

Sloan Career Cornerstone Center

Industrial Engineering Overview

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The Field

Industrial engineers determine the most effective ways to use the basic factors of production -- people, machines, materials, information, and energy -- to make a product or to provide a service. They are the bridge between management goals and operational performance. They are more concerned with increasing productivity through the management of people, methods of business organization, and technology than are engineers in other specialties, who generally work more with products or processes. Although most industrial engineers work in manufacturing industries, they may also work in consulting services, healthcare, and communications.



To solve organizational, production, and related problems most efficiently, industrial engineers carefully study the product and its requirements, use mathematical methods such as operations research to meet those requirements, and design manufacturing and information systems. They develop management control systems to aid in financial planning and cost analysis and design production planning and control systems to coordinate activities and ensure product quality. They also design or improve systems for the physical distribution of goods and services. Industrial engineers determine which plant location has the best combination of raw materials availability, transportation facilities, and costs. Industrial engineers use computers for simulations and to control various activities and devices, such as assembly lines and robots. They also develop wage and salary administration systems and job evaluation programs. Many industrial engineers move into management positions because the work is closely related.

The work of health and safety engineers is similar to that of industrial engineers in that it deals with the entire production process. Health and safety engineers promote worksite or product safety and health by applying knowledge of industrial processes, as well as mechanical, chemical, and psychological principles. They must be able to anticipate, recognize, and evaluate hazardous conditions as well as develop hazard control methods. They also must be familiar with the application of health and safety regulations.

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Note: Some resources in this section are provided by the US Department of Labor, Bureau of Labor Statistics.

Day in the Life

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.



Teams and Coworkers

Almost all jobs in engineering require some sort of interaction with coworkers. Whether they are working in a team situation, or just asking for advice, most engineers have to have the ability to communicate and work with other people. 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

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The Workplace

Industrial engineers, including health and safety, held about 194,000 jobs in 2002. Six in 10 of these jobs were in manufacturing industries, and an additional 1 in 10 worked in professional, scientific, and technical services firms, many of whom provide consulting services to manufacturing firms. Because their skills can be used in almost any type of organization, industrial engineers are more widely distributed among industries than are other engineers.

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, chemical, civil, or materials 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, often accompanied by a computer or laboratory class. A degree in Industrial Engineering might include the following types of courses: operations research, production and inventory control, probability and statistics, and information systems. Industrial Engineering students would also study people systems, conduct cost analyses, evaluate facilities, and explore other elements of business.



Admission Requirements

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. Some programs offer a general engineering curriculum; students then specialize in graduate school or on the job.

Co-ops

Internships and Coops provide students with a great opportunity to gain real-world experience while still in school. In addition to giving students direct experience in the field they are considering, interaction with others in the field can help provide perspective on career options.

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Alternate Degree Paths

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 experience and finance part of their education.

Graduate Training

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.

Accreditation

Those interested in a career in Industrial Engineering should consider reviewing engineering programs that are accredited by the Accreditation Board for Engineering and Technology, Inc. (ABET). ABET accreditation is based on an evaluation of an engineering program's student achievement, program improvement, faculty, curricular content, facilities, and institutional commitment. The following is a partial list of universities offering accredited degree programs in Industrial Engineering.

<ul style="list-style-type: none">• Alabama in Huntsville, The University of• Alabama, The University of• Arizona State University• Arizona, University of• Arkansas, University of• Auburn University• Bradley University• California Polytechnic State University, San Luis Obispo• California State Polytechnic University, Pomona• California State Univ., Fresno• California State University, Hayward• California, Berkeley, Univ. of• Central Florida, University of• Cincinnati, University of• Clemson University• Cleveland State University• Colorado State Univ. -Pueblo• Columbia University• Cornell University• Florida A & M University/Florida State University (FAMU-FSU)• Florida International	<ul style="list-style-type: none">• Massachusetts Amherst, University of• Miami, University of• Michigan, University of• Michigan-Dearborn, Univ. of• Milwaukee School of Engineering• Minnesota Duluth, Univ. of• Mississippi State University• Missouri-Columbia, University of• Montana State University - Bozeman• Morgan State University• Nebraska-Lincoln, Univ. of• New Haven, University of• New Jersey Institute of Technology• New Mexico State University• New York at Binghamton, State University of• New York at Buffalo, State University of• North Carolina Agricultural and Technical State Univ.• North Carolina State University at Raleigh	<ul style="list-style-type: none">• Rhode Island, University of• Rochester Institute of Technology• Rutgers, The State University of New Jersey• San Diego, University of• San Jose State University• South Dakota School of Mines and Technology• South Florida, University of• Southern California, University of• Southern Colorado, University of• Southern Illinois University-Edwardsville• St. Ambrose University• St. Mary's University• Stanford University• Tennessee at Knoxville, University of• Tennessee Technological University• Texas A & M University• Texas at Arlington, Univ. of• Texas at El Paso, Univ. of• Texas Tech University
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<ul style="list-style-type: none"> University (University Park) Florida, University of Georgia Institute of Technology Houston, University of Illinois at Chicago, Univ. of Illinois at Urbana-Champaign, University of Iowa State University Iowa, University of Kansas State University Kettering University Lamar University Lehigh University Louisiana State University and A&M College Louisiana Tech University Louisville, University of Marquette University 	<ul style="list-style-type: none"> North Dakota State Univ. Northeastern University Northern Illinois University Northwestern University Ohio State University, The Ohio University Oklahoma State University Oklahoma, The University of Oregon State University Pennsylvania State University Pittsburgh, University of Polytechnic University of Puerto Rico Puerto Rico, Mayaguez Campus, University of Purdue University Rensselaer Polytechnic Institute 	<ul style="list-style-type: none"> Toledo, The University of Virginia Polytechnic Institute and State University Washington, University of Wayne State University West Virginia University Western Michigan University Western New England College Wichita State University Wisconsin-Madison, Univ. of Wisconsin-Milwaukee, University of Wisconsin-Platteville, Univ. of Worcester Polytechnic Institute Wright State University Youngstown State University
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Earnings

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.

Starting Salary

According to a 2005 salary survey by the National Association of Colleges and Employers, bachelor's degree candidates in industrial engineering received starting salary offers averaging \$49,567 a year, master's degree candidates were offered \$56,561, and Ph.D. candidates were offered \$85,000.



Variation in median earnings and in the earnings distributions for engineers in the various branches of engineering also is significant. For industrial engineers, earnings distributions by percentile in May 2004 are shown in the following tabulation.

Specialty	10%	25%	50%	75%	90%
Industrial	\$42,450	\$52,210	\$65,020	\$79,830	\$93,950

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Employment

According to the U.S. Bureau of Labor Statistics, industrial engineers held about 177,000 jobs in 2004. This represents 12.2% of the 1.4 million jobs held by engineers in the U.S. in 2004.

Six in 10 of these jobs were in manufacturing industries, and an additional 1 in 10 worked in professional, scientific, and technical services firms, many of whom provide consulting services to manufacturing firms. Because their skills can be used in almost any type of organization, industrial engineers are more widely distributed among industries than are other engineers. Both small and large organizations employ industrial engineers. The following is a short sample list of employers of organizations that require the skills of industrial engineers:



<ul style="list-style-type: none">• American Express• Bausch & Lomb• Blue Cross Blue Shield• Boeing• Bosch• Eli Lilly• Federal Express• Fidelity Investments• Ford Motor Company	<ul style="list-style-type: none">• Hershey's• General Dynamics• General Electric• General MotorsKodak• IBM Corporation• Intel• Lockheed Martin Corporation• Motorola• NASA	<ul style="list-style-type: none">• PriceWaterhouseCoopers• Raytheon• Teradyne• UPS• W. L. Gore & Associates• Walt Disney Company• Xerox
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Career Path Forecast

According to the U.S. Department of Labor, Bureau of Labor Statistics, overall employment of industrial engineers, including health and safety, is projected to grow about as fast as the average for all occupations through 2014. As firms seek to reduce costs and increase productivity, they increasingly will turn to industrial engineers to develop more efficient processes to reduce costs, delays, and waste. Because their work is similar to that done in management occupations, many industrial engineers leave the occupation to become managers. Many openings will be created by the need to replace industrial engineers who transfer to other occupations or leave the labor force.



Because the main function of industrial and health and safety engineers is to make a higher quality product as efficiently and as safely as possible, their services should be in demand in the manufacturing sector as firms seek to reduce costs and increase productivity. The concern for health and safety within work environments should increase the need for health and safety engineers.

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Professional Organizations

Professional organizations and associations provide a wide range of resources for planning and navigating a career in Nuclear 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.

The following is a description of the Institute of Industrial Engineers. A broader list of professional associations is also available at www.careercornerstone.org.

- **Institute of Industrial Engineers**

(www.iienet.org)

IIE is the world's largest professional society dedicated solely to the support of the industrial engineering profession and individuals involved with improving quality and productivity. Founded in 1948, IIE is an international, non-profit association that provides leadership for the application, education, training, research, and development of industrial engineering. With more than 15,000 members and 280 chapters worldwide, IIE's primary mission is to meet the ever-changing needs of its membership, which includes undergraduate and graduate students, engineering practitioners and consultants in all industries, engineering managers, and engineers in education, research, and government.

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