Professionals in the Workplace: **Engineers**

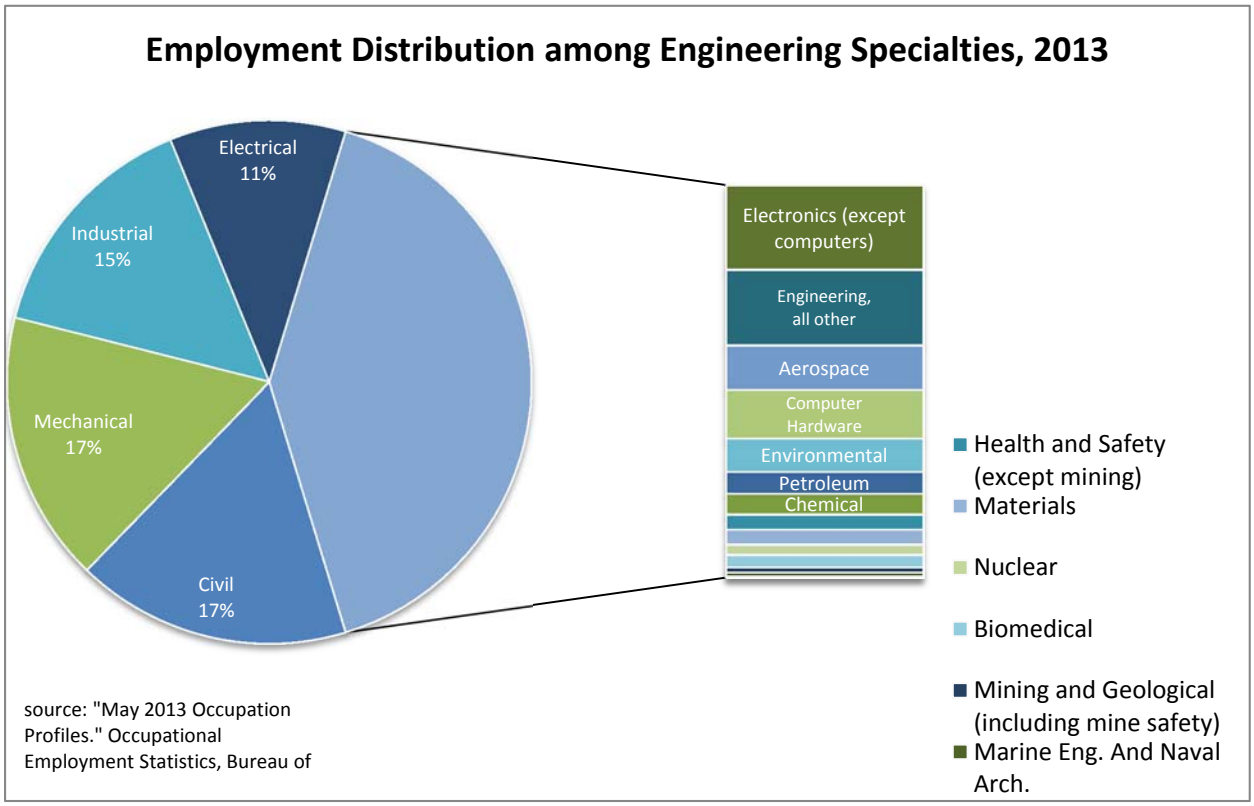
Updated December 2014

The engineering field provides many important middle-class jobs in the United States. Engineers use science and mathematics to design, build, test, and maintain a variety of structures, from molecules to bridges to space shuttles.

Rhetoric and policy in both education and labor arenas often point to the critical role of engineering in our economy now and in the future. Engineers are often highly educated and well-compensated workers, and for many occupations, union membership and its associated benefits are expanding. However, many occupations in the field still face racial and gender inequity, stagnant wages, long hours, and modest employment growth.

Employment in Engineering

The U.S. Bureau of Labor Statistics (BLS) maintains data on 17 specialty occupations within engineering including: aerospace, agricultural, biomedical, chemical, civil, computer hardware, electrical, electronics (except computers), environmental, health and safety (except mining), industrial, marine engineering and naval architecture, materials, mechanical, mining and geological, nuclear, and petroleum. However, even this list is not comprehensive and the BLS reports the remaining specialties together under "all others."[1]



Civil, mechanical, industrial, and electrical engineering were the four largest specialty occupations in 2013, representing a combined 60 percent of all engineering employment. Of the approximate 1.5 million engineers employed in 2013, an estimated 262,170 were civil engineers, 258,630 were mechanical engineers, 230,580 were industrial engineers, and 168,100 worked as electrical engineers. Forty percent of engineers worked in the remaining 14 occupational groups, including those under the catchall "all other." Agricultural engineering, with only 2,590 workers in 2013, was the smallest specialty in the field.[2]

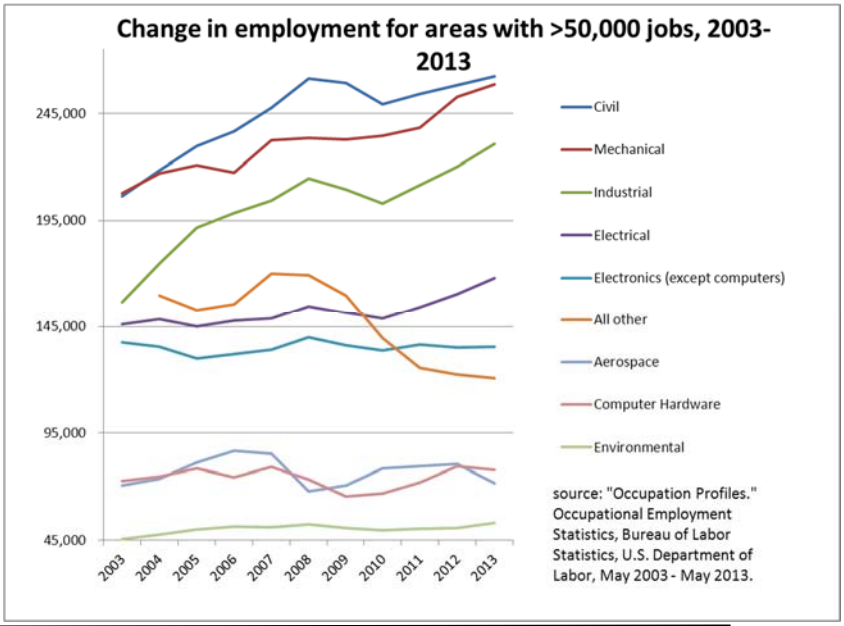
In September 2014, approximately 11.4 percent of engineers worked in the public sector for either local, state, or the federal government; however, employment was not evenly distributed across all types of engineering. For example, while more than 27 percent of civil engineers and 41 of environmental engineers worked in the public sector, the same is true for only 1.5 percent of mechanical engineers and 2.3 percent of industrial engineers.[3]

Engineers are predominately white men. Small numbers of observations mean data are not available for all specialty occupations; however, those that are available demonstrate the under-representation of women, African Americans, and those of Hispanic or Latino ethnicity. In 2013, while women were more than half of the professional workforce, they represented only 7.2 percent of mechanical engineers and 8.3 percent of electrical and electronics engineers. The highest proportion of women was in industrial engineering, including health and safety; however, even here they accounted for only 17.2 percent.[4]

While 8.5 percent of the professional workforce identified as Black or African American in 2013, only 3.3 percent of mechanical engineers were Black or African American. Civil engineering had the highest proportion of Black workers with 6.4 percent. Among Hispanic or Latino engineers, computer hardware engineering occupations had the highest representation, with 10.4 percent of the workforce, while aerospace engineering had the lowest with 4.7 percent.[5]

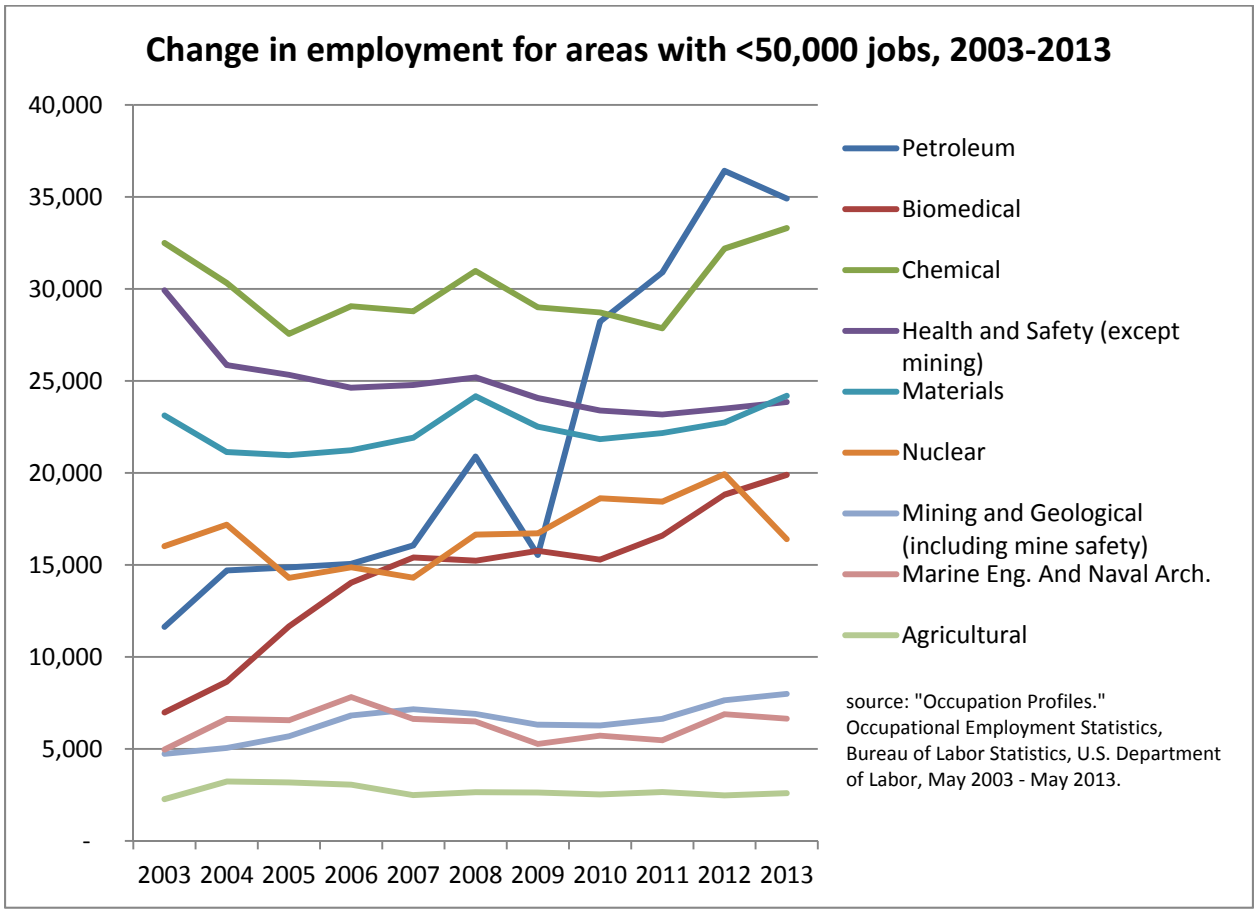
Job Outlook for Engineers

The BLS projects slow growth for most engineering fields from 2012-2022. With a few exceptions, most engineering occupations experienced only modest growth over the last decade. The three largest occupations, civil, mechanical, and industrial engineering, all experienced generally steady growth from 2003 to 2013 expanding by 27, 24, and 47 percent, respectively. Employment in civil and industrial engineering fell following the 2008 recession; however, both occupations have recovered and have



employment rates that are higher than pre-recession employment rates. Employment in health and safety engineering fell by over 20 percent between 2003 and 2013, losing approximately 6,000 jobs.[6]

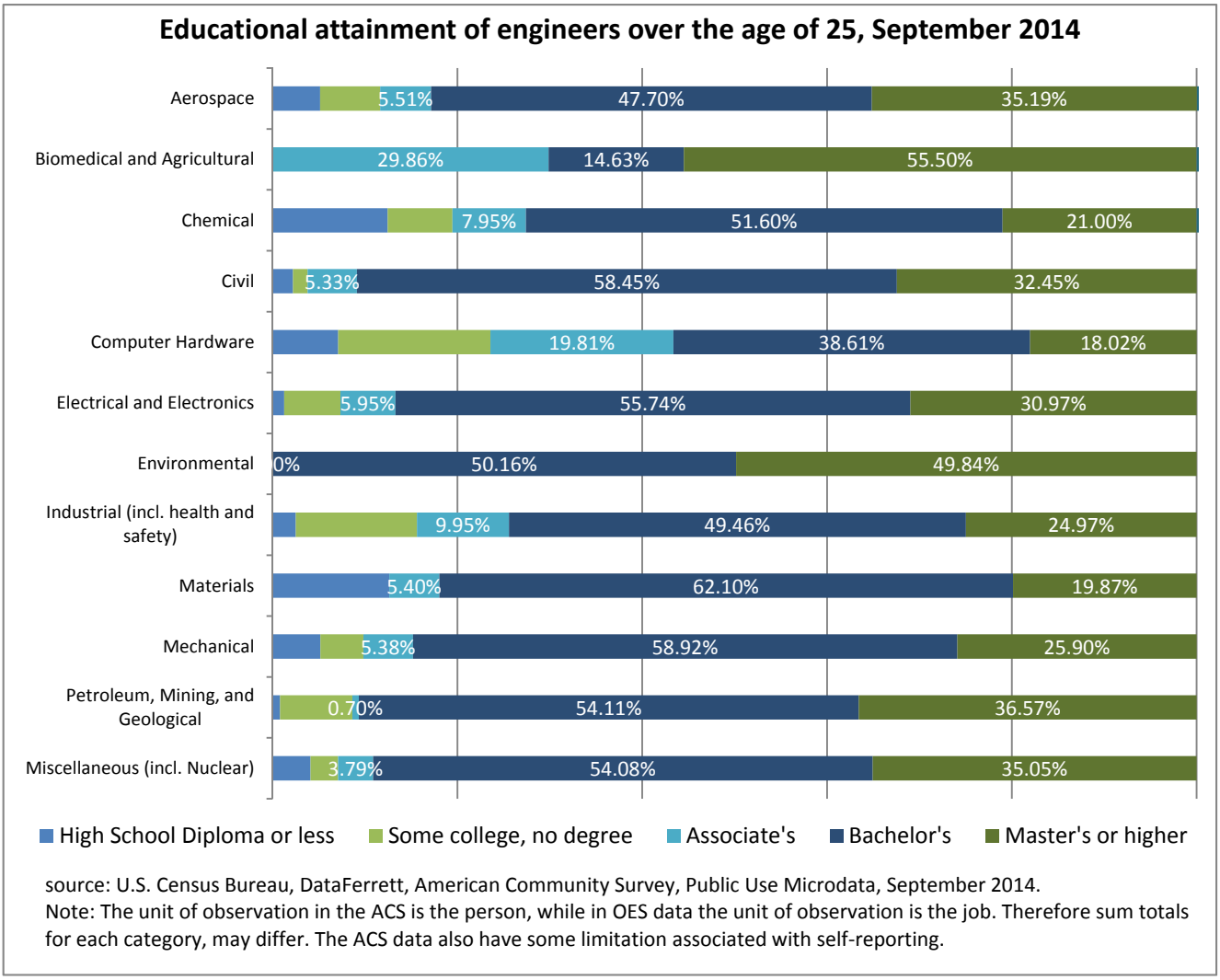
Most of the smaller occupations in engineering experienced only moderate growth or even stagnation, with year-to-year changes well within the margin of error. The three exceptions to this were mining and geological, biomedical, and petroleum engineering. While mining and geological engineering grew steadily, adding over 3,000 jobs in the last decade, employment in biomedical and petroleum engineering skyrocketed, growing by 184 and 200 percent respectively.[7]



In September 2014, the unemployment rate for those in all engineering occupations was 1.4 percent.[8] While many engineering specialty occupations have experienced recovery since the 2008 recession, the field remains vulnerable to layoffs from contracting budgets, automation, offshoring, and guest-worker programs.[9]

Education and Training

Engineers are, in general, a highly educated workforce. Well over half of engineers in all occupations held at least a bachelor's degree in September 2014. In all engineering occupations, except biomedical and agricultural engineering, the bachelor's degree remained the most common. However, the percentage of engineers with advanced degrees (master's degree or higher) varied slightly by field. This ranged from approximately 18 percent of computer hardware engineers, 19.8 percent of materials engineers, and 21 percent of chemical engineers with master's degrees or higher to an estimated 50 percent of environmental engineers and 55.5 percent of biomedical and agricultural engineers. Among those with advanced degrees, 85.1 percent held a master's degree, while 12.73 percent held a doctorate, and 2.5 percent held a professional degree.[10]

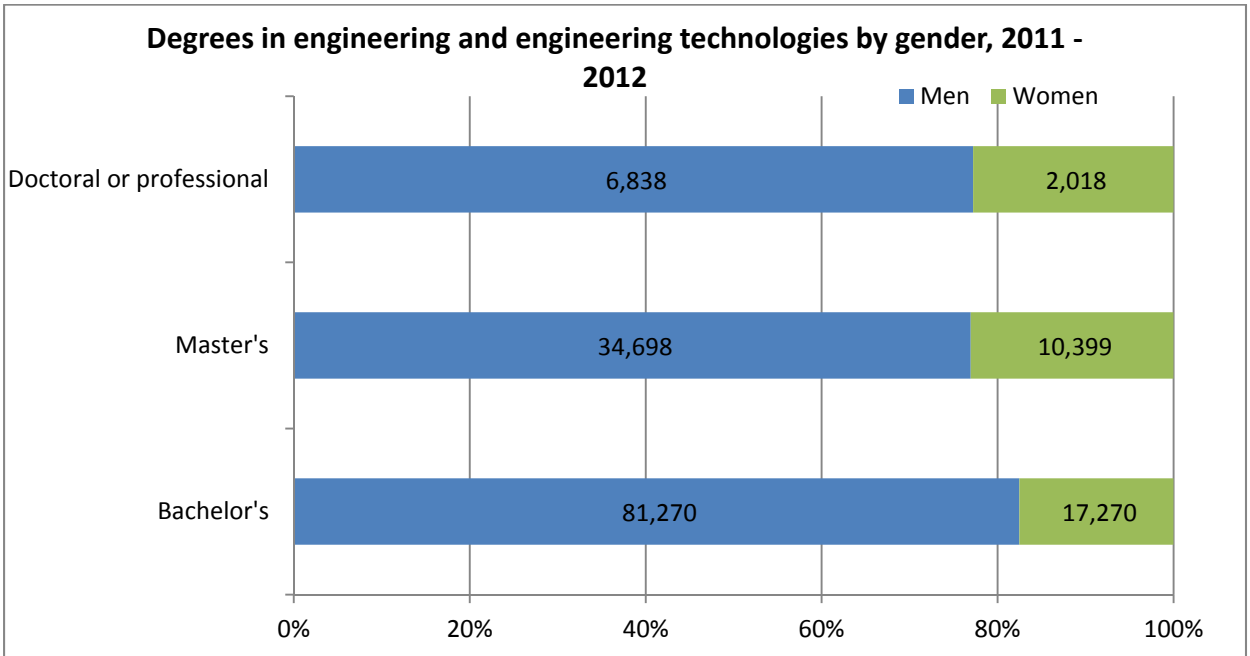


source: U.S. Census Bureau, DataFerrett, American Community Survey, Public Use Microdata, September 2014.
Note: The unit of observation in the ACS is the person, while in OES data the unit of observation is the job. Therefore sum totals for each category, may differ. The ACS data also have some limitation associated with self-reporting.

All states and the District of Columbia require licensure for professional engineers. While it is possible to work as an engineer without a professional licensure, (generally under the supervision of a licensed engineer), professional licensure allows engineers to advance

professionally.[11] Requirements vary by state and specialty occupation; however, most include a combination of a degree from an accredited engineering program and passing multiple exams such as the Fundamentals of Engineering Exam (FE) and the Principles and Practice of Engineering Exam (PE).[12] Further, many states and disciplines require continuing education or professional development to remained licensed or advance in the field.

Typically, engineers take the FE right before or right after graduating from their accredited engineering program. The PE, often the last step to professional licensure, is usually available to engineers after they have both passed the FE and acquired several years of work experience.[13] Pass rates on each exam vary by specialty occupation. According to the National Council of Examiners for Engineering and Surveying, the organization that administers these exams, 84 percent of first time takers passed the mechanical FE in January/February and April/May 2014, compared to 70 percent for the industrial exam module.[14] For the PE, 81 percent of first time takers in naval architecture and marine engineering received a passing score, while only 51 percent of those in environmental engineering passed the first time.[15]



source: "Table 325.45.Degrees in engineering and engineering technologies conferred by postsecondary institutions, by level of degree and sex of student: Selected years, 1949-50 through 2011-12." Integrated Postsecondary Education Data System (IPEDS), National Center for Education Statistics, U.S. Department of Education.

The gender gap in engineering starts in school. In the 2011-2012 school year, colleges and universities conferred over 150,000 degrees in engineering and engineering technology. Of these, more than 80 percent went to men.[16]

Compensation and Working Conditions

Median annual earnings for engineers vary by specialty occupation, employment sector, and region. In May 2013, agricultural engineers reported the lowest median annual earnings ($74,450), while petroleum engineers reported the highest ($132,320). Amongst petroleum engineers, those working in the oil and gas extraction industry, which employs roughly 18,000 engineers, reported mean annual earnings of $162,860, while industrial engineers working in the motor vehicle parts manufacturing industry reported a mean annual wage of $74,930.[17]

Detailed data on the gender pay gap for individual occupations is not available; however, median weekly earnings in all architecture and engineering occupations for women were approximately 18.5 percent lower than those for men in 2013. This gap actually represents an improvement since 2003 when median earnings for women were 24 percent less than those for men.[18]

While engineering occupations pay relatively well, most occupations in the field experienced modest growth or stagnation in real wages over the last 10 years. When controlling for inflation, median annual earnings for occupations, including chemical, civil, electrical, electronic, environmental, health and safety, industrial, marine engineering and naval architects, mechanical, and nuclear all grew by less than 4.5 percent from 2003-2013, many of which were within the margin of error for wages.[19]

Petroleum, agricultural, biomedical, and aerospace engineering all experienced the largest growth in real wages from 2003 to 2013, with median annual earnings increasing 24.5, 15.3, 10, and 10 percent respectively over the last 10 years, after controlling for inflation.[20]

Many engineers report long hours. In September 2014, 36 percent of engineers reported their usual workweek was longer than 40 hours. Roughly 61 percent of mining and geological engineers and 33 percent of chemical engineers reported they usually worked 50 hours or more each week.[21]

Unions in the Engineering Professions

In 2013, environmental engineers and aerospace engineers reported the highest levels of unionization in the field with 23.8 and 12.1 percent, respectively. Both of these represent large gains in membership since 2003 when only 8.4 percent of environmental engineers and 9.9 percent of aerospace engineers reported union membership. Some engineering fields, such as industrial, including health and safety, and mechanical engineering saw increases in union

density between 2012 and 2013, but most fields, including electrical and electronic, chemical, and civil engineering saw moderate declines. However, the small sample sizes mean these figures may represent an under or over estimation of union density.[22]

Many professional unions represent engineers including the American Federation of Government Employees, International Association of Machinists and Aerospace Workers, International Brotherhood of Electrical Workers, the International Federation of Professional and Technical Engineers, the Office Professional Employees International Union, the Seafarers International Union of North America, the United Steelworkers, and the Utility Workers Union of America.

For more information about scientists and engineers, guest worker visas, and professional and technical workers, visit the DPE website, www.dpeaflcio.org.

The Department for Professional Employees, AFL-CIO (DPE) comprises 22 AFL-CIO unions representing over four million people working in professional, technical and administrative support occupations. DPE-affiliated unions represent: teachers, college professors, and school administrators; library workers; nurses, doctors, and other health care professionals; engineers, scientists, and IT workers; journalists and writers, broadcast technicians and communications specialists; performing and visual artists; professional athletes; professional firefighters; psychologists, social workers, and many others. DPE was chartered by the AFL-CIO in 1977 in recognition of the rapidly growing professional and technical occupations.

Source: DPE Research Department
815 16th Street, N.W., 7th Floor
Washington, DC 20006

Contact: Jennifer Dorning
(202) 683-0320, extension 114
jdorning@dpeaflcio.org

December 2014

[1] "May 2013 Occupation Profiles." Occupational Employment Statistics, Bureau of Labor Statistics, U.S. Department of Labor, May 2013. Retrieved from http://www.bls.gov/oes/current/oes_stru.htm
[2] *Ibid.*
[3] U.S. Census Bureau, DataFerrett, American Community Survey, Public Use Microdata, September 2014

[4] "11. Employed persons by detailed occupation, sex, race, and Hispanic or Latino ethnicity." Current Population Survey, Bureau of Labor Statistics, U.S. Department of Labor, 2013. Retrieved from http://www.bls.gov/cps/cpsaat11.pdf
[5] *Ibid.*
[6] "Architecture and Engineering Occupations." Occupational Outlook Handbook, Bureau of Labor Statistics, U.S. Department of Labor, January 8, 2014. Retrieved from http://www.bls.gov/ooh/architecture-and-engineering/home.htm; "May 2013 Occupation Profiles." Occupational Employment Statistics, Bureau of Labor Statistics, U.S. Department of Labor, May 2013. Retrieved from http://www.bls.gov/oes/current/oes_stru.htm
[7] "May 2013 Occupation Profiles." Occupational Employment Statistics, Bureau of Labor Statistics, U.S. Department of Labor, May 2013. Retrieved from http://www.bls.gov/oes/current/oes_stru.htm
[8] U.S. Census Bureau, DataFerrett, Current Population Survey, September 2014.
[9] Babin, Janet. "Why more engineers are losing jobs." Marketplace, June 17, 2009. Retrieved from http://www.marketplace.org/topics/business/fallout-financial-crisis/why-more-engineers-are-losing-jobs; Levine, Linda. "Offshoring (or Offshore Outsourcing) and Job Loss Among U.S. Workers." Congressional Research Service, December 17, 2012. Retrieved from http://www.fas.org/sgp/crs/misc/RL32292.pdf
[10] U.S. Census Bureau, DataFerrett, Current Population Survey, September 2014.
[11] "Licensure." National Council of Examiners for Engineering and Surveying. Retrieved from http://ncees.org/licensure/
[12] "Civil Engineers." Occupational Outlook Handbook, Bureau of Labor Statistics, U.S. Department of Labor, January 8, 2014. Retrieved from http://www.bls.gov/ooh/architecture-and-engineering/civil-engineers.htm; "Exams." National Council of Examiners for Engineering and Surveying. Retrieved from http://ncees.org/exams/
[13] "Licensure." National Council of Examiners for Engineering and Surveying. Retrieved from http://ncees.org/licensure/
[14] "FE exam." National Council of Examiners for Engineering and Surveying. Retrieved from http://ncees.org/exams/fe-exam/
[15] "PE exam." National Council of Examiners for Engineering and Surveying. Retrieved from http://ncees.org/exams/pe-exam/
[16] "Table 325.45.Degrees in engineering and engineering technologies conferred by postsecondary institutions, by level of degree and sex of student: Selected years, 1949-50 through 2011-12." Integrated Postsecondary Education Data System (IPEDS), National Center for Education Statistics, U.S. Department of Education, July 2013. Retrieved from http://nces.ed.gov/programs/digest/d13/tables/dt13_325.45.asp
[17] "17-2171 Petroleum Engineers." Occupational Employment Handbook, Bureau of Labor Statistics, U.S. Department of Labor, April 1, 2014. Retrieved from http://www.bls.gov/oes/current/oes172171.htm; "17-2112 Industrial Engineers." Occupational Employment Handbook, Bureau of Labor Statistics, U.S. Department of Labor, April 1, 2014. Retrieved from http://www.bls.gov/oes/current/oes172112.htm
[18] "Table 39. Median weekly earnings of full-time wage and salary workers by detailed occupation and sex, 2003 and 2013." Current Population Survey, Bureau of Labor Statistics, U.S. Department of Labor. Retrieved from http://www.bls.gov/cps/tables.htm
[19] "List of SOC Occupations." Occupational Employment Statistics, Bureau of Labor Statistics, U.S. Department of Labor, May 7, 2004. Retrieved from http://www.bls.gov/oes/2003/may/oes_stru.htm; "May 2013 Occupation Profiles." Occupational Employment Statistics, Bureau of Labor Statistics, U.S. Department of Labor, April 1, 2014. Retrieved from http://www.bls.gov/oes/current/oes_stru.htm
[20] *Ibid*.
[21] U.S. Census Bureau, DataFerrett, American Community Survey, Public Use Microdata, September 2014.
[22] Hirsch, Barry T. and Macpherson, David A. "2014 Union Membership and Earnings Data Book." The Bureau of National Affairs Inc., 2014; Hirsch, Barry T. and Macpherson, David A. "Union Membership, Coverage, Density and Employment by Occupation, 2003." Union Stats, 2004. Retrieved from http://unionstats.com/