** of technicians and technologists. Finally, we will open your **horizons to the future** by describing the numerous employment opportunities that will be available to you upon graduation, highlighting those fields that show the greatest promise for growth.

The last section of the chapter will focus on **engineering technology as a profession**. We will look at eleven principles that distinguish the engineering technology profession. We also will discuss the importance of **professional registration** for engineering technologists and **professional certification** for engineering technicians. The chapter will conclude with a discussion of the role of **professional societies**.

2.1 Learn as Much as Possible about Engineering Technology

Why did you choose engineering technology as your major? Perhaps because you were good in math and science, liked to build and analyze things, or one of your teachers or counselors recommended that you study engineering technology. Or maybe you are doing it to please your parents, or because you don't know what else to do. It is very likely you don't know a great deal about engineering technology. Few students do.

<u>You Tend to Be More Aware of Other Fields</u>

As you have grown up, you have been exposed to teachers, doctors and dentists, ministers and rabbis, and pharmacists. You have a feel for what accountants do through managing your own finances. You have seen lawyers at work on TV shows such as *Law and Order*. Through your coursework you have developed some understanding of what mathematicians, chemists, and physicists do. You may have some idea of what engineers do, but it is doubtful that you have had much exposure to engineering technology. The exposure you have had has probably been indirect, through contact with the products that technology produces.

<u>Learning about Engineering Technology is Important</u>

How important is it to you to graduate in engineering technology? How strong are your motivation and commitment? Regardless of your reasons for being here, it is critically important that you develop a strong motivation. In Chapter 1, **determination to persist** was noted as a key factor for success in engineering technology study. Engineering technology is a demanding field of study. Even a student with excellent preparation and strong ability will not succeed without a high level of commitment.

An important aspect of developing your commitment to engineering technology study is increasing your awareness of technology as a profession. In particular, you need to know the opportunities and rewards that you will receive when you graduate with your A.S. or B.S. degree. After all, how can you expect to make the personal sacrifices and put in the hard work required unless you have a clear picture of what the "return" is and how that return will enhance your life?

Dr. Lawrence J. Wolf, for many years President of Oregon Institute of Technology (OIT), defines engineering technology in a promotional brochure, "The Added Value of Engineering Technology." In this brochure, he says:

> ***Engineering technology draws upon the same body of knowledge as engineering, but centers more heavily upon the applications related to manufacturing, testing, construction, maintenance, field service, and marketing. Youths and adults with an interest in building and making things and in making things work should consider engineering technology education. Employers newly concerned about manufacturing quality, decentralized responsibility, and market responsiveness should consider engineering technology programs among their sources of personnel.***

While Dr. Wolf's remarks are illuminating, they still may leave you wondering just what engineering technology entails. I myself have difficulty answering the question, "What is engineering technology?" It contains elements of science, engineering, and mathematics. It also draws on mechanical skills, abstract thinking, and laboratory skills.

The standard definition is that:

> ***<u>Engineering technology</u>*** **is the profession in which a knowledge of mathematics and natural sciences, gained by higher education, experience, and practice, is devoted primarily to the implementation and extension of existing technology for the benefit of humanity. Engineering technology education focuses primarily on the applied aspects of science and engineering, aimed at preparing graduates for practice in that portion of the technological spectrum closest to product improvement, industrial practices, and engineering operational functions [1].**

This definition helps, but technicians and technologists do so many different things and perform so many different functions that no single definition is adequate.

Take Every Opportunity to Learn about Engineering Technology

Learning about engineering technology will be a lifelong process, but it should begin now. Take advantage of every opportunity that presents itself. Start by studying this chapter thoroughly. Attend seminars on career opportunities, go on field trips to industry, talk to industry representatives at career day programs. Browse the resource library in your career planning and placement office. Become active in the student chapter of the professional engineering society corresponding to your major. Learn from your professors. Talk to graduates of your institution who have gone on to become successful. You can learn a great deal from such role models. If you have a summer job in a company, be curious and inquisitive. Look around. Talk to the technicians or technologists and find out what they do.

Over time, these efforts will pay off and your understanding of engineering technology will increase. Increased knowledge will bring increased motivation. We tend to like things we know a lot about.

2.2 Rewards and Opportunities of a Technological Career

Engineering technology is a unique and highly selective profession. Only about five percent of all employees in the U.S. are technicians, technologists, or engineers.

Even among college graduates, engineering technologists are represented in small numbers, as shown by the data below for 2002/03 graduates [2]:

Major	**Number of 2002/03 College Graduates**	**Percent of Total**
Business	293,545	21.8%
Social Science	143,218	10.6%
Communications/English	123,462	9.2%
Education	105,790	7.8%
Math and Science	90,505	6.7%
Psychology	78,613	5.8%
Visual and Performing Arts	71,474	5.3%
Health Professions	71,223	5.3%
Engineering	62,611	5.4%
Computer and Information Sciences	57,439	4.6%
Liberal Arts and Humanities	40,221	3.0%
Engineering Technology	14,656	1.1%
TOTAL	1,348,503	100.0%

You should note that the "Engineering Technology" category above lists only B.S. degree recipients. We could include A.S. degree recipients as well, and those figures would boost the overall "Percent of Total." Still, these statistics underscore the fact that engineering technology is a unique and selective profession.

So why choose to study engineering technology? Why seek to become one of those few college graduates who receive their A.S. or B.S. degree in engineering technology? What are the benefits that will come to you if you graduate in this field?

The benefits of an engineering technology education and the rewards and opportunities of a career in engineering technology are numerous. Students in an orientation class are often asked to make a list of reasons why they want to study engineering technology. They might develop a list of 30 to 40 reasons. Some are more important than others, depending on personal preferences. To one person, being well paid may be #1. Someone else may be attracted by the opportunity to do challenging work. Still another person may value engineering technology as a career because it will enable him or her to make a difference in people's lives.

The following is my "top ten list" of reasons for studying engineering technology:

Steve's Top Ten List

1) **Job satisfaction**
2) **Challenging work**
3) **Financial security**
4) **Intellectual development**
5) **Opportunities to understand how things work**
6) **Opportunities to benefit society**
7) **Variety of career opportunities**
8) **Professional work environment**
9) **Prestige**
10) **Avenues for expressing creativity**

1. Job Satisfaction

What do you think is the #1 cause of unhappiness among people in the United States? Health problems? Family problems? Financial problems? No. Studies have shown that, by far, the biggest cause of unhappiness among people in the U.S. is **job dissatisfaction**.

Do you know people who dislike their job? People who get up every morning and wish they didn't have to go to work? People who watch the clock all day and can't wait until their workday is over? People who work only to earn an income so they can enjoy the time that they don't have to work? Maybe you have been in that situation. Lots of people are.

Throughout my career, it has been very important to me that I enjoy my work. After all, I spend eight hours or more a day, five days a week, fifty weeks a year, for thirty or forty years working. This represents about 45 percent of my waking time. Which would you rather be: a person who spends 45 percent of his life working and dislikes every minute of it, or a person who spends 45 percent of his life working and loves it? I hope you agree with me that it is extremely important to find a life's work that is satisfying, work that you enjoy.

Engineering technology could very well be that life's work. It certainly has been for me and for many of my colleagues over the years. There are numerous reasons why engineering technology work can be satisfying. Some of these are discussed in the following sections.

2. Challenging work

Do you like intellectual stimulation? Do you enjoy taking on challenging problems? Not everyone does. If you do, however, engineering technology is for you. Certainly, during your years as an engineering technology student, you will face many challenging problems. But, as the saying goes, "you ain't seen nothing yet." In the technological work-world, there is no shortage of challenging problems. Any technical manager will tell you that they have a huge backlog of problems they need solved. What they lack is someone to solve those problems. You could be that person.

Much of your engineering technology education will prepare you to be the kind of problem solver that so many companies need. To this end, a portion of your coursework will likely consist of actual problems from industry that you and a team of other students will be asked to solve. Under a faculty member's guidance, such projects provide valuable learning experiences for students—while costing the company very little.

Generally, however, the problems you will solve in school differ from "real-world" technical problems. In school, most problems have a single correct answer. It would be better if they were more "open-ended," allowing for a number of possible solutions. But open-ended technical problems are difficult for your professors to make up, take more time for students to do, and are excessively time-consuming to grade.

When you get into the technological work-world, however, virtually all problems will be open-ended. There will be no single answer, no answer in the back of the book, no professor to tell you that you are right or wrong. You will be expected to select the best solution from many possible solutions and persuade others that your solution is the one to adopt.

3. Financial security

When I ask a class of students to come up with a list of the rewards and opportunities that success in engineering technology studies will bring to them, money is almost always #1. As you saw in my "Top Ten List," I have it #3. It's not that technicians and technologists don't make good money. They do! But I cannot deny that financial security is important to me. I have always been "security conscious," and because of my desire for a predictable income, I never would have been happy as an entrepreneur. My wife successfully ran her own company for a time, and it drove me crazy just watching from the sidelines. Yet, I have had many students who would not hesitate to start their own company rather than work for someone else. Because that is not me, I have ranked financial security pretty high (as many of you do).

Having said that, I also strongly believe that if you choose something you like doing, work hard at it, and do it well, the money will take care of itself. I admit this is easy for someone to say who chose the engineering field. It probably is not true for all career choices. Still, I hope that you don't make money your primary reason to study technology. Other things are much more important to the quality of your life.

Financial Security Is Important, But . . .

There are many things in life that are far more important to me than money. Certainly, job satisfaction and challenging work fit that category. My wife, children, grandchild, parents, and my faith are all far more important to me than money. As I think about it, my family and I were just as happy years ago when I was in the Navy, living in base housing and earning very little income. I sometimes think we had even more discretionary income then than we do now! While all of us want to know that the bills will be paid, beyond that, money is not a huge motivator for most of us. In fact, many families these days are voluntarily downsizing to simplify their lives. There is a wonderful book called <u>Your Money or Your Life</u>, by Joe Dominquez and Vicki Robin [3], that has motivated hundreds of people to analyze their priorities and simplify their lives. You might want to get a copy and read it now, at the beginning of your career, before you fall into some of the "traps'" that many people have fallen into.

If you do choose engineering technology, however, **you will be rewarded financially**. Technical people are well paid. Computer science and engineering graduates receive the highest starting salary of any disciplines, and engineering technologists are not far behind, as shown by the data below.

Beginning Offers to 2005 Graduates [4]

Discipline	**Avg. Salary**
Computer Science	$51,042
Engineering	49,619
Engineering Technology	**47,109**
Construction Science/Management	41,566
Business	40,934
Nursing	38,788
Sciences	37,280
Agriculture & Natural Resources	30,930
Education	30,700
Communications	30,266
Humanities & Social Sciences	29,061

It is not unusual for technicians and technologists to receive four or five good job offers at (or before) graduation. They almost always receive many more job offers than other college graduates do. Employers want and need technological graduates, and they seek them out by recruiting them and offering them excellent salaries. Of course, these are "base" salaries and do not include fringe benefits—which for professionals can be as high as 40 percent of their base salary.

Salary data is not as readily available for engineering technicians as it is for engineering technologists, but annual starting salaries will typically be in the $35,000 to $40,000 range. Of course, both technicians and technologists will have opportunities and salaries that fit along a "bell curve." That is, some graduates will receive fewer offers and lower than average salaries, while others will have more offers than they can deal with at salaries way above average. I have known several B.S. graduates who started their first job after graduation with a salary as high as $60,000 and A.S. graduates who started as high as $50,000. While these examples are not typical, they indicate that wide variation is possible. Regardless of this variation, I can assure you that students who work hard and earn good grades, are active on campus, and have good communications and interpersonal skills are very likely to do well. Rarely are these students disappointed with their job offers or salaries.

4. Intellectual development

Engineering technology education "exercises" your brain, developing your ability to think logically and to solve problems—much as working out at a gym develops your muscles. These days, cognitive research is teaching us much about the potential for developing our minds. For example, we know that the brain is made up of as many as 180 billion neuron cells. Each neuron cell has a large number of tentacle-like protrusions called dendrites. The dendrites make it possible for each neuron cell to receive signals (synapses) from thousands of neighboring neuron cells. These "neural networks" are determined in large part by our experience. When we study and learn, we develop new connections in our brain. Research also shows that we can "exercise" our brain by active thought well into old age, so that "senility" (barring any organic reasons) need never happen.

One of the assets I value most from my college education is my logical thinking ability. I feel quite confident in my ability to solve problems—and not just technical problems. I can use these skills to take on such varied tasks as planning a vacation, seeking a job, dealing with my car breaking down, organizing a banquet to raise money, purchasing a new home, consulting with industry, running a university, or writing this book. I'm sure that you will also come to value the role your technical education plays in developing your mind and your ability to solve problems.

5. Understanding how things work

Do you know why golf balls have dimples on them? Do you understand how the loads are transmitted to the supports on a suspension bridge? Do you know what a laser is, or how a computer works? When you drive on a mountain road, do you look at the guard rails and understand why they were designed that way? Do you know why split-level houses experience more damage in earthquakes? Do you know why we use alternating current (AC) rather than direct current (DC)? One thing I value about my technical education is that I understand how the objects and systems around me work.

Furthermore, there are many serious questions facing our society that depend on an understanding of technology. Why don't we have zero-emission electric vehicles rather than highly polluting cars powered by internal combustion engines? Should we have stopped building nuclear reactors? What will we use for energy when the oil runs out? Can we count on nuclear fusion? Should we have supersonic aircraft, high-speed trains, and automated highways? Is it technically feasible to develop a "Star Wars" defense system to protect us against nuclear attack? Why are the Japanese building better quality automobiles than we are? Can we produce enough food to eliminate world hunger? Do high-voltage power lines cause cancer in people who live or play near them?

Your technological education will equip you to understand the world around you and to develop informed views regarding important social, political, and economic issues facing our nation and the world. Who knows, maybe this understanding will lead you into politics.

6. Benefiting society

I hope that you are motivated to do something worthwhile in your career, something that will benefit society. Engineering technology can certainly be the field that enables you to do this.

Many educational institutions, from high school on up, are beginning to emphasize "service learning." It is important for students to discover that there are many advantages, as well as great satisfaction, in serving others. I am always pleased to see college students participating in activities such as feeding the homeless, donating clothing, tutoring disadvantaged youth, organizing voter registration drives, and the like. Activities such as these should become part of everyone's life.

Certainly you have chosen a career that offers countless opportunities to serve your fellow human beings. Just about everything that technicians and technologists do benefits society. They work with transportation systems that enable people and products to move about so easily. They design the buildings that we live and work in. They implement the systems that deliver our water and electricity, design and maintain the machinery that produces our food, and develop and repair the medical equipment that keeps us healthy. Almost everything we use was made possible by engineers, technologists, and technicians.

Depending on your value system, you may not view all things that technicians and technologists do as benefiting people. For example, you may have moral concerns about working with military equipment like missiles, tanks, bombs, artillery, and fighter airplanes. You also may find it unethical to contribute to the production of pesticides, cigarettes, liquor, fluorocarbons, or asbestos. Of course, technical people working in such areas have their own reasons and values to justify their involvement. Take, for example, the 1991 Gulf War. One could argue that many more lives would have been lost were it not for the "surgical" capability of our laser-guided weapons systems. Military technology and the development of these high-tech weapons permitted the precise bombing of military targets, while largely sparing the civilian population from harm.

As an engineering technician or technologist, you will need to examine your own value system in deciding what work you are willing to do. Fortunately, the vast field of engineering technology has numerous opportunities for work that will clearly benefit society. Entire careers can be devoted to projects such as cleaning up the environment, developing prosthetic aids for disabled persons, developing clean and efficient transportation systems, finding new sources of energy, helping solve the world's hunger problems, or increasing the standard of living in underdeveloped countries.

7. Variety of career opportunities

How do you view engineering technology? Do you see it as solving math or science problems? As designing or building something? As conducting laboratory experiments? Engineering technology can involve some or all of these things, but it is much more. When you receive your associate's degree in engineering technology, you will have opened a door than can lead to rewarding careers and degrees in a variety of fields. If you earn a bachelor's degree, you will find many, many ways you can go upon graduation.

As we will discuss shortly, engineering technology offers an enormous variety of jobs. Positions for those who complete their A.S. degree include biomedical technicians, instrumentation technicians, testing technicians, automotive technicians, industrial maintenance technicians, computer technicians, and literally dozens of others.

Engineering technology graduates also qualify for many types of applied engineering positions. Although a B.S.E.T. graduate is technically not an engineer, companies frequently hire engineering technologists for positions such as manufacturing engineers, analytical engineers, test engineers, development engineers, city or county engineers, power plant engineers, sales engineers, and customer service or field engineers.

Most engineering technologists utilize the applied practice and problem solving aspects of their education much more than the theoretical abstract components, pointing to the fact that engineering technology *study* and engineering technology *work* can be somewhat different. A major value in the calculus-based, theoretical portion of your education is not so much in the day-to-day need to utilize it on the job, but rather in its value in helping you understand the underlying fundamentals that all practical industrial applications, as well as emerging technologies, are built upon.

Even if engineering technology graduates do not spend all of their professional lives as technicians or technologists, they would certainly say that the practical and problem solving skills they learned in school prepared them for success in whatever area they subsequently chose. By stressing these basic skills, engineering technology studies provide a strong foundation for many professions—like law, business, or even medicine. I know quite a few B.S.E.T. graduates who have become successful politicians, company presidents, teachers, plant managers, sales managers, and entrepreneurs who have established their own companies.

8. Professional work environment

As an engineering technician or technologist, you will work in a professional environment. You will be treated with respect. You will work with other professionals.

You will have a certain amount of freedom in choosing your work. And you will be in a position to influence the directions taken by your organization.

You will be provided with adequate workspace and the tools you need to do your work, including the latest computer equipment and software. You will also be provided with the support staff you need to get your work done. After all, your employer will benefit from making sure you have what you need to do a good job.

You will usually not be required to punch a time clock (some two-year graduates may be, but most four-year graduates will not). Rather, you will be judged on your productivity—i.e., on the quality and quantity of your work. You can usually expect to receive an annual merit salary increase, which will be based on your management's evaluation of your performance.

You will have the opportunity to learn and grow through both on-the-job and formal training. Early on, your immediate supervisor will closely mentor you and bring you along through the assignment of progressively more challenging tasks. You will also learn from more experienced engineers, technologists, and technicians in your organization. To complement your on-the-job training, you will be offered seminars and short courses conducted by your company or an outside organization. Most likely, your employer will have an educational reimbursement program that will pay for you to attend a local university to take courses for professional development or to pursue an advanced degree.

As a professional in industry, you will receive liberal benefits, which typically include life and health insurance, sick leave, paid vacations and holidays, a retirement plan, and a savings or profit-sharing plan.

9. Prestige

What is prestige? *Prestige* is defined a "the power to command admiration or esteem." You may have already experienced the prestige associated with being an engineering technology major. Just stop on campus to talk with another student, and see the reaction you get when you say you are an engineering technology major. It will probably be one of respect, even a bit of awe.

Engineering technology is a respected field of study. Everyone knows that it requires hard work, and people assume that you must be a serious, highly capable student since you are taking some of the most challenging courses on campus.

I often ask students to tell me what professions are more prestigious than engineering technology. "Medicine" always comes up immediately. I agree. If you want to be a medical doctor and have the ability, you should go see a pre-med advisor and get started on your program. Doctors are well paid and highly respected for the essential role they play in helping people. I certainly want to have the most capable and best-trained people as my doctors.

Generally after medicine, law, business, architecture, or even theology will come up. I'll argue against these as being more prestigious that engineering technology. Whether you think they are or not, the point is that engineering technology is a highly respected profession. There is general agreement that engineers, technologists, and technicians play a primary role in sustaining our nation's international competitiveness, in maintaining our standard of living, in ensuring a strong national security, and in protecting public safety.

Engineers, technologists, and technicians are critical to our:

International competitiveness
Standard of living
National security
Public safety

10. Expressing your creativity

Engineering technology is by its very nature a field that emphasizes creativity. The word "engineering" derives from the Latin word *ingenium*, which means "ingenious." Engineers, technologists, and technicians all have great opportunities to be ingenious, inventive, and creative. Indeed, these opportunities are practically unlimited. Engineers, technologists, and technicians are typically teamed together to develop solutions to open-ended, real-world problems—problems to which there is rarely a single correct solution. Ultimately, the team's job is to choose the best solution of those that have been identified. However, the "best" solution is sometimes overlooked because of barriers to creative thinking, such as false assumptions, negative thinking, fear of failure, and discomfort with ambiguity.

An excellent book that could help you improve your creativity is *Creative Problem Solving: Thinking Skills for a Changing World* by Edward and Monika Lumsdaine [5]. According to the Lumsdaines:

> ***CREATIVITY*** **is playing with imagination and possibilities, leading to new and meaningful connections and outcomes while interacting with ideas, people, and the environment.**

This is just what technical people do. In fact, this could almost be a definition of "engineering technology."

The need for technicians and technologists to think creatively is greater now than ever before, because we live in a time when the rate of social and technological changes have greatly accelerated. Only through creativity can we cope with and adapt to these changes. If you like to question, explore, invent, discover, and create, then engineering technology could be the ideal profession for you.

2.3 What is Engineering Technology?

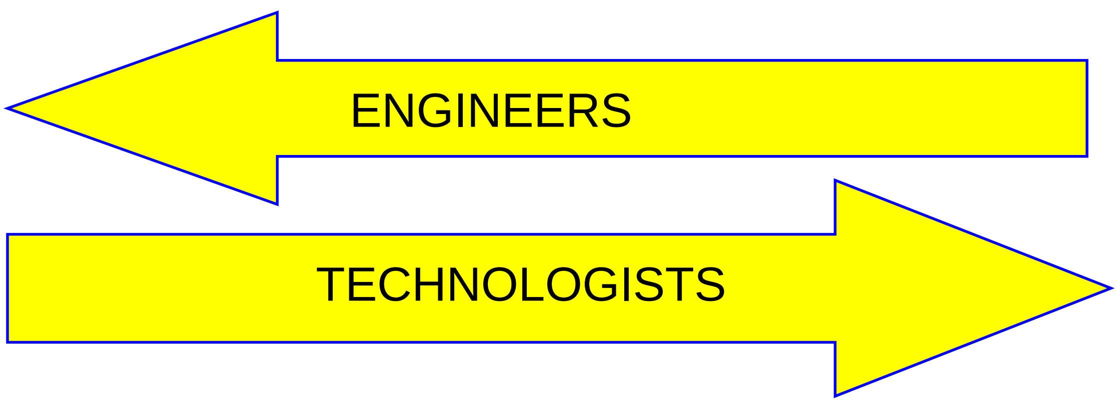
Earlier in this chapter, you were urged to learn as much as possible about engineering technology. You were given a brief overview of the field to preface my “Top Ten List” of the rewards and benefits of studying engineering technology. We now need to flesh out that introductory sketch, so that you have a solid understanding of the field.

As noted before, engineering technology is not an easy field to define. Those of us who have spent our professional lives in engineering technology education know how difficult it often is to explain our field to prospective students and their parents. Even “engineering” is not a well-understood field in our society. Many think they know pretty well what an engineer does, but on close examination, they usually do not. This lack of understanding is compounded for engineering technology. Especially at the baccalaureate level, engineering technology is so closely related to engineering that it is hard to make gross distinctions between them. Many employers do not make distinctions and utilize both types of graduates in the same, or nearly the same, ways.

To understand engineering technology, I find it useful to visualize a *technological spectrum*, showing both the professions and functions found within it. Figure 1 illustrates this spectrum:

Figure 1. The Technological Spectrum

Research	**Product Design**	**Product Development**	**Manufacturing**	**Production Testing**	**Technical Sales**	**Field Service**



Notice that the spectrum is horizontal rather than vertical, indicating that all functions are equally important in creating technical products. Since American industry is very diverse, one finds individuals with every level of educational background working throughout the spectrum. However, scientists would most likely be found employed doing the functions toward the left-hand side of the spectrum, while technicians and craftspersons would most likely be found doing the functions toward the right. Engineers and technologists would see a great deal of overlap in their functional interests, and they would most likely be employed throughout the middle part of the spectrum.

Generally speaking, scientists are best prepared to study the basic nature of things. Their interests lie along the lines of trying to understand the "why" of things in our universe. Engineers and technologists have interest that tend toward the "how" of things—that is, how to take the findings of the sciences and use them to develop useful products for humankind. Engineers are often interested in the conceptual development of new products, while technologists are often interested in improving existing technologies and building and refining products.

The great strength of engineering and technology, however, is their diversity. In spite of the tendencies described above, it is not unusual to find technicians and technologists working in research labs or engineers selling and maintaining technical products. Technical specialties have become so sophisticated that it also is not unusual to find individuals who are very focused and do not have the title of either technologist or engineer. An example might be a computer networking specialist or a telecommunications specialist. Or one might hold a B.S. degree in manufacturing, with no other modifier. Such is the diversity of today's technical world.

To illustrate this diversity, let's look at an example or two of how members of a technical team might interact. Consider the design and manufacture of aircraft. At the "research" end of the technological spectrum, scientists would be employed to research new materials, such as composites, that might be suitable structural materials for the aircraft. Research engineers would be employed to study the scientists' input and develop feasible aircraft designs. Developmental and design engineers would work on implementing "flyable designs" for the proposals coming out of the scientific and engineering research labs. Manufacturing engineers and technologists would be engaged in preparing to manufacture the selected design. Technicians and craftspersons would be involved in fabricating and testing all of the components, as well as actually assembling the aircraft.

Another example might be helpful. Consider the design and manufacture of digital satellite systems. Scientists and theoretical engineers would be engaged in studying the characteristics of signal transmission, including ways to optimize signal strength to ensure consistently clear reception of satellite TV signals. They also might study ways to improve the fidelity of the signals through digitization processes. Applied engineers and technologists would likely be involved in the refinement and quality design of the various components as well as the manufacturing process itself, while fabrication and testing technicians would do the actual production of the satellite dishes and receivers.

Of course, in most industries there is great overlap among all these functions, and the delineations reflected in the examples above are not usually this clear-cut.

2.4 Engineering Technology Disciplines

The technological spectrum and examples in the previous section provide a good start to our goal of defining the field of engineering technology. With the context that section established, we can now enhance our understanding of this complex, diverse field by examining the many disciplines in it.

Since industry usually does not make disciplinary distinctions between engineering and engineering technology, we won't dwell much on it either in this section.

Engineering technology disciplines in technical institutes, colleges, and universities virtually parallel their engineering counterparts and exist in **almost** a one-to-one correspondence.

Engineers, engineering technologists, and engineering technicians can all be classified by their fundamental academic discipline. We have:

- **Electrical and electronics engineering technology**
- **Computer engineering technology**
- **Mechanical and manufacturing engineering technology**
- **Civil and construction engineering technology**
- **Architectural and design drafting**
- **Industrial engineering technology**

These are the larger areas of engineering technology. Over eighty percent of the engineering technology B.S. degrees awarded in 2004 were in the first four disciplines listed above. About 73 percent of the A.S. degrees in engineering technology awarded that year also were in these areas, if you include the architectural and design drafting fields.

There are also more specialized, non-traditional fields of engineering technology. Aerospace/aeronautical, materials, biomedical, marine, environmental, petroleum, mining, nuclear, and textile are examples. The following chart shows the number of programs and bachelor's degrees awarded in 2004 in each engineering technology discipline [6].

ENGINEERING TECHNOLOGY DISCIPLINES RANKED BY NUMBER OF B.S. DEGREES—2004

Engineering Technology Disciplines	Number of Accredited Programs*	B.S. Degrees Awarded in 2004	Percent of Total E.T. Degrees
Electrical and Electronic	115	2,250	23.9%
Computer	33	1,360	14.5
Mechanical	67	1,296	13.8
Construction	23	748	8.0
Industrial	9	563	6.0
Civil	31	483	5.1

* A listing of accredited Engineering Technology programs at both the A.S. and B.S. degree levels by discipline, institution, state, and region can be found on the web at: http://www.abet.org/accredittac.asp

Manufacturing	32	469	5.0
"Other"	12	467	5.0
General	5	443	4.7
Nuclear	2	259	2.8
Architectural	7	198	2.1
Aeronautical	2	161	1.7
Chemical	4	127	1.4
Electro/Mechanical	8	112	1.2
Drafting/Design	2	93	1.0
Automotive	1	84	0.9
Marine	2	69	0.7
Mining/Metallurgy/Welding	0	44	0.5
Heating, Ventilating, and Air Conditioning	0	37	0.1
TOTAL	**355**	**9,396**	**100.0%**

The following sections provide information about each engineering technology discipline. More detail is provided for the "more popular" disciplines (i.e., those with higher enrollment and more employment opportunities).

Electrical and Electronics Engineering Technology

Electrical and electronics engineering technology is the largest of all the engineering technology disciplines. Electrical engineers, technologists and technicians are concerned with electrical devices and systems and with the use of electrical energy. Virtually every industry utilizes electrical and electronic equipment, every business and home requires electric power and electronic devices, so electrical engineering technologists and technicians have extensive employment opportunities. Evidence of the work they do can be seen in the microwave ovens in our homes, in the computers and communications devices used by businesses, in numerically controlled machines used by manufacturing companies, and in the early warning systems used by the federal government to ensure our national security.

The Institute of Electrical and Electronics Engineers (IEEE), which has thousands of technologists and technicians as members, is the largest of all of the professional engineering societies. With more than 365,000 members, it is organized into the following 39 technical societies, which represent the interests of its members.

Technical Societies of the IEEE

Aerospace and electronic systems	**Antennas and propagation**
Broadcast technology	**Circuits and systems**
Communications	**Electromagnetic compatibility**
Ultrasonics, ferroelectrics, and frequency control	**Components, packaging, and manufacturing technology**
Computer	**Control systems**
Consumer electronics	**Education**
Dielectrics and electrical insulation	**Electron devices**
Engineering management	**Industrial electronics**
Geoscience and remote sensing	**Information theory**
Industry applications	**Lasers and electro-optics**
Instrumentation and measurement	**Microwave theory and techniques**
Magnetics	**Oceanic engineering**
Nuclear and plasma sciences	**Power engineering**
Computational intelligence	**Solid-state circuits**
Power electronics	**Reliability**
Professional communication	**Signal processing**
Robotics and automation	**Systems, man and cybernetics**
Social implication of technology	**Vehicular technology**
Product safety engineering	**Intelligent transportation systems**
Engineering in medicine and biology	

The listing of IEEE societies gives you an idea of the scope encompassed by the broad electrical engineering field. Within electrical engineering technology programs of study, the above 39 societies fall into six primary technical specialties:

Computers
Electronics (Analog and Digital)
Communications/Telecommunications
Power Generation and Distribution
Controls
Instrumentation

At many institutions, **Computer Engineering Technology** is a subspecialty or option within the electrical engineering technology program, while at other institutions, it is a totally separate degree program. Computer engineering technology will be discussed in a later section.

Electronics deals with the design of circuits and electric devices to produce, amplify, detect, or rectify electrical signals. Electronics is a rapidly changing field because of new advances in microelectronics. Our standard of living has been significantly improved through the advent of transistors, semiconductors, integrated circuits, and microprocessors (the heart of computers and computing devices). Digital electronics has been an especially rapidly growing field. High-definition TV, crystal clear CD's, laser discs, and DVD's would not be possible without digital electronics.

Communications/Telecommunications involves a broad spectrum of applications from consumer entertainment to military radar and sonar. Recent advances in personal communications systems (e.g., cellular telephones and video-conferencing), as well as cable and small-dish satellite TV, medical diagnostic equipment, and precision worldwide navigation/positioning equipment are all changing our way of life. Technological advances in lasers and fiber optics are also bringing about a revolution in the communications field. In some institutions (both two-year and four-year), telecommunications is a separate program from electrical engineering technology, with its own degree.

Power involves the generation, transmission, and distribution of electric power. Power engineers, technologists, and technicians are involved in conventional generation systems such as hydroelectric, steam, and nuclear power, as well as alternative generation from solar, wind, and fuel cells. A power specialist must have an in-depth knowledge of such things as transmission lines, electric motors, and generators.

Controls engineers, technologists, and technicians design systems that control automated operations and processes (e.g., manufacturing). Control systems generally compare a measured quantity to a desired standard and make adjustments through a feedback "loop" to automatically bring the measured quantity closer to the desired value.

Instrumentation involves the use of electronic and electro-mechanical devices to make measurements such as pressure, temperature, flow rate, speed, acceleration, voltage, and current. Instrumentation technologists and technicians are involved not only with the measurement device (called a "transducer"), but also with processing, storage, and transmission of data detected by the transducer. Computer "workstations" are usually integrated into these processes.

Some institutions offer **electro-mechanical engineering technology** options or even full degree programs in this discipline. In industry generally, and in manufacturing industries especially, it is often important to interface electrical/electronic equipment with mechanical systems (e.g., applying electronic control circuits to control the operation of various machines). If your institution does not offer an electro-mechanical engineering technology program, it might be wise for electrical/electronics majors to take as many mechanical engineering technology courses as possible and for mechanical engineering technology majors to do the reverse. Electives are almost always available for students who want to take courses outside their major.

Mechanical Engineering Technology

Mechanical engineering technology is the second largest engineering technology discipline and one of the oldest engineering fields. Mechanical engineers, technologists, and technicians apply the principles of mechanics and energy to the design of machines and devices. Mechanical engineering technology is perhaps the broadest of all engineering technology disciplines. The American Society of Mechanical Engineers (ASME), which has many engineering technologists and technicians as members, is organized into the 38 technical divisions listed below [7].

Technical Divisions of ASME

Applied mechanics	**Internal combustion engine**
Bioengineering	**Fuels and combustion technologies**
Fluids engineering	**Nuclear engineering**
Heat transfer	**Power**
Tribology	**Advanced energy systems**
Aerospace	**Pipeline systems**
Environmental control	**Noise control and acoustics**
Rail transportation	**Petroleum technology**
Solid waste processing	**Solar energy**
Gas turbine	**Management**
Materials handling engineering	**Safety engineering and risk analysis**
Process industries	**Plant engineering and maintenance**
Manufacturing engineering	**Technology and society**
Materials	**Nondestructive evaluation**
Computers and information in engineering	**Information storage and processing systems**
Design engineering	**Pressure vessels and piping**
Fluid power systems and technology	**Electrical and electronic packaging**
Microelectromechanical systems	**Nanotechnology**
Textile engineering	**Dynamic systems and control**

This list demonstrates that mechanical engineering technology encompasses a broad range of interesting technical fields. As a mechanical engineering technology graduate, you could eventually become an expert in any one or several of them.

The above technical fields are generally combined into three broad categories, which form the basis of most mechanical engineering technology programs:

Energy

Structures and Motion in Mechanical Systems

Manufacturing

Energy is the field of mechanical engineering technology involved in the production and transfer of energy and the conversion of one form of energy to another. Mechanical engineers, technologists, and technicians design and operate power plants and are concerned with the economical combustion of fuels, the conversion of heat energy into mechanical energy, and the productive use of mechanical energy. They design heating, ventilation, and air conditioning systems; and they develop equipment and systems for the refrigeration of foods and other cold storage facilities. They are also involved in the design and implementation of heat exchangers to transfer heat from one object to another, and with the production of energy from alternative sources such as solar, geothermal, and wind.

Those in the mechanical engineering field are also involved in the **design of structures** and the **motion of mechanical systems**. They design, develop, and build automobiles, trucks, tractors, airplanes, trains, and even interplanetary space vehicles. They develop copying machines, fax machines, staplers, and mechanical pencils used in offices; and lathes, milling machines, grinders, and drill presses used in the manufacture of goods. There is no piece of machinery in our homes, our businesses, or our industrial plants that was not designed, developed, built, and improved by mechanical engineering teams.

Manufacturing is also often a curricular option in mechanical engineering technology programs. There are many roles for MET graduates to play in manufacturing, from the design of machine tools to the design of manufacturing processes. Increasingly, manufacturing is offered as a separate field of engineering technology.

Manufacturing Engineering Technology

Manufacturing engineering technologists and technicians are actively involved across the spectrum of manufacturing activities. A strong manufacturing base is an essential element in any country's quest for global economic competitiveness. The United States, after losing some ground in worldwide manufacturing success during the '60s and '70s, has bounced back—now producing some of the highest quality and most innovative products in the world.

Manufacturing involves converting raw materials into a final product. Innovative manufacturing processes, involving robotics, electronics, and automation technology, have enable us to manufacture products more economically, even while improving the quality of those products. Manufacturing engineering technology programs are lab intensive and also often include field trips to industry as well as co-op and internship possibilities. The manufacturing field has its own society, the Society of Manufacturing Engineers (SME), which welcomes engineering technology graduates to its membership.

Industrial Engineering Technology

Industrial engineering technologists and technicians determine the most effective ways for an organization to use the basic factors of production—people, machines, materials, information, and energy—to make or process a product. Industrial engineers, technologists, and technicians plan, design, implement, and manage integrated production and service delivery systems that assure quality, performance, reliability, maintainability, schedule adherence, and cost control [8].

The broad field of industrial engineering technology, perhaps more than any other engineering technology discipline, is involved with the human and organizational aspects of developing systems. As one example of industrial engineering technology's involvement with people, the Institute of Industrial Engineers (IIE) describes industrial engineering as "The People-Oriented Engineering Profession" [9].

Traditionally, industrial engineering technologists have been involved in facilities and plant design, plant management, quality control, human factors engineering, and production engineering. The majority of industrial engineering technologists are employed by manufacturing companies, but they can be found in every sector of business, industry, and government.

The industrial engineering technology field has been strongly impacted by recent changes and advances in computer technology, automated manufacturing systems, artificial intelligence, database systems, management practices (especially the "quality movement"), and strategic planning. Quality programs have, in fact, been developed into full degree programs, some at the master's level, by several engineering technology institutions.

Civil Engineering Technology

Civil engineering is the oldest and third largest branch of engineering, and when combined with **Construction**, it is also one of the largest engineering technology fields. Major civil engineering projects date back more than 5,000 years (from the Egyptian pyramids to the Roman aqueducts), and continue to modern times.

Today, members of civil engineering teams plan, design, supervise, and build the infrastructure and facilities essential to modern life. Their projects range from high-rise buildings to mass transit systems, from airports to water treatment facilities, from space telescopes to offshore drilling platforms.

There are seven primary specialties within the civil engineering technology discipline:

Structural engineering technology
Transportation engineering technology
Environmental engineering technology
Water resources engineering technology
Geotechnical engineering technology
Surveying and mapping
Construction engineering technology

Structural engineers, technologists, and technicians plan, design, and build all types of structures: bridges, buildings, dams, tunnels, tanks, power plants, transmission line towers, offshore drilling platforms, and space satellites. They analyze the forces that a structure will encounter and develop a design that will withstand those forces. They select structural components, systems, and materials that will provide adequate strength, stability, and durability. Structural dynamics is a specialty within the field that accounts for dynamic forces on structures such as those resulting from earthquakes.

Transportation engineers, technologists, and technicians are involved with the safe and efficient movement of both people and goods. They plan and design highways and streets, harbors and ports, mass transit systems, airports, and railroads. They are also involved in the design of systems to transport goods such as gas, oil, and commodities. Technologists and technicians work closely with transportation engineers to build, maintain, and improve these facilities.

Specialists in the **environmental engineering** field design and operate systems to provide safe drinking water and to reduce pollution in water, in the air, and on the land. They are involved with water distribution systems, wastewater treatment facilities, sewage treatment plants, disposal of garbage, cleanup of toxic waste sites, recycling and reclamation, reduction of air pollution, and control of pesticides.

Water resources entails the evaluation of potential sources of new water, improvement of water availability, harbor and river development, flood control, irrigation and drainage, coastal protection, and construction and maintenance of hydroelectric power facilities.

Geotechnical specialists analyze the properties of soil and rocks that support and affect the behavior of structures, pavement, and underground facilities. They take part in the design and construction of earth structures (dams and levees), building foundations, offshore platforms, tunnels, and dams. In conjunction with these responsibilities, they evaluate settlement of buildings, stability of slopes and fills, seepage of groundwater, and effects of earthquakes.

Surveying and mapping involve the location of property and building lines and the survey of locations, elevations, and alignment of engineering and other projects. Surveyors make measurements over a surface and locate right-of-ways and property boundaries. Current surveying practices make use of modern technology, including laser transits, satellites, aerial and terrestrial photogrammetry, and computer processing of photographic and field data. The Ground Position Indicator (GPI) equipment that they often use is similar to the new automobile electronic maps/direction finders. Surveying programs are often separate from civil engineering technology programs and are offered as "stand alone" programs. In most states, surveyors are licensed by a separate process from engineering. In many states it is possible to become a registered surveyor with an associate's degree, although the growing trend is to require a bachelor's degree.

Construction engineers and technologists use both technical and management skills to plan and build facilities that other engineers and architects design—including buildings, bridges, tunnels, and dams. Construction engineering technologists are involved in planning the job from start to finish, estimating construction costs, determining the equipment and personnel needs, supervising the construction, starting up the facility, and initially operating the facility until the client assumes responsibility. They apply knowledge of construction methods and equipment along with principles of planning, organizing, financing, managing, and operating construction enterprises.

Computer Engineering Technology

Computer engineers, technologists, and technicians are involved in the design, construction, operation, and maintenance of computer systems. They deal with both computer hardware and software problems, although their primary focus is on hardware issues (unlike the computer scientist, whose primary focus is on software design, development, installation, and support). Some institutions offer programs in "Data processing," "Information Technology," "Computer Information Systems," or just "Computer Technology" to support the computer science emphasis, whereas computer engineering technology programs typically support the computer hardware emphasis.

The following is a list of some of the technical areas computer engineers and technologists are involved with:

Digital systems
Computer architecture
Parallel and distributed computing
Software engineering
Algorithms
Programming languages
Compilers
Operating systems
Computer networks

With the proliferation of computers in virtually every environment, opportunities for computer specialists of all types are outstanding.

Architectural Engineering Technology

Architectural engineering technologists and technicians work closely with architects and engineers on the "production aspects" of facility design and construction. Whereas the architect focuses primarily on space utilization and aesthetics, the architectural engineering technologist and technician are concerned with safety, cost, and sound construction methods, as well as doing a lot of the "board work" on production drawings and plans.

Drafting and Design

Drafting and design engineering technologists and technicians may receive similar educational programs as architectural engineering technology graduates and often are employed in similar capacities. Usually, though they are somewhat different.

Drafting and design graduates gain expertise in drafting as well as becoming specialists in computer-aided design (CAD). These skills are useful in the architectural and construction fields, but they are utilized in many other industries as well. Some drafting and design graduates even find employment as industrial illustrators or graphic artists as they gain experience.

Aerospace/Aeronautical Engineering Technology

Aerospace/aeronautical engineers, technologists, and technicians design, develop, test, and help manufacture commercial and military aircraft, missiles, and spacecraft. They develop new technologies in commercial aviation, defense systems, and space exploration. They may specialize in one type of aerospace product such as commercial transports, helicopters, spacecraft, or rockets. Specialties within this field include aerodynamics, propulsion, thermodynamics, structures, celestial mechanics, acoustics, and guidance and control systems.

Chemical Engineering Technology

In general, **chemical engineers and technicians** are responsible for translating the laboratory developments of chemists into commercial realities. The work of chemical engineers and technicians can be seen in a wide variety of products that affect our daily lives, such as plastics, building materials, food products, pharmaceuticals, synthetic rubber, and synthetic fibers. They design the plants and processes that produce a wide range of petroleum products, like shampoos, soaps, cosmetics, shower curtains, and molded bathtubs. They also play a major role in keeping our environment clean by developing processes to both clean up the problems of the past and prevent pollution in the future. In addition, they play an important role in eliminating world hunger through the development of processes to produce fertilizers economically.

The nature of this discipline is such that technologists are not often utilized by industry and, as a result, there are no accredited B.S. programs in chemical engineering technology. There are, however, many accredited A.S. degree programs and job opportunities for chemical engineering technicians.

Overview of Other Engineering Technology Disciplines

Nuclear Engineering Technology. Nuclear engineers, technologists, and technicians are involved in the design, construction, and operation of nuclear power plants for power generation, propulsion of nuclear submarines, and space power systems. They are also involved in the handling of nuclear fuels, the safe disposal of radioactive wastes, and the medical uses of radioactive isotopes.

Marine Engineering Technology. Marine/ocean engineers and technologists are involved in the design of offshore drilling platforms, harbor facilities, breakwaters, and underwater machines.

Automotive Engineering Technology. The modern automobile is an incredibly "high tech" vehicle. It has been said that there is more computing power on a new car than on the Apollo spacecraft. Automotive engineers, technologists, and technicians are involved in every phase of automotive design, development, and production. The Society of Automotive Engineers (SAE) is the professional organization representing this field. You have probably seen their initials many times, as they are on every can of oil that you have added to your car's engine (e.g., SAE 10W-30). The Society of Automotive Engineers has many automotive technologists and technicians as members.

Mining Engineering Technology. Mining and geological engineers and engineering technologists are involved in all aspects of discovering, removing, and processing minerals from the earth. They design the mine layout, supervise its construction, and devise systems to transport minerals to processing plants. They also devise plans to return the area to its natural state after extracting the minerals.

Heating, Ventilating, and Air Conditioning (HVAC) Engineering Technology. Modern climate control technology finds application most everywhere in today's world. Whether it be for the "built environment," automobiles, trains, airplanes, or even spacecraft, HVAC engineers, technologists, and technicians plan, design, develop, manufacture, install, maintain, and improve today's climate control systems and equipment.

Bioengineering/Biomedical Engineering Technology. Biomedical engineers, technologists, and technicians work with biologists, medical doctors, and other health professionals to develop medical instrumentation, diagnostic equipment, artificial organs, and prosthetic devices. They also work in hospitals and clinics to install, calibrate, maintain, and repair this sophisticated equipment. The biomedical field is rapidly advancing. Whether it be new diagnostic equipment, laser surgery, or genetic engineering, changes abound.

***Ceramic Engineering Technology*.** Ceramic engineers and technologists direct processes that convert non-metallic minerals, clay, or silicates to ceramic products. Ceramic products include glass, magnets, electronic parts, automobile parts, tiles on space shuttles, solar panels, and manufactured single crystals.

Plastics Engineering Technology. One need not be reminded how pervasive the use of plastics is in our society. Plastics are utilized in hundreds of applications in every home and business. The development, improvement, manufacture, and innovative application of plastics technology to new products is the responsibility of plastics engineers, technologists, and technicians.

Environmental Engineering Technology. Environmental engineers, technologists, and technicians are involved with both pollution prevention and cleaning up the environment. This field encompasses such areas as air pollution control, water and wastewater management, solid and hazardous waste technologies, and environmental and occupational health and safety technologies.

Agricultural Engineering Technology. Agricultural engineers, technologists, and technicians are involved in every aspect of food production, processing, marketing, and distribution. They design and develop agricultural equipment, food processing equipment, and farm structures, as well as selling, operating, and maintaining this equipment.

Textile Engineering Technology. Textile engineers, technologists, and technicians are involved in all aspects of fiber and fabric research and development, testing, manufacture, and utilization.

2.5 Engineering Technology Job Functions

In addition to their disciplinary designations, engineers, technologists, and technicians are also classified by the job junction they perform.

Analysis

The **analytical engineer or technologist** is primarily involved in the mathematical modeling of physical problems. Analysis is critical in the early stages of a project because it enables answers to be obtained quickly and inexpensively. Once the project moves into the hardware stage, making changes is time-consuming and expensive. The work of the analytical engineer extensively uses principles of mathematics, physics, and engineering science, as well as engineering applications software. Engineering technologists would be infrequently employed in this category.

Design

The **design engineer or technologist** converts concepts and information into detailed plans and specifications from which a finished product can be manufactured. The designer must set down every detail needed to bring the product into existence. Recognizing that many designs are possible, the designer must consider manufacturing costs, ease of production, availability and characteristics of materials, performance requirements, and overall quality. Creativity and innovation are key qualifications for a designer. They may even have to consider the potential demand for the new product and the expectations of the specific market segment being targeted.

Test

The **test engineer, technologist, or technician** is responsible for developing and conducting tests to verify that a new product meets design specifications. They also do quality control checks on existing products. Products are tested for such characteristics as structural integrity, performance, and reliability under all expected (and sometimes unexpected) environmental conditions. These functions are common employment situations for technicians and technologists.

Development

The **development engineer or technologist** works to develop products, processes, or systems. The major part of this work involves using well-known principles and techniques—and employing existing processes or machines—to perform a new or improved function. "Developers" may also be involved with design, construction, and testing of prototypes or experimental models. Engineering technology graduates find frequent employment in this category.

Sales

The **sales, customer service, or field "engineer"** is the liaison person between the company and the customer. Engineering sales is different from retail sales. "Sales engineers" must be technically proficient so that they can understand both the product and the needs of the customer. They must be able to explain the product, how it operates, why it will satisfy the customer's requirements, and why it is cost competitive compared to other alternatives. People skills, as well as technical knowledge, are very important attributes for these positions. Such sales and customer service jobs are another common area of employment for technicians and technologists (especially industrial engineering technology graduates).

Research

Research engineers are involved in solving new problems, obtaining new data, devising new methods of calculation, and gaining new knowledge. Their work is not like that of research scientists, who seek to explain phenomena not understood; rather, there is applied research that puts the results of basic research to use. Most research engineers secure advanced degrees, through which they gain additional technical background as well as researching skills. Technologists and technicians work less frequently in this area than in other engineering areas, although virtually every research lab depends upon engineering technicians to construct and carry out the various research experiments.

Management

If you are successful in engineering technology and have strong leadership skills, within a few years of graduation you could very well move into management, as thousands of graduates have. Opportunities exist primarily in two areas: **line management** and **project management**.

In a company, the technical staff is typically organized into an engineering "line organization." Ten to fifteen engineers and technologists (along with their support staff of technicians and other employees) are managed by a unit supervisor; several units are managed by a group manager. This organizational line goes on up to department managers, the chief engineer or engineering vice president, and finally the president. Often the president of a technical company is an engineer or engineering technologist who worked his or her way up through the line organization. Remember again that the term "engineer" as used above and in subsequent discussions also includes engineering technology graduates, who are found in many of these same employment situations, often with the same job titles as traditional engineers.

Project management is a little different, as the staff is organized according to a specific project or assignment. At the head of each project is a project manager. For a small project, the project manager may oversee the entire project; for larger projects, the project manager is usually assisted by a project management staff, ranging from one to several hundred people. The role of the project management staff is to see that the project is completed successfully, on time, and within budget. One of their major responsibilities is to oversee the work of engineers, technologists, and technicians assigned to their project from the line organization.

Consulting

A **technical consultant** is an independent professional who performs services for clients on a contractual basis. The services rendered by a technical consultant include investigations and analyses, pre-planning, construction management, and consultations on engineering-related problems. Engineering technology graduates who work as technical consultants typically are licensed as Professional Engineers (PE)—a credential currently available to them in some 35 states. This is especially true if their consulting affects public safety; it also is the case for many civil engineering or technology consultants.

Teaching

The **engineering technology professor** is involved in teaching, scholarship, and service. Teaching includes not only classroom instruction but also course and curriculum development, laboratory development, and supervision of student projects or theses. Scholarship involves creating and organizing new knowledge; disseminating that knowledge through the publication of papers, textbooks, software, and presentations at scholarly meetings; participation in professional societies; and success in generating funds to support applied research and other scholarship. Service may include community involvement, public service, consulting, participation in faculty governance, service on various campus committees, and advisory work with student organizations.

An M.S. degree in engineering or engineering technology, along with industrial experience, is virtually mandatory to qualify for a full-time position on an engineering technology faculty at a four-year institution. Some institutions require a Ph.D. degree while others prefer it. For a teaching position at a community college or technical institute, an M.S. degree with industrial experience would typically be expected. A B.S. degree, along with professional licensure, may also be acceptable. In certain skills courses (like welding, printed circuit fabrication, or basic drafting), experience may supplant the need for an academic degree. More information about academic careers can be found in the References [10].

2.6 Employment Opportunities

As the foregoing discussion of engineering technology disciplines and job functions suggests, technologists and technicians find employment in a vast array of industries and positions. Whereas it was common in the past for graduates of these programs to find employment with a large Fortune 500 company and stay with the company throughout their careers, today this is much less common. It is not unusual for today's graduates to change employment numerous times throughout their lives. It is also common for many graduates to find fulfillment in being entrepreneurs, working for themselves or for very small companies.

When you graduate in engineering technology, your first decision will be whether to continue your education full-time, or to go to work as a practicing engineering technologist or technician. If you decide to continue your education, you may want to pursue your M.S. degree in engineering technology (or engineering) or do graduate work in other fields, such as business administration, management, law, or even medicine. If you have earned your associate's degree, you may want to enter employment or continue on toward a B.S. degree.

If you decide to go directly to work, you will have a multitude of choices. Opportunities exist in a variety of industry sectors as well as government. Opportunities in government exist at the local, state, and federal levels. At the federal level, you can choose between civil or military service. While the following table shows the percentage of engineers working in each major employment sector, it is fairly representative of employment for technologists or technicians as well [11].

Employment Sector	**Percentage of engineers working in that sector**
Industry	79.1%
Federal Government	7.6%
State/Local Government	6.6%
Education	4.9%
Self-Employed	1.8%

As you can see, almost eighty percent of engineers (and technologists) work in industry. (Almost all engineering technicians work in industry.) Fourteen percent of engineers and engineering technologists work in local, state, or federal government. You might be interested in the fact that two percent are self-employed. The largest share of these is technical consultants. Engineering technology education is an excellent path to working for yourself either as a technical consultant or even as president of your own company.

If you choose private industry, you will want to be aware of the various industry sectors. Industry can be subdivided into two major categories: (1) manufacturing; and (2) non-manufacturing. Manufacturing industry is involved with converting raw materials into products. Non-manufacturing industry is involved primarily with delivering services.

The following is a list of industry sectors within these two categories that are the largest employers of engineers, technologists, and technicians. The number and percentage of "engineers" employed in each sector are also shown.

Employment of Engineers by Industry Sector
Reference: "Science and Engineering Indicators—1993" [12]

Industry Sector	Number of Engineers	Percent of All Engineers
Manufacturing		
Chemical products	50,000	3.8
Petroleum refining	11,000	0.8
Machinery	148,000	11.3
Electrical equipment	137,000	10.5
Transportation equipment	202,000	15.5
Scientific instruments	116,000	8.9
Non-manufacturing		
Mining	24,000	1.8
Construction	30,000	2.3
Communications/transportation/utilities	80,000	6.1
Trade	75,000	5.7
Engineering services	162,000	12.4
Computer services	69,000	5.3

The following sections provide a brief description of each of these industry sectors [12].

Manufacturing Sector

Chemical Products. These industries manufacture three general classes of products: (1) basic chemicals, such as acids, alkali's, salts, and organic chemicals; (2) chemical products to be used in further manufacture, such as synthetic fibers, plastics materials, dry colors, and pigments; and (3) finished chemical products to be used for human consumption, such as drugs, cosmetics, and soaps; or products to be used as materials or supplies in other industries, such as paints, fertilizers, and explosives.

Petroleum Refining. These industries are engaged in petroleum refining, manufacturing paving and roofing materials, and compounding lubricating oils and greases from purchased materials.

Industrial and Commercial Machinery and Computer Equipment. These industries are engaged in the manufacture of engines and turbines; farm and garden machinery; construction, mining, and oil field machinery; elevators and conveying equipment; hoists, cranes, monorails, and industrial trucks and tractors; metalworking machinery; computer and peripheral equipment and office machinery; and refrigeration and service industry machinery.

Electronic and Other Electrical Equipment. These industries are engaged in the manufacturing of electricity distribution equipment; electrical industrial apparatus; household appliances; electrical lighting and wiring equipment; radio and television receiving equipment; communications equipment; and electronic components and accessories.

Transportation Equipment. These industries are engaged in manufacturing motor vehicles, aircraft, guided missiles and space vehicles, ships, boats, railroad equipment, and miscellaneous transportation equipment, such as motorcycles, bicycles, and snowmobiles.

Scientific Instruments. These industries are engaged in manufacturing instruments for measuring, testing, analyzing, and controlling and their associated sensors and accessories; optical instruments and lenses; surveying and drafting instruments; hydrographic, meteorological, and geophysical equipment; search detection, navigation, and guidance systems and equipment; surgical, medical, and dental instruments, equipment, and supplies; ophthalmic goods; photographic equipment and supplies; and watches and clocks.

Non-Manufacturing Sector

Mining. These industries are engaged in the extraction of naturally occurring minerals, such as coal, ores, crude petroleum, and natural gas. These substances can be quite varied. Kaolin, for example, is a "mined" product that when refined and applied gives the shiny, slick surface to magazine covers and pages.

Construction. These industries cover three broad types of construction: (1) building construction, such as dwellings, office buildings, commercial buildings, stores, "strip" shopping centers, malls, and farm buildings; (2) bridges, sewers, railroads, irrigation projects, flood control projects, and marine construction; and (3) special trades associated with heavy construction including painting, electrical work, plumbing, heating, air-conditioning, roofing, and sheet metal work.

Communications. These industries furnish point-to-point communication services, including telephone and telegraph communications, cable and satellite signal delivery, microwave and fiber optic systems, and radio and television broadcasting.

Digital signal processing has been refined to the point that television, videotape, and disk technologies make possible pictures that are virtually noise free and crystal clear. When signals are transmitted through fiber optic cables, very wide bandwidths are possible with almost no susceptibility to electromagnetic interference. From the Internet and Worldwide web, to cable and satellite TV, cellular phones and pagers, fax machines and radios, telecommunications plays a big part our lives. Various types of telemetry, remote sensing, and data transmissions are also "big business" but are less obvious to the average consumer. Yet technicians and technologists are employed at every stage in the generation, distribution, and reception of such information. This field should continue to grow explosively.

Transportation. These industries are engaged in transporting goods and people, including railroads, buses, taxis, trucking freight, public warehousing and storage, freight and passenger transportation via water, land and air, operation and maintenance of airports and other "terminals," petroleum pipelines, and arrangement of passenger and freight transportation.

Utilities. These industries are engaged in the generation, transmission, and distribution of electricity, gas, or steam. Water and irrigation systems, and sanitary systems engaged in the collection and disposal of garbage, sewage, and other wastes are also included.

Trade. Trade encompasses both wholesale trade and retail trade. Wholesale trade includes: (1) merchant wholesalers who take title to the goods they sell; (2) sales branches and sales offices maintained by manufacturing, refining, or mining enterprises; and (3) agents, merchandise or commodity brokers and commission merchants. Retail sales includes establishments engaged in selling merchandise for personal or household consumption.

Engineering Services. These industries are primarily engaged in providing engineering services including engineering staff on temporary contract to other firms; professional architectural services; and professional land, water, and aerial surveying services.

Computer Services. These industries are primarily engaged in providing computer services such as programming, prepackaged software, computer integrated systems design, computer processing and data preparation, information retrieval services, computer facilities management services, computer rental and leasing, computer maintenance and repair, and computer consultants.

2.7 Important Fields for the Future

We are in a period of intense change. Several major factors that will impact your future are listed below.

Major Changes Affecting the Future

Internationalization of technology
The end of the "Cold War"
Advances in computer technology
Advances in communications and related technologies
"Spaceship Earth"—the environmental movement
Shift to a "service" and "information" economy
World population explosion

Understanding these changes can guide you as to which fields within the broad technological spectrum are going to be important in the future. The following technology areas have been targeted for rapid development by the National Science Foundation [13].

Advanced Manufacturing Technologies

Manufacturing is the foundation of the U.S. economy. There is now an unprecedented opportunity to accelerate the application of new knowledge and advanced technologies to dramatically improve the manufacturing capabilities of U.S. industries. Important technologies include intelligent manufacturing, advanced fabrication and processing methods, integrated computer-based tools for product design and manufacturing, pollution prevention and minimization of resource waste, and total quality management.

Information and Communication Technologies

Advances in **information technologies and communications** are key to U.S. economic growth and competitiveness and to our national defense. The transition from analog to digital processing may enable the U.S. to regain its competitiveness in consumer electronics. A major national goal is the development of the information superhighway, a universally accessible national information infrastructure. Information and communication technologies will bring about major changes in health care delivery systems, advanced manufacturing technology, civil infrastructure systems, and approaches to learning in engineering and engineering technology education.

Advanced Materials and Processing

Improvement in the manufacture and performance of **materials** will enhance our quality of life, national security, industrial productivity, and economic growth. New materials will be created that feature precisely tailored properties and enhanced performance. Examples of these materials are biodegradable polymers, high-temperature ceramics, "composites" for aircraft structures, and durable materials for artificial limbs and joints.

Biotechnology

Biotechnology is expected to have a profound impact on health care, agriculture, energy, and environmental management. Major areas of activity include development of pharmaceutical production/manufacturing processes; restoration, maintenance, and remediation of the environment; and improving, restoring, and preserving human health.

Civil Infrastructure Systems

Our **civil engineering infrastructure—**consisting of roads, bridges, rail networks, sewage treatment plants, deep-water ports, and municipal water systems—is deteriorating and is inadequate to meet growing demands. Rebuilding and expanding this infrastructure will involve new designs, more durable materials, network systems with better controls and communications, and improved decision making and management processes.

Improved Health Care Delivery

There is a critical national need to contain the costs of health care, while also **improving the quality of and access to the health care system**. Engineering and engineering technology will assist in developing new approaches to increased productivity in the hospital environment, new technologies for the delivery of care outside the hospital environment, advanced materials for use in implants or external devices to increase device longevity, and improved information and communications systems for better access to health care and increased patient independence.

One Exciting Medical Advance

In our overview of engineering technology disciplines (Section 2.4), we briefly discussed the rapidly advancing field of biomedical engineering. Perhaps the most exciting development in this field is "distance diagnosing." By combining medical instrumentation technology, distance technology, and computers, today a doctor in one location can examine a patient at another location by wearing an "electronic" tactile glove. A second doctor at yet another location (perhaps a medical research university) can put on a similar electronic glove and actually "feel" the patient being examined, while giving advice through a teleconferencing link on the same network. This is but one example of how engineering technology is playing a critical role in improving our nation's health care delivery system.

Advanced Environmental Technologies

Securing present and future industrial developments and economic growth will require solution of extremely **complex environmental problems**, finding new ways for managing natural resources, and finding new ways for producing goods and services. Engineering technology graduates will be involved in improving existing and creating new remedial environmental technologies, developing environmentally sound extraction/production systems that minimize or prevent waste and contamination, and developing a better understanding of the relationships between human activities and the environment.

A Special Word about Computers

In addition to the aforementioned fields that the National Science Foundation has targeted for future growth, we cannot leave this section without a special word about the role computers play—and will continue to play—in the future. Many computer-related positions already exist for technologists and technicians. A few years ago no one could have imagined the impact that computers would have on virtually every field of human endeavor. Almost every company today employs computer specialists. They range from software engineers who develop sophisticated computer programs to "help desk" or networking technicians who assist end-users in their utilization of computers.

Think, too, of how computes have impacted such fields as design, drafting, industrial illustration, and presentation graphics. Not long ago, employees working in these areas would sit at a drawing board and drafting table, doing everything manually. Working this way required the development of significant mechanical drawing and visualization skills. Much time was spent practicing the art of lettering, for example, and fairly simple revisions to a drawing could require hours of redrawing.

Today most folks in these fields sit at a sophisticated computer graphics terminal, which allows them to be far more productive and to exercise their creativity in many more ways than were previously possible. Even some traditional artists are now completing their "paintings" totally on the computer using a graphics menu in place of brushes, paint, and palette. Who can guess where the future will take us in fields like these as computer technology becomes even more sophisticated?

Computer Technology Revolutionizing the Apparel Industry

One example of how computers are affecting every aspect of our lives comes from the apparel industry. Prior to about ten years ago, the most automated aspect of clothing manufacture was the attachment of pockets. Virtually everything else was done by hand using the skills of trained operators. If a key operator was absent from work, it was not unusual for an entire operation to have to be shut down until the operator returned. Today much more is automated. With the advent of desktop computer design stations, it is possible to scan a specific fabric into a PC and design various articles of clothing around it. When satisfactory designs have been completed, the software can "dump" to another PC so that patterns in various sizes can be automatically designed and cut. Not only are the patterns scaled to the various sizes, the fabric is also optimized by the computer so that minimal waste occurs. After patterns are cut, a laser fabric cutter cuts dozens of layers of material at once on a vacuum table so that the automated assembly process can begin.

It will soon be routine, as a customer, to be scanned for size by a laser scanner and then have your photo scanned into a design PC to see how you would actually look in various clothing styles. When you see what you like, the design shop will transfer its computer file to the manufacturing facility, which will custom-make a piece of clothing and ship it in several days to a nearby store. The store does not then need to stock a large inventory of clothing that may never sell. And you get tailor-made clothing that you have had an opportunity to "try on" before ordering. If you prefer wider lapels or a different hemline, these changes are simply made on the computer before ordering. Many fields are benefiting in similar ways from the creative utilization of modern technology. Engineering technologists and technicians are often the ones who make it all happen.

2.8 Engineering Technology as a Profession

When you receive your A.S. or B.S. degree in engineering technology, you will join the "engineering enterprise." As we have seen, however, distinguishing engineering and engineering technology as separate professions is not always easy. Both engineers and engineering technologists have four-year baccalaureate degrees, and many of their job opportunities and functions overlap. Engineering technicians, with their two-year associate's degrees, are somewhat easier to identify. Yet their jobs often blur with those of engineering technologists, and certainly engineering technicians qualify as "para-professionals" in that they function in support of scientists, engineers, and engineering technologists.

In the beginning of this chapter, I quoted the standard definition of engineering technology, which was formulated in 1992 by the Engineering Technology Council (ETC) of the American Society for Engineering Education (ASEE). Along with that definition, the ETC also drafted a set of principles to help explain the essence of engineering technology. Many of the principles help clarify the often subtle differences between engineering and engineering technology. But they also clearly establish engineering technology as a profession [1].

Eleven Principles

1. The ASEE's Engineering Technology Council (ETC) believes that the "engineering enterprise" includes professionals and para-professionals in engineering, engineering technology, and related fields.
2. The ETC supports a single definition of the engineering enterprise which:
    a) is understandable to the general public
    b) describes the breadth of engineering education and engineering practice
    c) makes clear the various educational paths into the profession of engineering

d) emphasizes the interdependency of professionals and para-professional engineering work, and explains the relationships among the educational paths to the engineering enterprise

"Engineering Enterprise:" Example Definition
The engineering enterprise of the United States includes professional and para-professionals in engineering, engineering technology, and related fields. Entry to professional positions in engineering requires at least a baccalaureate degree in engineering, engineering technology, or a related field. Entry to para-professional positions requires a two-year associate degree in engineering, engineering technology, or a related field.

Engineering and engineering technology are both academic fields of study that lead to professional career opportunities within the "engineering enterprise." They are as follows:

Engineering	**Engineering is the profession in which a knowledge of advanced mathematical and natural sciences gained by higher education, experience, and practice is devoted to the creation of new technology for the benefit of humanity. Engineering education for the professional focuses primarily on the conceptual and theoretical aspects of science and engineering aimed at preparing graduates for the practice of engineering closest to the research, development, and conceptual design functions.**

Engineering Technology	**Engineering technology is the profession in which a knowledge of the applied mathematical and natural science gained by higher education, experience, and practice is devoted to application of engineering principles and the implementation of technological advances for the benefit of humanity. Engineering technology education for the professional focuses primarily on analyzing, applying, implementing, and improving existing technologies and is aimed at preparing graduates for the practice of engineering closest to the product improvement, manufacturing, and engineering operational functions.**

3. The ETC views engineering technology as an integral part of the engineering enterprise and holds that baccalaureate engineering technologists appropriately function as professional practitioners, rather than supporting para-professionals, in this enterprise. It is further held that an appropriate accreditation activity is necessary to support the uniqueness of this component. The Technology Accreditation

Commission (TAC) of the Accreditation Board for Engineering and Technology (ABET) serves this function.

4. The ETC believes that efforts to improve the professional status of all components of the engineering enterprise are important and should be encouraged, so long as access through methods of articulation to the highest levels of professionalism (including graduate education and professional licensure) remain open to all components of the enterprise.
5. The ETC supports the concept of the associate degree in engineering technology being the appropriate entry-level preparation for employment as an engineering technician, and the baccalaureate degree being the appropriate entry-level educational preparation for employment as a professional in the engineering enterprise. It further supports the continued use of the modifier "engineering" in describing the technology component of the enterprise.
6. The ETC believes that adequate bridging among engineering enterprise degree programming, including articulation between two-year to four-year programs, should be facilitated such that alternative career options within the enterprise may be undertaken with the minimal additional required coursework.
7. The ETC supports access and participation for qualified engineering technology graduates through full membership in the appropriate professional societies, since engineering technology is an integral component of the engineering enterprise.
8. The ETC believes that professional registration is important, especially as it relates to those activities that directly affect the health, safety, and welfare of the public. Further, it supports the continuance of the industrial exemption, while recognizing the importance of registration in industry for some disciplines. The ETC further supports and encourages registration for all eligible engineering technology faculty, since they typically are engineering practitioners.
9. The ETC believes that it is the responsibility of each of the educational components of the engineering enterprise to develop and present programming that meets the social, economic, and human resource needs of the public, while protecting their health, safety, and welfare.
10. The ETC believes that, in light of long-term projected shortages of technological human resources, strategies implemented should support increasing enrollments drawn from the diversity of American culture, with continuous quality improvement, in each of the educational components of the engineering enterprise.
11. The ETC believes that it is in the best interests of international competitiveness and the wise utilization of limited resources to fully integrate, rather than fragment, the components of the engineering enterprise.

Professional registration

Principle #8 above stresses the importance of professional registration for practicing engineering technologists. For most technologists (and engineers, for that matter), professional registration is optional. However, in certain fields of work that involve public safety, professional registration may be mandatory. Whether it is optional or mandatory for you, you will greatly enhance your status as a professional by seeking registration as a *Professional Engineer* (P.E.). Professional registration is an impressive credential, and you will find the title **P.E.** proudly displayed following the name on the business cards of engineers and engineering technologists who have acquired that status.

Principle #8 also makes reference to "industrial exemption." This means that not all engineering employees in an industry, even those industries doing work that has a "public safety consequence," are required to become registered. Someone must still "sign off" on critical plans and designs, but it may be a supervisor who has checked the work and not necessarily the employee him/herself.

Because of the difficulty of obtaining registration in some states, few engineering technologists are registered, although the number is increasing. Unfortunately, the number of states permitting engineering technologists to become registered is decreasing. This is a shame, since the very nature of engineering technology is that it is "practice oriented" and most programs are taught by faculty who are "engineering practitioners," many of whom are registered professional engineers. As of 1997, the following 15 states did not allow engineering technologists to register as Professional Engineers: Arkansas, Florida, Illinois, Iowa, Kansas, Kentucky, Louisiana, Michigan, Minnesota, Mississippi, Missouri, New Hampshire, Tennessee, Utah, and Wyoming.

Professional registration is handled by individual states, each of which has a registration board. Although the laws, requirements, and procedures differ somewhat from state to state, they are fairly uniform due to the efforts of the National Council of Examiners for Engineers and Surveyors. It should be noted, however, that registration in one state does not allow you to practice as a registered Professional Engineer in other states. You must be licensed on a state-by-state basis. Almost all states allow either **comity** or **reciprocity** for licensees from other states wishing to practice in their state. "Comity" means that you have to meet all of the new state's requirements and regulations before you may be licensed there. "Reciprocity" means that the new state will accept your license as is and will grant you a license in that state.

The state boards are responsible for evaluating the education and experience of applicants for registration, administering an examination to those applicants who meet the minimum requirements, and granting registration to those who pass the examination.

Although registration laws vary, most boards require four steps:

1. Graduation from a four-year engineering (or in many states engineering technology) program accredited by the Accreditation Board for Engineering and Technology (ABET)
2. Passing the Fundamentals of Engineering (FE) examination
3. Completion of a required number of years of acceptable "engineering" experience
4. Passing the Principles and Practice of Engineering (PE) examination

The Fundamentals of Engineering Exam (FE) is administered each year in April and October. The FE exam is an eight-hour multiple-choice exam. The four-hour morning session covers mathematics, physics, chemistry, basic engineering science, engineering economics, computers, and ethics. The four-hour afternoon session covers one of six engineering disciplines (electrical, mechanical, civil, industrial, chemical, or general) chosen by you. In many cases, the FE exam can be taken prior to your graduation in engineering technology, ideally during your senior year or soon after you graduate. This is the time when you have the best command of the fundamentals of your field. Once you have passed this exam and graduated, you are designated as an Intern Engineer or Engineer-in-Training.

The Principles and Practice of Engineering Exam is an eight-hour exam in your specific engineering (or engineering technology) discipline that you can take only after acquiring the required years of supervised engineering work experience as an Intern Engineer or an Engineer-in-Training. Currently, some 16 states require more work experience for engineering technologists than for engineers—ranging from one to ten years [14].

Certification in Engineering Technology

The National Society of Professional Engineers (NSPE) sponsors the National Institute for Certification in Engineering Technologies (NICET), which certifies technicians and technologists in dozens of "Technical Field Code Classifications." Some examples (of the approximately 85 currently in place) are electronics, highway construction, bridge safety inspection, fluid power, telecommunications, electrical testing, geosynthetic materials installation and inspections, manufacturing, concrete testing, erosion and sediment control, air pollution control, and energy. Certifications are also granted in the traditional disciplines of electrical, mechanical, civil, industrial, and construction engineering technology.

Information on NICET certifications can be obtained from:

National Institute for Certification in Engineering Technologies
1420 King Street
Alexandria, VA 22314-2794
Telephone: 888-IS-NICET
www.nicet.org

Professional Societies

Each of the engineering technology disciplines described in Section 2.4 has a professional society that serves the technical and professional needs of the practitioners in that discipline. These societies are usually organized on both national and local levels and also have a mechanism for establishing student chapters on college and university campuses. The societies publish technical journals and magazines, organize technical conferences, sponsor short courses for professional development, develop codes and ethical standards, and oversee the accreditation of engineering and engineering technology programs in their discipline.

You will derive many benefits from becoming involved in the student chapter in your engineering technology discipline. In the meantime, you can gain valuable free guidance material and other information about the various engineering and engineering technology disciplines by writing to or calling the respective societies listed on the following pages. You can also find a wealth of information by visiting a society's web page at the address indicated. These web pages often link to related pages, leading to even more information. The following professional societies are partner or affiliated (*) organizations with the Accreditation Board for Engineering and Technology (ABET) and with the accreditation of engineering technology programs.

American Academy of Environmental Engineers (AAEE)
130 Holiday Court, Suite 100
Annapolis, Maryland 21404
Telephone: (410) 266-3311
www.aaee.net

American Congress on Surveying and Mapping (ACSM)
6 Montgomery Village Avenue, Suite #403
Gaithersville, Maryland 20879
Telephone: (240) 632-9716
www.ascm.net

American Institute of Aeronautics and Astronautics (AIAA)
1801 Alexander Bell Drive, Suite 500
Reston, Virginia 20191-4344
Telephone: (800) 639-2422
www.aiaa.org

American Institute of Chemical Engineers (AIChE)
Three Park Avenue
New York, New York 10016-5901
Telephone: (800) 242-4363
www.aiche.org

American Institute of Mining, Metallurgical and Petroleum Engineers (AIME)*
345 East 47th Street
New York, New York 10017-2397
Telephone: (212) 705-7695
www.idis.com/aime

American Nuclear Society (ANS)
555 North Kensington Avenue
La Grange Park, Illinois 60526
Telephone: (800) 323-3044
www.ans.org

American Society of Agricultural and Biological Engineers (ASABE)
2950 Niles Road
St. Joseph, Michigan 49085-9659
Telephone: (269) 429-0300
www.asae.org

American Society of Civil Engineers (ASCE)
1801 Alexander Bell Drive
Reston, Virginia 20191-4400
Telephone: (800) 548-2723
www.asce.org

American Society for Engineering Education (ASEE)
1818 N Street, N.W., Suite 600
Washington, D.C. 20036
Telephone: (202) 331-3500
www.asee.org

American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)
1791 Tullie Circle, N.E.
Atlanta, Georgia 30329
Telephone: (404) 636-8400
www.ashrae.org

American Society of Mechanical Engineers (ASME)
Three Park Avenue
New York, New York 10016-5990
Telephone: (800) 843-2763
www.asme.org

American Society of Safety Engineers (ASSE)*
1800 East Oakton Street
Des Plaines, Illinois 60018
Telephone: (847) 699-2929
www.asse.org

Biomedical Engineering Society
8401 Corporate Drive, Suite 140
Landover, Maryland 20785-2224
Telephone: (301) 459-1999
www.bmes.org

The Institute of Electrical and Electronics Engineers (IEEE)
445 Hoes Lane, P.O. Box 1331
Piscataway, New Jersey 08855-1331
Telephone: (800) 678-4333
www.ieee.org

Institute of Industrial Engineers (IIE)
3577 Parkway Lane, Suite 200
Norcross, Georgia 30092
Telephone: (800) 494-0460
www.iienet.org

The International Society for Measurement and Control (ISA)
67 Alexander Drive, P.O. Box 12277
Research Triangle Park, North Carolina 27709
Telephone: (919) 549-8411
www.isa.org

Materials Research Society (MRS)*
506 Keystone Drive
Warrendale, Pennsylvania 15086-7573
Telephone: (724) 779-3003
www.mrs.org

The Minerals, Metals & Materials Society (TMS)
184 Thorn Hill Road
Warrendale, Pennsylvania 15086
Telephone: (800) 759-4867
www.tms.org

National Council of Examiners for Engineering and Surveying
P.O. Box 1686
Clemson, South Carolina 29633-1686
Telephone: (800) 250-3196
www.ncees.org

National Society of Professional Engineers (NSPE)
1420 King Street
Alexandria, Virginia 22314
Telephone: (703) 684-2800
www.nspe.org

Society of Automotive Engineers (SAE)
400 Commonwealth Drive
Warrendale, Pennsylvania 15096
Telephone: (724) 776-4841
www.sae.org

Society of Manufacturing Engineers (SME)
One SME Drive, P.O. Box 930
Dearborn, Michigan 48121-0930
Telephone: (800) 733-4763
www.sme.org

Society for Mining, Metallurgy, and Exploration (SME-AIME)
8307 Shaffer Parkway
Littleton, Colorado 80127-4102
Telephone: (800) 763-3132
www.smenet.org

Society of Naval Architects and Marine Engineers (SNAME)
601 Pavonia Avenue
Jersey City, New Jersey 07306
Telephone: (800) 798-2188
www.sname.org

Society of Petroleum Engineers (SPE)
222 Palisades Creek Drive, P. O. Box 833836
Richardson, Texas 75083-3836
Telephone: (800) 456-6863
www.spe.org

Society of Plastics Engineers (SPE)*
14 Fairfield Drive
Brookfield Center, Connecticut 06804-0403
Telephone: (203) 775-0471
www.4spe.org

Summary

In this chapter you were introduced to the field of engineering technology. You were encouraged to take every opportunity to learn as much as you can about engineering technology. This will be a lifelong process, but it should begin now.

Ten of the most important rewards and opportunities that will be yours if you succeed in graduating in engineering technology were presented and discussed. It is necessary for you to have a clear picture of what all the hard work and personal sacrifice will mean to the quality of your life.

Next we assisted you in understanding what the field of engineering technology entails. You learned that there is no simple definition of the field. Instead, it is part of a myriad of fields and functions, represented best on a “technological spectrum.”

Expanding your understanding of the engineering technology field, you learned that engineering technology graduates can be categorized both by their academic discipline and by their job function. You explored each of those technical disciplines and the most common job functions performed by engineering technologists.

Next you learned about the employment opportunities that will exist for you upon graduation. In particular, you were exposed to those technical fields that are expected to grow rapidly in the future. You may want to consider preparing for employment in one of these “hot” fields.

Finally, you learned that engineering technology is a vital part of the broad “engineering enterprise” that you will join when you graduate with your A.S. or B.S. degree. Technicians and technologists may seek certification through NICET, while many baccalaureate engineering technologists may seek to become licensed as Registered Professional Engineers (P.E.). You also learned about the opportunity to participate in the technical society appropriate to your academic discipline.

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9. "Planning Your Career as an IE: The People-Oriented Engineering Profession," Institute of Industrial Engineers, Norcross, Georgia.
10. Landis, R. B., "An Academic Career: It Could be for You," American Society for Engineering Education, Washington, D.C., 1989.
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13. "The Long View," National Science Foundation Publication 93-154, Arlington, Virginia, 1993.
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Problems

1. Write a one-page paper outlining the influences (teachers, parents, TV, etc.) that led you to choose engineering technology as your major.
2. Develop a list of activities you can do that would increase your understanding of engineering technology careers. Develop a plan for implementing some of these activities.
3. Add ten or more additional items to the list of rewards and opportunities of an engineering technology career presented in Section 2.2. Pick your top ten from the total list and rank them in order of importance.
4. Write a 3-4 page paper on "Why I Want to be an Engineering Technologist (or Engineering Technician)" by expanding on your top three items and explaining why each is important to you personally.
5. Have you ever had a job you didn't like? Describe the job and explain what you didn't like about it.
6. Pick one of the technical disciplines listed in Section 2.4. Write a 2-3 page paper describing that discipline.
7. Access the Web page for the professional society of the discipline you chose in Problem #6. Find out what information is posted there about the discipline.
8. Go to your career planning and placement office and find out how many employers interview on campus annually. What percentage of those employers interview engineering or engineering technology graduates only? What percentage interview business graduates only? What percentage interview all other majors?
9. Find out how the following things work (if you don't already know):
    a. Compact disk
    b. Radar or laser gun
    c. Microwave oven
    d. Solar cell
    e. Digital display
10. Which of the engineering technology disciplines listed in Section 2.4 are offered at your institution? How many students graduate annually in each of these disciplines?
11. Pick one of the American Society of Mechanical Engineers (ASME) technical divisions or one of the Institute of Electrical and Electronics Engineers (IEEE) technical specialties listed in Section 2.4. Research the area and write a one-page paper describing it.
12. Which of the civil engineering specialties described in Section 2.4 would provide you the greatest opportunity to benefit society? Why?
13. Which of the job functions presented in Section 2.5 is the most appealing to you? Write a one-page paper describing why.

14. Interview a practicing engineer, engineering technologist, or engineering technician. Find out the following: (1) What technical discipline did he or she study? (2) What technical skills or knowledge does he or she use currently? (3) What industry sector does he or she work in? (4) What percentage of his or her time is spent in the various technical job functions (design, test, development, management, etc.)?
15. Develop a list of attributes that would be desirable for each of the technical job functions described in Section 2.5.
16. Pick one of the industry sectors described in Section 2.6. Make a list of companies in your area that are part of this industry sector.
17. Pick one of the companies from your list in Problem #16. Contact the company and seek information about what they do and how they use engineering technologists or technicians.
18. Make a list of ten products that would be manufactured by each of the six industry sectors listed under "Manufacturing" in Section 2.6.
19. Obtain a list of employers that conduct on-campus interviews of engineering technology graduates through your career planning and placement office. Identify which industry sector from those described in Section 2.6 each employer belongs in. Do some of the employers fit into more than one industry sector?
20. Pick one of the important fields for the future described in Section 2.7. Research this field and write a three-page paper describing the field and the future employment opportunities it offers.
21. Explain how the "Major Factors Affecting the Future" in Section 2.7 will personally impact your future. What effect will each factor have on the technical job market? (e.g., Increase jobs? Decrease jobs? Change nature of jobs?)
22. Obtain information about the process of becoming a registered Professional Engineer in your state. How do the requirements and procedures differ from those presented in Section 2.8? What engineering disciplines are licensed in your state? If your discipline is civil engineering technology, how are surveyors licensed in your state?
23. Drawing from a variety of the information presented in this chapter, write a 3-4 page essay that explains how engineering and engineering technology differ.