



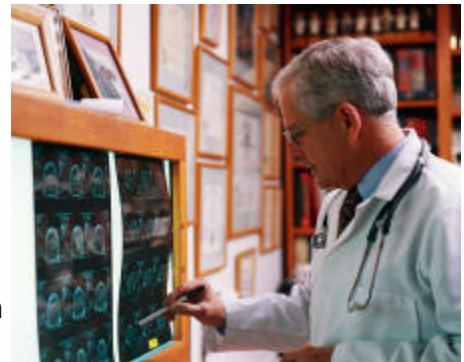
Engineering Overview

**The Field - Engineering Disciplines - Preparation - Accreditation -
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The Field

Engineers apply the theories and principles of science and mathematics to research and develop economical solutions to technical problems. Their work is the link between perceived social needs and commercial applications. Engineers design products, machinery to build those products, plants in which those products are made, and the systems that ensure the quality of the products and the efficiency of the workforce and manufacturing process. Engineers design, plan, and supervise the construction of buildings, highways, and transit systems. They develop and implement improved ways to extract, process, and use raw materials, such as petroleum and natural gas. They develop new materials that both improve the performance of products and take advantage of advances in technology.

They harness the power of the sun, the Earth, atoms, and electricity for use in supplying the Nation's power needs, and create millions of products using power. They analyze the impact of the products they develop or the systems they design on the environment and on people using them. Engineering knowledge is applied to improving many things, including the quality of healthcare, the safety of food products, and the operation of financial systems. Engineers consider many factors when developing a new product. For example, in developing an industrial robot, engineers determine precisely what function the robot needs to perform; design and test the robot's components; fit the components together in an integrated plan; and evaluate the design's overall effectiveness, cost, reliability, and safety. This process applies to many different products, such as chemicals, computers, gas turbines, helicopters, and toys.



In addition to design and development, many engineers work in testing, production, or maintenance. These engineers supervise production in factories, determine the causes of breakdowns, and test manufactured products to maintain quality. They also estimate the time and cost to complete projects. Some move into engineering management or into sales. In sales, an engineering background enables them to discuss technical aspects and assist in product planning, installation, and use.

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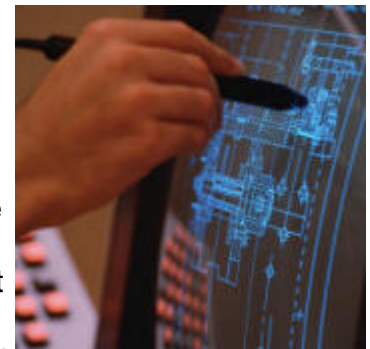
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Engineers use computers to produce and analyze designs; to simulate and test how a machine, structure, or system operates; and to generate specifications for parts. Using the Internet or related communications systems, engineers can collaborate on designs with other engineers around the country or even abroad. Many engineers also use computers to monitor product quality and control process efficiency. The field of nanotechnology, which involves the creation of high-performance materials and components by integrating atoms and molecules, also is introducing entirely new principles to the design process. They spend a great deal of time writing reports and consulting with other engineers, as complex projects often require an interdisciplinary team of engineers. Supervisory engineers are responsible for major components or entire projects.



Engineering Disciplines

Most engineers specialize. More than 25 major specialties are recognized by professional societies, and the major branches have numerous subdivisions. In the United States, degrees in the different fields of engineering are accredited to ensure that the programs provide students with a top notch engineering education. Engineers also may specialize in one industry, such as motor vehicles, or in one field of technology, such as turbines or semiconductor materials. Engineers in each branch have a base of knowledge and training that can be applied in many fields. Electronics engineers, for example, work in the medical, computer, communications, and missile guidance fields. Because there are many separate problems to solve in a large engineering project, engineers in one field often work closely with specialists in other scientific, engineering, and business occupations. The Sloan Career Cornerstone Center (www.careercornerstone.org) offers in-depth information on a continually expanding list of both engineering and engineering technology degree fields, including:



Aerospace Engineering
Agricultural Engineering
Architectural Engineering
Bioengineering
Ceramic Engineering
Chemical Engineering
Civil Engineering
Computer Engineering
Construction Engineering
Electrical and Electronics Engineering
Engineering Management
Engineering Mechanics
Engineering Physics / Engineering Science
Environmental Engineering
Forest/Paper Engineering

Geological Engineering
Industrial Engineering
Manufacturing Engineering
Materials Science and Engineering
Mechanical Engineering
Metallurgical Engineering
Microelectronic Engineering
Mining Engineering
Naval Architecture and Marine Engineering
Nuclear Engineering
Ocean Engineering
Petroleum Engineering
Software Engineering
Surveying and Geomatics

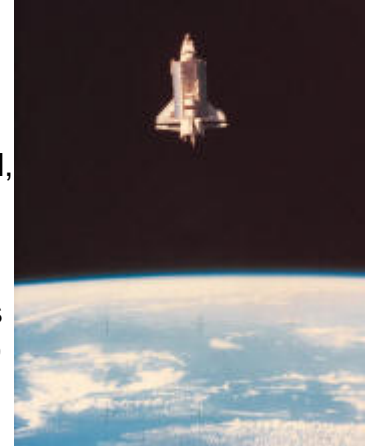
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Preparation

A bachelor's degree in engineering is required for almost all entry-level engineering jobs. College graduates with a degree in a physical science or mathematics occasionally may qualify for some engineering jobs, especially in specialties in high demand. Most engineering degrees are granted in electrical, electronics, mechanical, or civil engineering. However, engineers trained in one branch may work in related branches. For example, many aerospace engineers have training in mechanical engineering. This flexibility allows employers to meet staffing needs in new technologies and specialties in which engineers may be in short supply. It also allows engineers to shift to fields with better employment prospects or to those that more closely match their interests.



Most engineering programs involve a concentration of study in an engineering specialty, along with courses in both mathematics and science. Most programs include a design course, sometimes accompanied by a computer or laboratory class or both.

In addition to the standard engineering degree, many colleges offer 2- or 4-year degree programs in engineering technology. These programs, which usually include various hands-on laboratory classes that focus on current issues, prepare students for practical design and production work, rather than for jobs that require more theoretical and scientific knowledge. Graduates of 4-year technology programs may get jobs similar to those obtained by graduates with a bachelor's degree in engineering. Engineering technology graduates, however, are not qualified to register as professional engineers under the same terms as graduates with degrees in engineering. Some employers regard technology program graduates as having skills between those of a technician and an engineer.

About 1,830 programs at colleges and universities offer bachelor's degrees in engineering that are accredited by ABET, Inc. and there are another 710 accredited programs in engineering technology. The Sloan Career Cornerstone Center provides lists of accredited programs within specific engineering disciplines. The lists are also embedded in PDF files describing each degree field.



Graduate training is essential for engineering faculty positions and many research and development programs, but is not required for the majority of entry-level engineering jobs. Many engineers obtain graduate degrees in engineering or business administration to learn new technology and broaden their education. Many high-level executives in government and industry began their careers as engineers.

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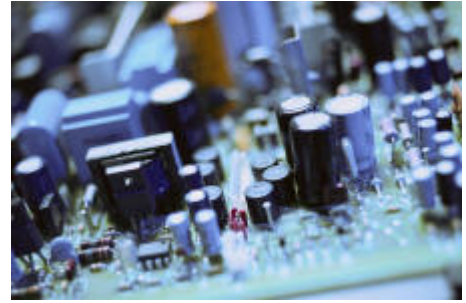
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Admissions requirements for undergraduate engineering schools include a solid background in mathematics (algebra, geometry, trigonometry, and calculus) and science (biology, chemistry, and physics), and courses in English, social studies, humanities, and computer and information technology.

Bachelor's degree programs in engineering typically are designed to last 4 years, but many students find that it takes between 4 and 5 years to complete their studies. In a typical 4-year college curriculum, the first 2 years are spent studying

mathematics, basic sciences, introductory engineering, humanities, and social sciences. In the last 2 years, most courses are in engineering, usually with a concentration in one branch. For example, the last 2 years of an aerospace program might include courses in fluid mechanics, heat transfer, applied aerodynamics, analytical mechanics, flight vehicle design, trajectory dynamics, and aerospace propulsion systems. Some programs offer a general engineering curriculum; students then specialize in graduate school or on the job.



Some engineering schools and 2-year colleges have agreements whereby the 2-year college provides the initial engineering education, and the engineering school automatically admits students for their last 2 years. In addition, a few engineering schools have arrangements whereby a student spends 3 years in a liberal arts college studying pre-engineering subjects and 2 years in an engineering school studying core subjects, and then receives a bachelor's degree from each school. Some colleges and universities offer 5-year master's degree programs. Some 5-year or even 6-year cooperative plans combine classroom study and practical work, permitting students to gain valuable experience and to finance part of their education.

Licensure

In the United States, all 50 States and the District of Columbia require licensure for engineers who offer their services directly to the public. Engineers who are licensed are called Professional Engineers (PE). This licensure generally requires a degree from an ABET-accredited engineering program, 4 years of relevant work experience, and successful completion of a State examination. In Canada, the Canadian Council of



Professional Engineers established the Canadian Engineering Accreditation Board in 1965 to accredit undergraduate engineering programs which provide aspiring engineers with the academic requirements necessary for registration as a Canadian professional engineer. The latest Engineering & Technology Enrollments survey undertaken by the Engineering Workforce Commission, showed that Mechanical Engineering is now the largest undergrad engineering discipline with 75,319 students enrolled. The survey found Electrical Engineering numbers remained relatively steady, declining less than 1%, while Computer Engineering was down 18% from its zenith in 2001. Civil, General and Chemical engineering comprised the next largest groups, ranging from over 21,000 to 43,000 total undergrads each in 2004. Chemical engineering showed its first upswing in over 10 years due to a 7% increase in freshman enrollments. Within these largest disciplines, women account for the largest percentages in Bioengineering, Chemical Engineering, and Industrial Engineering (39, 35, and 32% respectively), while accounting for only 11% of mechanical engineering enrollments.

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Accreditation

Those interested in a career in engineering technology should consider reviewing engineering programs that are accredited by the Accreditation Board for Engineering and Technology, Inc. (ABET). ABET accreditation is based on an examination of an engineering program's student achievement, program improvement, faculty, curricular content, facilities, and institutional commitment. ABET accreditation is based on an examination of an engineering program's student achievement, program improvement, faculty, curricular content, facilities, and institutional commitment. Although most institutions offer programs in the major branches of engineering, only a few offer programs in the smaller specialties. Also, programs of the same title may vary in content. For example, some programs emphasize industrial practices, preparing students for a job in industry, whereas others are more theoretical and are designed to prepare students for graduate work. Therefore, students should investigate curricula and check accreditations carefully before selecting a college. Specific lists for each Engineering Field may be found at www.careercornerstone.org.



Day in the Life

Many engineers work a standard 40-hour week. At times, deadlines or design standards may bring extra pressure to a job, sometimes requiring engineers to work longer hours.

The Workplace

Most engineers work in office buildings, laboratories, or industrial plants. Others may spend time outdoors at construction sites and oil and gas exploration and production sites, where they monitor or direct operations or solve onsite problems. Some engineers travel extensively to plants or worksites.



Teams and Coworkers

Engineers should be creative, inquisitive, analytical, and detail-oriented. They should be able to work as part of a team and to communicate well, both orally and in writing. Communication abilities are important because engineers often interact with specialists in a wide range of fields outside engineering.

Tasks

Beginning engineering graduates usually work under the supervision of experienced engineers and, in large companies, also may receive formal classroom or seminar-type training. As new engineers gain knowledge and experience, they are assigned more difficult projects with greater independence to develop designs, solve problems, and make decisions. Engineers may advance to become technical specialists or to supervise a staff or team of engineers and technicians. Some may eventually become engineering managers or enter other managerial or sales jobs.

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Earnings

According to the National Association of Colleges and Employers in their 2007 Salary Survey, engineering graduates saw increases across the board and fared extremely well in terms of starting salaries. For example, the average offer to mechanical engineering graduates spiked 7.7 percent, bringing the average to these graduates to \$54,587.



Similarly, chemical engineering majors saw their average offer rise 7.4 percent; it now stands at \$60,054. Civil engineering grads also saw a healthy increase in their average salary offer, which is up 4.8 percent over last year and bumps up to \$47,145. Electrical engineering graduates posted one of the "smaller" increases of the engineering disciplines -- 3.2 percent. Still, that brings their average starting salary up to \$54,599. In the Federal Government, mean annual salaries for engineers ranged from \$75,144 in agricultural engineering to \$107,546 in ceramic engineering in 2007.

Earnings for engineers vary significantly by specialty, industry, and education. Even so, as a group, engineers earn some of the highest average starting salaries among those holding bachelor's degrees. The following tabulation shows average starting salary offers for engineers, according to a recent survey by the National Association of Colleges and Employers.

Curriculum	Bachelor's	Master's	Ph.D.
Aerospace/aeronautical/astronautical	\$53,408	\$62,459	\$73,814
Agricultural	49,764		
Architectural	48,664		
Bioengineering and biomedical	51,356	59,240	
Chemical	59,361	68,561	73,667
Civil	48,509	48,280	62,275
Computer	56,201	60,000	92,500
Electrical/electronics and communications	55,292	66,309	75,982
Environmental/environmental health	47,960		
Industrial/manufacturing	55,067	64,759	77,364
Materials	56,233		
Mechanical	54,128	62,798	72,763
Mining and mineral	54,381		
Nuclear	56,587	59,167	
Petroleum	60,718	57,000	

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Variation in median earnings and in the earnings distributions for engineers in various specialties is especially significant.

Specialty	Lowest 10%	Lowest 25%	Median	Highest 25%	Highest 10%
Aerospace engineers	59,610	71,360	87,610	106,450	124,550
Agricultural engineers	42,390	53,040	66,030	80,370	96,270
Biomedical engineers	44,930	56,420	73,930	93,420	116,330
Chemical engineers	50,060	62,410	78,860	98,100	118,670
Civil engineers	44,810	54,520	68,600	86,260	104,420
Computer hardware engineers	53,910	69,500	88,470	111,030	135,260
Electrical engineers	49,120	60,640	75,930	94,050	115,240
Electronics engineers, except computer	52,050	64,440	81,050	99,630	119,900
Environmental engineers	43,180	54,150	69,940	88,480	106,230
Health and safety engineers, except mining safety engineers and inspectors	41,050	51,630	66,290	83,240	100,160
Industrial engineers	44,790	55,060	68,620	84,850	100,980
Marine engineers and naval architects	45,200	56,280	72,990	90,790	113,320
Materials engineers	46,120	57,850	73,990	92,210	112,140
Mechanical engineers	45,170	55,420	69,850	87,550	104,900
Mining and geological engineers, including mining safety engineers	42,040	54,390	72,160	94,110	128,410
Nuclear engineers	65,220	77,920	90,220	105,710	124,510
Petroleum engineers	57,960	75,880	98,380	123,130	Over 145,600
All other engineers	46,080	62,710	81,660	100,320	120,610

Employment

Engineers hold 1.5 million jobs in the United States. About 37 percent of engineering jobs were found in manufacturing industries and another 28 percent were in the professional, scientific, and technical services sector, primarily in architectural, engineering, and related services. Many engineers also worked in the construction, telecommunications, and wholesale trade industries.

Federal, State, and local governments employ about 12 percent of engineers. About half of these were in the Federal Government, mainly in the U.S. Departments of Defense, Transportation, Agriculture, Interior, and Energy, and in the National Aeronautics and Space Administration. Most engineers in State and local government agencies worked in highway and public works departments. About 3 percent of engineers are self-employed, many as consultants.



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The distribution of employment by engineering specialty follows:

Civil engineers	256,000
Mechanical engineers	227,000
Industrial engineers	201,000
Electrical engineers	153,000
Electronics engineers, except computer	138,000
Aerospace engineers	90,000
Computer hardware engineers	79,000
Environmental engineers	54,000
Chemical engineers	30,000
Health and safety engineers, except mining safety engineers and inspectors	25,000
Materials engineers	22,000
Petroleum engineers	17,000
Nuclear engineers	15,000
Biomedical engineers	14,000
Marine engineers and naval architects	9,200
Mining and geological engineers, including mining safety engineers	7,100
Agricultural engineers	3,100
All other engineers	170,000

Engineers are employed in every state, in small and large cities and in rural areas. Some branches of engineering are concentrated in particular industries and geographic area -- for example, petroleum engineering jobs tend to be located in areas with sizable petroleum deposits, such as Texas, Louisiana, Oklahoma, Alaska, and California. Others, such as civil engineering, are widely dispersed, and engineers in these fields often move from place to place to work on different projects.

Engineers are employed in every major industry. The industries employing the most engineers in each specialty are given in the table below, along with the percent of occupational employment in the industry. Be sure to check within the Sloan Career Cornerstone Center's profiles of engineering disciplines for detailed list of employers, and more specific salary information.



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Specialty	Industry	Percent
Aerospace engineers	Aerospace product and parts manufacturing	49
Agricultural engineers	Food manufacturing	25
	Architectural, engineering, and related services	15
Biomedical engineers	Medical equipment and supplies manufacturing	20
	Scientific research and development services	20
Chemical engineers	Chemical manufacturing	29
	Architectural, engineering, and related services	15
Civil engineers	Architectural, engineering, and related services	49
Computer hardware engineers	Computer and electronic product manufacturing	41
	Computer systems design and related services	19
Electrical engineers	Architectural, engineering, and related services	21
Electronics engineers, except computer	Computer and electronic product manufacturing	26
	Telecommunications	15
Environmental engineers	Architectural, engineering, and related services	29
	State and local government	21
Health and safety engineers, except mining safety engineers and inspectors	State and local government	10
Industrial engineers	Transportation equipment manufacturing	18
	Machinery manufacturing	8
Marine engineers and naval architects	Architectural, engineering, and related services	29
Materials engineers	Primary metal manufacturing	11
	Semiconductor and other electronic component manufacturing	9
Mechanical engineers	Architectural, engineering, and related services	22
	Transportation equipment manufacturing	14
Mining and geological engineers, including mining safety engineers	Mining	58
Nuclear engineers	Research and development in the physical, engineering, and life sciences	30
	Electric power generation, transmission and distribution	27
Petroleum engineers	Oil and gas extraction	43

Career Path Forecast

According to the U.S. Department of Labor, Bureau of Labor Statistics, overall engineering employment is expected to grow by 11 percent over the 2006-16 decade, about as fast as the average for all occupations. Engineers have traditionally been concentrated in slower growing or declining manufacturing industries, in which they will continue to be needed to design, build, test, and improve manufactured products. However, increasing employment of engineers in faster growing service industries should generate most of the employment growth. Job outlook varies by engineering specialty, as discussed later.



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Competitive pressures and advancing technology will force companies to improve and update product designs and to optimize their manufacturing processes. Employers will rely on engineers to increase productivity and expand output of goods and services. New technologies continue to improve the design process, enabling engineers to produce and analyze various product designs much more rapidly than in the past. Unlike in some other occupations, however, technological advances are not expected to substantially limit employment opportunities in engineering because engineers will continue to develop new products and processes that increase productivity.

Offshoring of engineering work will likely dampen domestic employment growth to some degree. There are many well-trained, often English-speaking engineers available around the world willing to work at much lower salaries than U.S. engineers. The rise of the Internet has made it relatively easy for part of the engineering work previously done by engineers in this country to be done by engineers in other countries, a factor that will tend to hold down employment growth. Even so, there will always be a need for onsite engineers to interact with other employees and clients.



Overall job opportunities in engineering are expected to be good because the number of engineering graduates should be in rough balance with the number of job openings between 2006 and 2016. In addition to openings from job growth, many openings will be created by the need to replace current engineers who retire; transfer to management, sales, or other occupations; or leave engineering for other reasons.

Many engineers work on long-term research and development projects or in other activities that continue even during economic slowdowns. In industries such as electronics and aerospace, however, large cutbacks in defense expenditures and in government funding for research and development have resulted in significant layoffs of engineers in the past.



The trend toward contracting for engineering work with engineering services firms, both domestic and foreign, has also made engineers more vulnerable to layoffs during periods of lower demand.

It is important for engineers, as it is for workers in other technical and scientific occupations, to continue their education throughout their careers because much of their value to their employer depends on their knowledge of the latest technology. Engineers in high-technology areas, such as biotechnology or information technology, may find that technical knowledge becomes outdated rapidly. By keeping current in their field, engineers are able to deliver the best solutions and greatest value to their employers. Engineers who have not kept current in their field may find themselves at a disadvantage when seeking promotions or during layoffs.

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Professional Organizations

Professional organizations and associations provide a wide range of resources for planning and navigating a career in engineering. These groups can play a key role in your development and keep you abreast of what is happening in your industry. Associations promote the interests of their members and provide a network of contacts that can help you find jobs and move your career forward. They can offer a variety of services including job referral services, continuing education courses, insurance, travel benefits, periodicals, and meeting and conference opportunities. Many professional societies also have student chapters. Student engineers are encouraged to join their local chapter and participate in programs and activities to help network with other students and professional engineers.



A broad list of professional associations is available at www.careercornerstone.org.

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