STEM Workers in the Manufacturing Sector

Samantha Sterns Cole[1,2]

INTRODUCTION

This paper focuses on science, technology, engineering, and math (STEM) workers in the manufacturing sector.[3] About one in 10 or 15.6 million, U.S. workers 16 and over, worked in the manufacturing sector in 2017 (Figure 1). About 2 million of these workers were in STEM occupations. The manufacturing sector is defined as those industries that use raw materials to produce finished goods. STEM workers are people who work in computer, mathematical, engineering, and life, physical, and social scientist occupations.

This research asks: 1) Who are the STEM workers in the manufacturing sector?; 2) In which industries are STEM workers working?; and 3) How does STEM work in manufacturing compare with other sectors?

STEM, INDUSTRY, and SECTOR CLASSIFICATIONS

The data presented in this paper are from the 2017 American Community Survey (ACS).[4] The ACS is a nationwide survey designed to provide communities with reliable and timely demographic, social, economic and housing data for congressional districts, counties, places, and other localities every year. All comparative statements in this paper have undergone statistical testing, and comparisons are significant at the 90 percent level unless otherwise noted.[5]

Occupation was coded based on responses to two write-in questions in the American Community Survey (ACS): "What kind of work was this person doing?" and "What were this

---

[1] The views expressed in this paper are those of the author and are not necessarily those of the U.S. Census Bureau.
[2] The U.S. Census Bureau reviewed this data product for unauthoriezed disclosure of confidential information and has approved the disclosure avaoidance practices applied to this release CBDRB-FY20-POP001-0006.
[3] Prior Census reports on STEM included a population of workers 25 to 64 with a bachelor's degree or higher. Although the majority of the STEM workforce has at least a bachelor's degree, the STEM workforce also includes those with associate's degrees and high school diplomas. In the manufacturing industry there are many technical positions that do not require a bachelor's degree. People 16 and over with any educational background are the primary universe for this paper.
[4] For information on the ACS sample design and other topics, visit <www.census.gov/acs/www>.
[5] For more information on sampling and estimation methods, confidentiality protection, and sampling and nonsampling errors, please see the 2017 ACS Accuracy of the Data document located at https://www.census.gov/programs-surveys/acs/technical-documentation/code-lists.html.>.

person's most important activities or duties?". Census occupation codes were based on the 2010 Standard Occupation Classification (SOC) manual.[6] The Standard Occupation Classification Policy Committee (SOCPC), an interagency workgroup organized by the request of the Office of Management and Budget (OMB), created guidelines for the classification of STEM occupations. Consistent with prior Census reports, this paper follows the SOCPC recommendations on how to classify STEM occupations (Landivar, 2013a and Landivar, 2013b).

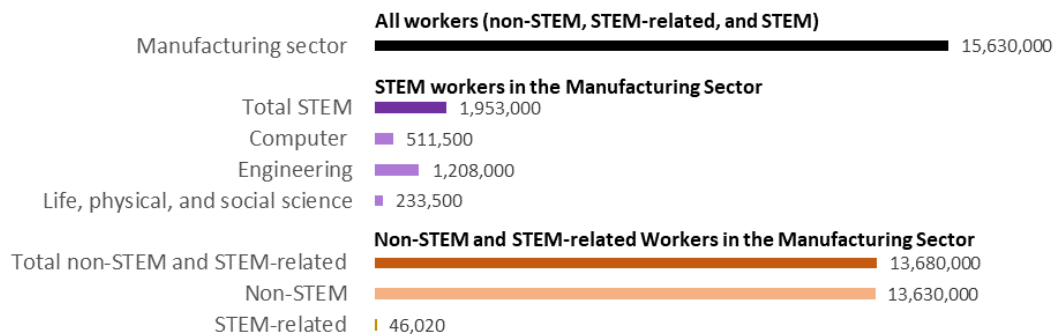| High-level occupation aggregation	Occupation group	STEM occupation classification
Table 1: Classsification of STEM, STEM-Related and non-STEM Occupations for all Workers		
Management, business, science, and arts	Management	Non-STEM (excludes computer and information systems managers; architectural and engineering managers; natural sciences managers)
	Business and financial operations	Non-STEM
	Computer, math, engineering, and sciences (life, physical, and social science)	STEM (excludes architects; includes sales engineers, computer and information system managers, architectural and engineering managers, and natural sciences managers)
	Education, legal, community service, arts, and media	Non-STEM
	Health care practitioners and technicians	STEM-related (includes architects)
Service	Healthcare support	Non-STEM
	Protective service	Non-STEM
	Food preparation and serving	Non-STEM
	Building and grounds cleaning	Non-STEM
	Personal care and service	Non-STEM
Sales and office	Sales and related	Non-STEM (excludes sales engineers)
	Office and administrative support	Non-STEM
Natural resources, construction, and maintenance	Farming, fishing, and forestry	Non-STEM
	Construction and extraction	Non-STEM
	Installation, maintenance, and repair	Non-STEM
Production, transportation, and material moving	Production	Non-STEM
	Transportation	Non-STEM
	Material moving	Non-STEM
Note: The full list of census Bureau occupations used in this report and occupation specific classifications available at <https://www.census.gov/topics/employment/industry-occupation/guidance/code-lists.html>		

---

[6] The SOC manual is available at < www.bls.gov/soc >

Responses were coded into 536 detailed census occupation codes, which were classified as STEM, non-STEM and STEM-related occupations (Table 1). STEM occupations included 63 detailed occupations while non-STEM and STEM-related occupations made up 473 detailed occupations. Some broad categories of non-STEM occupations are service occupations and sales and office occupations, while STEM-related occupations primarily include healthcare practitioners and healthcare technicians (Table 1).

Less than one percent of workers in the manufacturing sector (46,020 workers) were classified as working in STEM-related occupations (see Figure 1).[7] For the purpose of this research, STEM-related and non-STEM occupations were grouped together into a single category: "non-STEM and STEM-related", sometimes referred to as "non-STEM/STEM-related".

STEM occupations were further classified into three sub-categories: 1) computer and mathematical occupations; 2) engineering occupations; and 3) life, physical, and social science occupations (Figure 1).

Figure 1: Employment in Manufacturing by STEM, STEM-Related, and Non-STEM Occupations: 2017

All workers (non-STEM, STEM-related, and STEM)
Manufacturing sector — 15,630,000

STEM workers in the Manufacturing Sector
Total STEM — 1,953,000
Computer — 511,500
Engineering — 1,208,000
Life, physical, and social science — 233,500

Non-STEM and STEM-related Workers in the Manufacturing Sector
Total non-STEM and STEM-related — 13,680,000
Non-STEM — 13,630,000
STEM-related — 46,020

Source: 2017, 1-year American Community Survey
Note: ACS estimates may not add to the total due to rounding. For information on confidentiality protection, sampling error, nonsampling error, and definitions, see http://www2.census.gov/programs-surveys/acs/tech_docs/accuracy/MultiyearACSAccuracyofData2016.pdf.

Industry describes the kind of business done by a person's employing organization. Two write-in questions in the ACS were used to determine industry: "For whom did this person work?" and "What kind of business or industry was this?". Industries were coded using definitions based on

---

[7] In this paper, the universe excludes Puerto Rico.

the 2012 North American Industrial Classification System (NAICS).[8] The 2012 Census industry classification system consisted of 269 industries, which were classified into 20 sectors. The manufacturing sector includes 81 industries. In this report, the manufacturing "sector" refers to summary data from all 81 manufacturing industries. The term "industry" refers to one of the 81 industries within the manufacturing sector.

FINDINGS

The data are presented in three sections. Section 1 compares STEM workers with non-STEM/STEM-related workers in the manufacturing sector, including socio-demographics, full-time work status, and median earnings. Section 2 identifies industries in the manufacturing sector with high percentages or numbers of STEM workers. Section 3 compares STEM occupations in the manufacturing sector with STEM occupations in other sectors.

Section 1: Who are the STEM workers in the manufacturing sector?

Table 2 and Figures 2 and 3 report on socio-demographics, full-time work status, and median earnings, of workers in the manufacturing sector. Workers in STEM occupations are compared with workers in non-STEM or STEM-related occupations.

Compared with non-STEM/STEM-related workers in the manufacturing section, STEM workers were more often male, White, or Asian (Table 2). Men made up 80.7 percent of all STEM workers and 69.7 percent of non-STEM/STEM-related workers. STEM workers in the manufacturing sector were more often White or Asian than non-STEM/STEM-related workers (69.7 compared with 64.1 percent; 15.7 percent compared with 5.6 percent). In contrast, there was a higher percentage of Hispanic and Black workers in non-STEM/STEM-related occupations than in STEM occupations (17.8 percent and 7.4 percent; 10.6 and 4.8 percent respectively).

STEM workers were slightly younger than non-STEM/STEM-related workers, with a median age of 44.2 compared with 45.3 (Figure 2). There were a higher share of workers 25 to 34 and 35 to 44 in STEM occupations than in non-STEM/STEM-related occupations (23.5 percent compared with 19.8 percent and 22.5 percent compared with 20.9 percent) (Table 2). There was a higher share of workers aged 16 to 24, however, in non-STEM/STEM-related occupations than STEM occupations (8.5 percent compared with 5.8 percent).

---

[8] For more information on NAICS see < https://www.census.gov/eos/www/naics/ >

Table 2: Selected Characteristics of STEM and Non-STEM or STEM-Related Workers in the Manufacturing Sector: 2017

Civilian employed population 16 and over

	All Manufacturing Workers				All STEM workers in Manufacturing				All Non-STEM and STEM-related workers in Manufacturing			
	N	MOE	Percent	MOE	N	MOE	Percent	MOE	N	MOE	Percent	MOE
Total Population	15,630,000	62,070	100	0.1	1,953,000	24,750	12.5	0.1	13,680,000	58,550	87.5	0.2
Sex												
Female	4,520,000	36,930	28.9	0.2	376,300	9,692	19.3	0.4	4,145,000	35,050	30.3	0.2
Male	11,110,000	54,580	71.1	0.2	1,577,000	21,060	80.7	0.4	9,533,000	49,600	69.7	0.2
Race/ Ethnicity												
Not Hispanic or Latino:												
White alone	10,120,000	44,130	64.8	0.2	1,362,000	18,130	69.7	0.6	8,762,000	42,620	64.1	0.3
Black or African American alone	1,540,000	23,900	9.9	0.1	93,740	6,397	4.8	0.3	1,446,000	23,220	10.6	0.2
Asian alone	1,067,000	19,080	6.8	0.1	307,000	10,580	15.7	0.5	760,100	14,230	5.6	0.1
All other races alone; two or more races	327,300	8,969	2.1	0.1	45,140	3,968	2.3	0.2	282,200	8,289	2.1	0.1
Hispanic or Latino	2,573,000	30,517	16.5	0.2	145,400	6,930	7.4	0.3	2,428,000	28,310	17.8	0.2
Age												
16-24	1,271,000	22,474	8.1	0.1	113,800	5,924	5.8	0.3	1,157,000	21,700	8.5	0.2
25-34	3,174,000	30,246	20.3	0.2	459,600	11,880	23.5	0.5	2,714,000	25,160	19.8	0.2
35-44	3,303,000	31,155	21.1	0.2	438,500	10,420	22.5	0.5	2,865,000	29,050	20.9	0.2
45-54	3,976,000	29,113	25.4	0.2	485,600	11,650	24.9	0.5	3,490,000	27,430	25.5	0.2
55+	3,907,000	27,909	25.0	0.2	455,600	10,080	23.3	0.5	3,452,000	26,860	25.2	0.2
Educational Attainment												
Less than high school graduate or equivalency	1,702,000	25,629	10.9	0.2	20,560	2,282	1.1	0.1	1,682,000	25,270	12.3	0.2
High school graduate	5,048,000	38,237	32.3	0.2	140,100	6,556	7.2	0.3	4,908,000	37,870	35.9	0.2
Some college or associate's degree	4,608,000	36,051	29.5	0.2	437,200	10,530	22.4	0.4	4,170,000	32,780	30.5	0.2
Bachelor's degree	2,944,000	33,489	18.8	0.2	850,800	14,570	43.6	0.5	2,094,000	26,490	15.3	0.2
Master's degree or higher	1,329,000	19,280	8.5	0.1	504,500	10,140	25.8	0.4	824,200	16,200	6.0	0.1
Work Status												
Worked full-time year round	13,470,000	57,270	86.2	0.2	1,776,000	23,240	90.9	0.4	11,690,000	53,740	85.5	0.2
Worked less than full-time year round	2,162,000	26,730	13.8	0.2	177,100	7,652	9.1	0.4	1,985,000	25,330	14.5	0.2

Source: 2017, 1-year American Community Survey, U.S. Census Bureau

Note: ACS estimates may not add to the total due to rounding. For information on confidentiality protection, sampling error, nonsampling error, and definitions, see http://www2.census.gov/programs-surveys/acs/tech_docs/accuracy/MultiyearACSAccuracyofData2016.pdf.

Figure 2: Median Age of Workers in the Manufacturing Sector by STEM Classification: 2017
(Civilian employed population 16 and over)

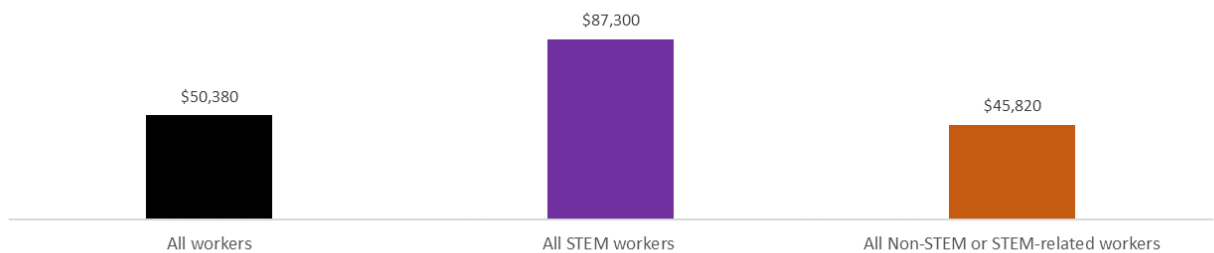|	
All Non-STEM and STEM-related...	45.3
All STEM workers	44.2
All Workers	45.2

Source: 2017, 1-year American Community Survey

Note: . For information on confidentiality protection, sampling error, nonsampling error, and definitions, see http://www2.census.gov/programs-surveys/acs/tech_docs/accuracy/MultiyearACSAccuracyofData2016.pdf.

Compared with non-STEM/STEM-related workers, a much higher percentage of STEM workers had at least a bachelor's degree (Table 2). The share of STEM workers with at least a Bachelor's degree was much greater than for non-STEM/STEM-related workers (43.6 percent compared with 15.3 percent). Furthermore, while a quarter of STEM workers had a master's degree or more, only 6.0 percent of non-STEM/STEM-related workers did. It was much more likely that people working in non-STEM/STEM-related occupations completed high school and did not complete additional education, compared with STEM workers (35.9 percent and 7.2 percent).

Lastly, STEM workers more often worked full-time year-round (FTYR)[9] compared with non-STEM and STEM-related workers (90.9 percent compared with 85.5 percent).

Figure 3: Median Earnings of Full-time Year-Round Workers in the Manufacturing Sector by STEM Classification: 2017
(Civilian employed population 16 and over)

	$87,300	
$50,380		$45,820
All workers	All STEM workers	All Non-STEM or STEM-related workers

Source: 2017, 1-year American Community Survey
Note: For information on confidentiality protection, sampling error, nonsampling error, and definitions, see http://www2.census.gov/programs-surveys/acs/tech_docs/accuracy/MultiyearACSAccuracyofData2016.pdf.

The median income of all FTYR workers in the manufacturing sector was $50,380, with substantial differences based on whether workers were in STEM occupations or in non-STEM/STEM-related occupations (Figure 3). STEM workers in manufacturing had a median income of $87,300 compared with $45,820 for non-STEM/STEM-related workers, a difference of $41,480.

---

[9] Full-time year-round is defined as working at least 50 weeks a year for 35 or more hours a week.

Section 2: In which industries are STEM workers working?

STEM workers were concentrated in a handful of industries in the manufacturing sector, and often made up a large share of workers in those industries (Figure 4). About 65 percent of all STEM workers in the manufacturing sector worked in one of the 10 industries shown in Figure 4.[10] In those industries, STEM workers made up 13.5 percent to 38.6 percent of all workers. Highlighting a few examples, there were 218,000 workers in the aircraft and parts industry, where STEM workers made up 32.4 percent of all workers in the industry; there were 113,000 STEM workers in the medical equipment and supplies industry, where STEM occupations made up 18.4 percent of all occupations in the industry.

Some manufacturing industries had a relatively small number of STEM workers, but a high percentage of STEM workers in the industry. For example, while there were only 57,090 STEM workers in the computer and peripheral equipment industry, STEM workers made up 38.6 percent of all workers in that industry. Conversely, other industries had a relatively high number of STEM workers, but a low share of STEM workers in the industry. For example, there were 193,000 STEM workers in the motor vehicle and motor vehicle equipment industry, which made up 13.5 percent of all workers.

---

[10] The Census Bureau codes 81 industries in the manufacturing sector. For a detailed list, see
https://www.census.gov/topics/employment/industry-occupation/guidance/code-lists.html

Figure 4: Number and Percentage of STEM Workers in Selected Industries in the Manufacturing Sector: 2017
(Civilian employed population 16 and over)
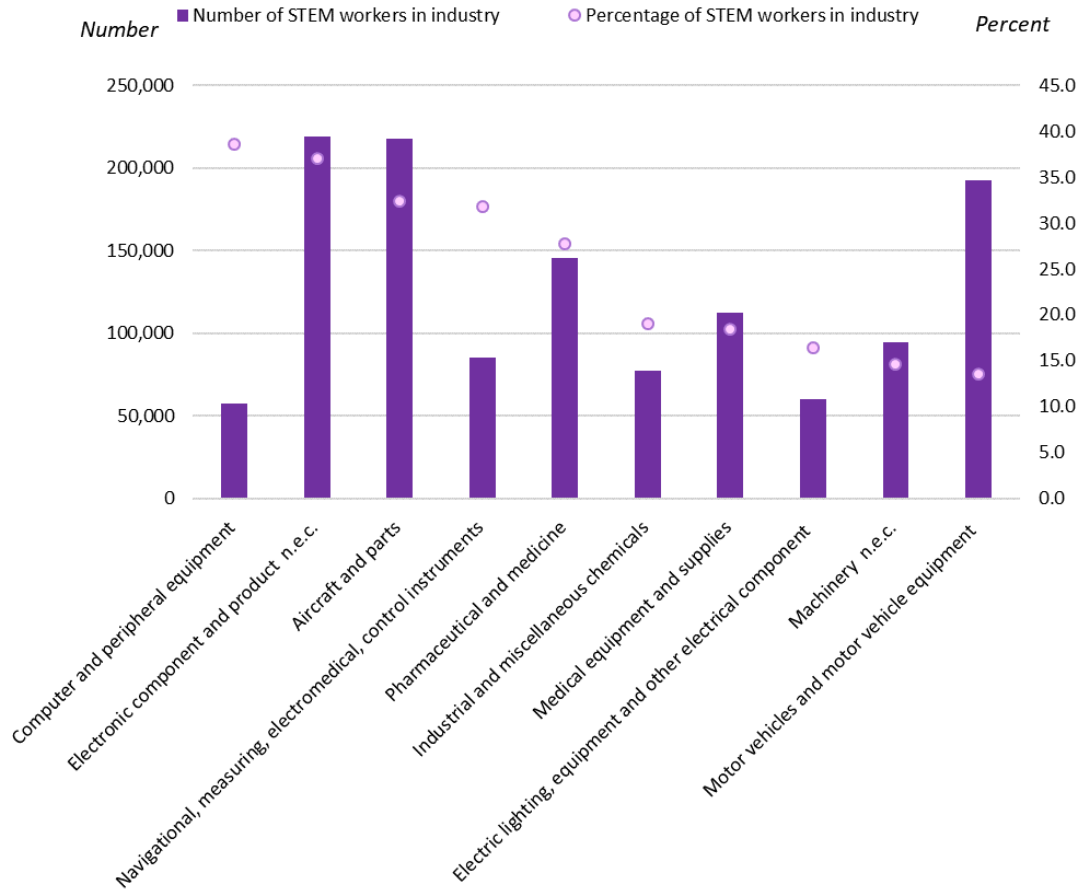
Source: 2017, 1-year American Community Survey
Note: ACS estimates may not add to the total due to rounding. For information on confidentiality protection, sampling error, nonsampling error, and definitions, see http://www2.census.gov/programs-surveys/acs/tech_docs/accuracy/MultiyearACSAccuracyofData2016.pdf.

Section 3: How does STEM work in Manufacturing compare with others Sectors?

In the manufacturing sector, 12.5 percent of workers were in STEM occupations, about double the national average (6.2 percent) (Figure 5). There was a higher percentage of STEM workers in manufacturing than 9 other sectors (12.5 percent compared with 0.6 to 10.2 percent). Three sectors had a higher share of STEM workers than manufacturing, with the largest share of STEM Workers in the industry sector "professional, science, management, administration, and waste management services" (18.6 percent).

Figure 5: Percentage of Workers in STEM Occupations by Industry Sector: 2017
(Civilian employed population 16 and over)

STEM workers in total population	6.2

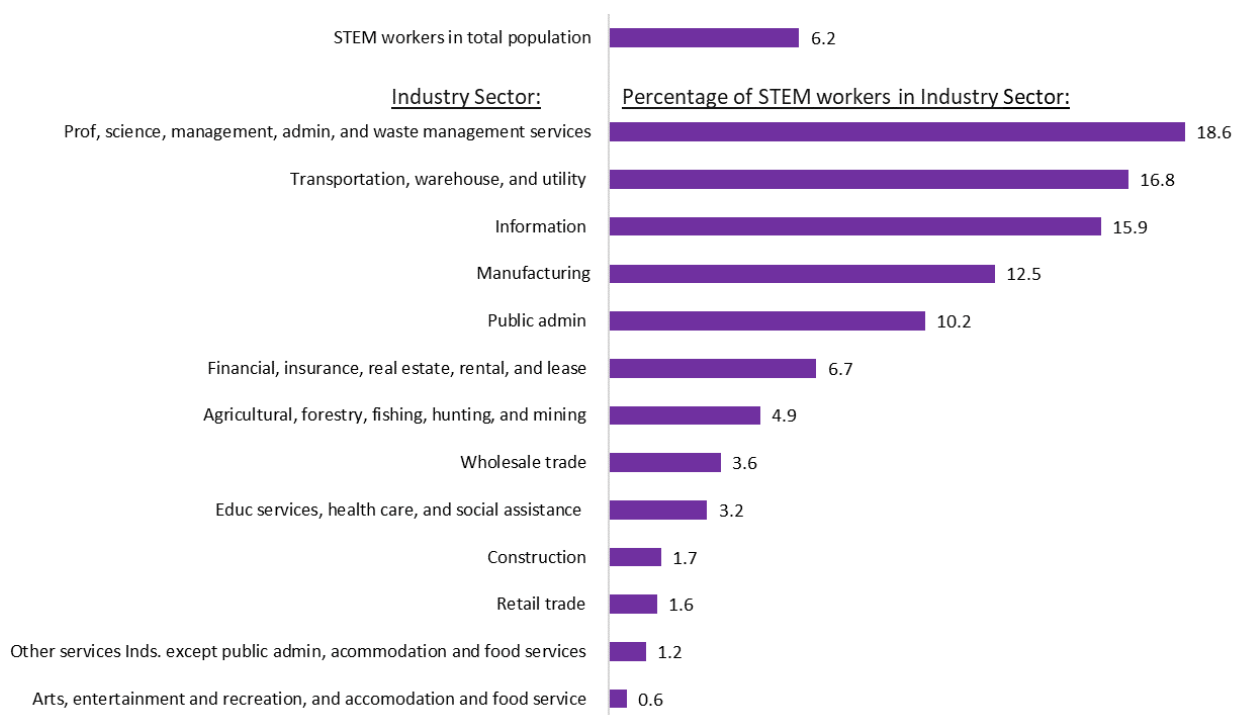| Industry Sector:	Percentage of STEM workers in Industry Sector:
Prof, science, management, admin, and waste management services	18.6
Transportation, warehouse, and utility	16.8
Information	15.9
Manufacturing	12.5
Public admin	10.2
Financial, insurance, real estate, rental, and lease	6.7
Agricultural, forestry, fishing, hunting, and mining	4.9
Wholesale trade	3.6
Educ services, health care, and social assistance	3.2
Construction	1.7
Retail trade	1.6
Other services Inds. except public admin, acommodation and food services	1.2
Arts, entertainment and recreation, and accomodation and food service	0.6

Source: 2017, 1-year American Community Survey
Note: ACS estimates may not add to the total due to rounding. For information on confidentiality protection, sampling error, nonsampling error, and definitions, see http://www2.census.gov/programs-surveys/acs/tech_docs/accuracy/MultiyearACSAccuracyofData2016.pdf.
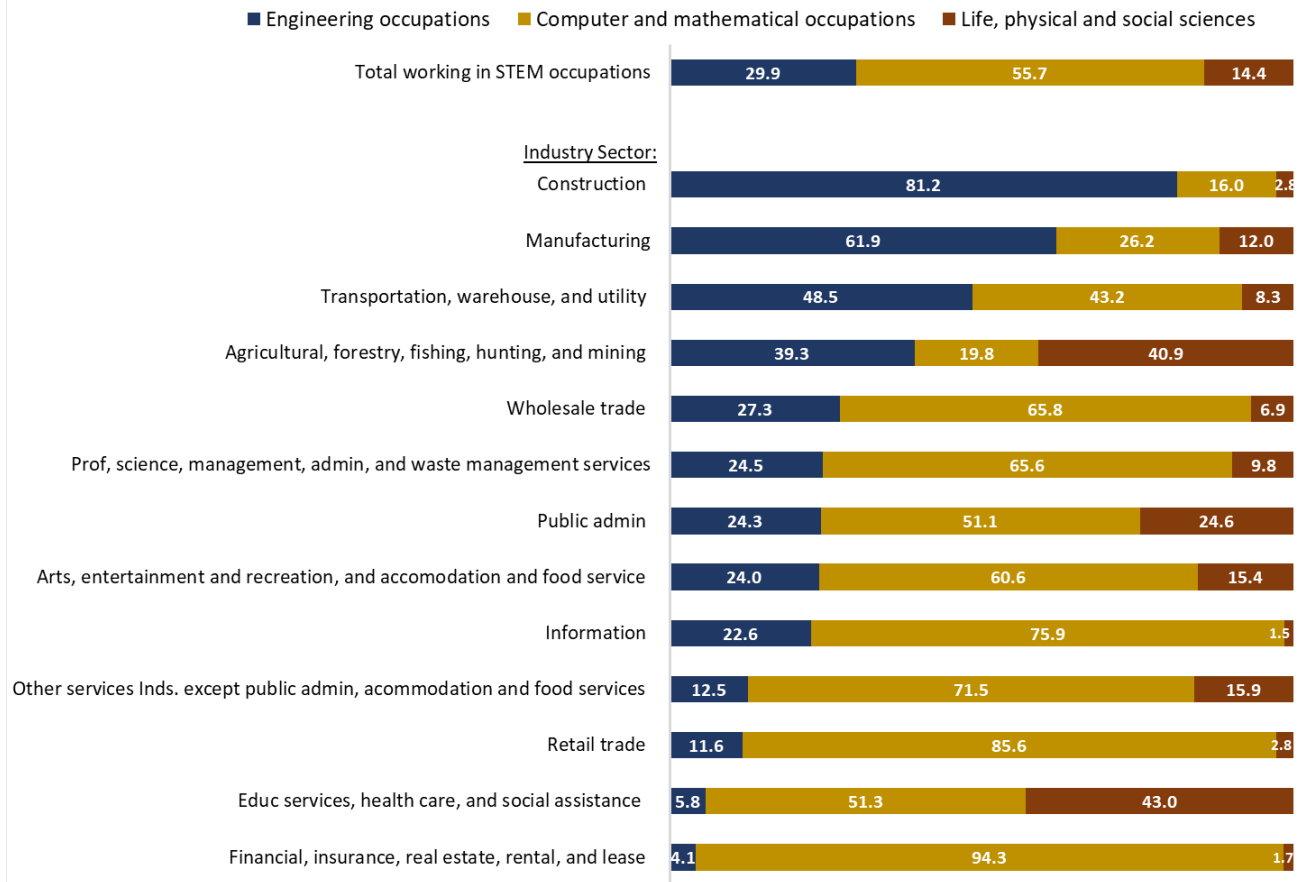
Figure 6 shows the type of STEM work done in each sector and in the total population. In the manufacturing sector, compared with the all workers, there was a much higher percentage of STEM workers in engineering occupations (61.9 percent compared with 29.9 percent), a much lower percentage of workers in computer occupations (26.2 percent compared with 55.7 percent), and a similar percentage of STEM workers in life, physical, and social sciences occupations (12.0 percent compared with 14.4 percent).

The manufacturing sector had a higher percentage of STEM workers in engineering occupations than 11 other sectors (61.9 percent compared with 4.1 percent to 48.5 percent) (Figure 6). The construction sector was the only sector in the U.S. with a higher percentage of STEM workers in engineering occupations than the manufacturing sector (81.2 percent compared with 61.9 percent).

Computer occupations made up a much smaller share of STEM workers in manufacturing than 10 other sectors (26.2 percent compared with 43.2 percent to 94.3 percent) (Figure 6). Only the

construction sector (16 percent) and agriculture, forestry, fishing, hunting, and mining sector (19.8 percent) had a smaller percentage of STEM workers in computer occupations than the manufacturing sector (26.2 percent).

Figure 6: Percentage of STEM Workers by STEM Occupation and Industry Sector: 2017
(Civilian employed population 16 and over)

■ Engineering occupations   ■ Computer and mathematical occupations   ■ Life, physical and social sciences

Category	Engineering occupations	Computer and mathematical occupations	Life, physical and social sciences
Total working in STEM occupations	29.9	55.7	14.4
Industry Sector:			
Construction	81.2	16.0	2.8
Manufacturing	61.9	26.2	12.0
Transportation, warehouse, and utility	48.5	43.2	8.3
Agricultural, forestry, fishing, hunting, and mining	39.3	19.8	40.9
Wholesale trade	27.3	65.8	6.9
Prof, science, management, admin, and waste management services	24.5	65.6	9.8
Public admin	24.3	51.1	24.6
Arts, entertainment and recreation, and accomodation and food service	24.0	60.6	15.4
Information	22.6	75.9	1.5
Other services Inds. except public admin, acommodation and food services	12.5	71.5	15.9
Retail trade	11.6	85.6	2.8
Educ services, health care, and social assistance	5.8	51.3	43.0
Financial, insurance, real estate, rental, and lease	4.1	94.3	1.7

Source: 2017, 1-year American Community Survey
Note: ACS estimates may not add to the total due to rounding. For information on confidentiality protection, sampling error, nonsampling error, and definitions, see http://www2.census.gov/programs-surveys/acs/tech_docs/accuracy/MultiyearACSAccuracyofData2016.pdf.

REFERENCES

Landivar, Christin Liana. 2013a. "The Relationship Between Science and Engineering Education and Employment in STEM Occupations", *American Communtiy Survey Reports*, ACS-23, U.S. Census Bureau.

Landivar, Christin Liana. 2013b. "Disparities in STEM Employment by Sex, Race, and Hispanic Origin", *American Communtiy Survey Reports*, ACS-23, U.S. Census Bureau.