Hitachi Energy, Halifax County

Evolve Services, Frederick County

Press Glass, Henry County

An Analysis of Manufacturing Occupations, Skills Demand, and Graduate Outcomes in Virginia

May 2025

VOEE | Virginia Office of Education Economics

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Executive Summary

Using a comprehensive, longitudinal dataset on graduates from Virginia postsecondary institutions, the Virginia Office of Education Economics (VOEE) examined the relationship between higher education and employment in the Manufacturing industry. For each of the top occupational groups in Manufacturing requiring a bachelor's degree, this report examines the most common occupations, employers, educational programs, colleges and universities, and job skills. The longitudinal nature of the dataset also allows for the analysis of the career pathways of graduates working in these Manufacturing occupations, including the wage progression and occupations of graduates who worked in Manufacturing prior to earning a degree. While only 18% of Manufacturing workers are in occupations that typically require a bachelor's degree, these workers have important jobs in Business and Financial Occupations, Management, Architecture and Engineering, and other occupational groups. This report does not address the 82% of Manufacturing workers in occupations that require less than a bachelor's degree.

Data

The primary data source for these analyses is the Virginia College and Career Outcomes Dataset. This unique dataset contains information about the skills and career pathways of over 640,000 graduates from Virginia postsecondary institutions. Some analyses also rely on staffing pattern data sourced from Lightcast.

Key Findings

- Since 2020, Manufacturing employment has grown by 8% in Virginia, adding 18,000 jobs.
- According to Deloitte, the US Manufacturing industry is expected to experience significant job growth, including in higher skilled occupations. Many of these positions could remain unfilled due to skills gaps and a lack of applicants.
- Approximately 18% of Manufacturing workers are in occupations that require a bachelor's degree.
- The top six occupational groups for Virginia graduates with a bachelor's degree working in Manufacturing are:

1. Business and Financial Operations
    - With roughly 16,000 employees and 34% growth since 2020, Business and Financial Operations occupations is the largest category for bachelor's-level Manufacturing workers in Virginia. The most frequently observed occupation for graduates is Management Analysts.

2. Management
    - Management occupations in Manufacturing requiring a bachelor's degree grew by over 25% from 2020–2024, adding nearly 3,000 new jobs. As for Business and Financial Operations occupations, most graduates working in these occupations completed programs in business or management.

3. Architecture and Engineering
    - Nearly 14,000 Virginia Manufacturing workers were employed in Architecture and Engineering occupations requiring a bachelor's degree in 2024. The top observed occupations for graduates were Industrial Engineers and Mechanical Engineers. Virginia Tech produced over half of these graduates.

4. Computer and Mathematical

   - Approximately 5,600 people worked in bachelor's-level Computer and Mathematical occupations in the Manufacturing industry in 2024. The most common occupation among graduates was Software Developers, Applications. The most frequent program among graduates was Computer and Information Sciences, followed by Business Administration and Management.

5. Life, Physical, and Social Science

   - Approximately 2,000 Virginians were employed in bachelor's-level Life, Physical, and Social Science occupations in the Manufacturing industry in 2024. Graduates work in a variety of occupations, including Medical Scientists, and they completed an array of programs at institutions across the Commonwealth.

6. Arts, Design, and Media[1]

   - Virginia's Manufacturing industry employed approximately 1,800 workers in Arts, Design, and Media occupations typically requiring a bachelor's degree in 2024. Employment of graphic designers has grown by 10% since 2020, but overall employment in these occupations declined by 7% over the same time period. The top two occupations among graduates were Public Relations Specialists and Graphic Designers.

- Most graduates working in Manufacturing made lateral transitions between occupations with similar education and experience requirements.
- Workers in Manufacturing experience substantial wage growth in the years following graduation, and they have the third-highest wages among bachelor's degree holders in the five years following graduation.
- Prior to pursuing higher education, the most common occupation in Manufacturing for future graduates was Retail Salespersons.

Conclusion

This report highlights the important, but often overlooked, pathways between bachelor's degree programs and the Manufacturing workforce. By understanding the educational backgrounds and career progressions of those working in Manufacturing, policymakers, educators, and workforce professionals can better align training programs with industry demands, ensuring a steady pipeline of skilled talent to support the sector's growth in Virginia.

[1]The official Standard Occupational Classification (SOC) title for this group is Arts, Design, Entertainment, Sports, and Media, but most Manufacturing workers are employed in Design and Media occupations. Arts, Design, and Media is used throughout the report for brevity.

Introduction

The Virginia Office of Education Economics (VOEE) is engaged in a multi-year, multistage project to assess how Virginia college graduates' education and skills affect their career outcomes over time. The purpose of the Virginia Skills Initiative is to collect data and conduct analyses to address pivotal research questions related to graduates' entry into the labor market and their career progression. This report examines the relationship between higher education (bachelor's degrees) and employment in the Manufacturing industry. These analyses are intended to inform educators, workforce and economic development professionals, and policymakers as they implement strategies to support the state's growing Manufacturing sector.

Since the dataset consists of individuals who received a degree or credential from a Virginia postsecondary institution, this report is focused on occupations in the Manufacturing industry that require higher levels of education. This includes occupations related to Business and Finance; Management; Architecture and Engineering; Computer and Mathematical; Life, Physical, and Social Science; and Arts, Design, and Media. For each of the top occupational groups in Manufacturing requiring a bachelor's degree, this report examines the most common occupations, employers, educational programs, colleges and universities, and job skills.

The longitudinal nature of the dataset also allows for the analysis of the career pathways of graduates working in these Manufacturing occupations, including the wage progression and occupations of graduates who worked in Manufacturing prior to earning a degree.

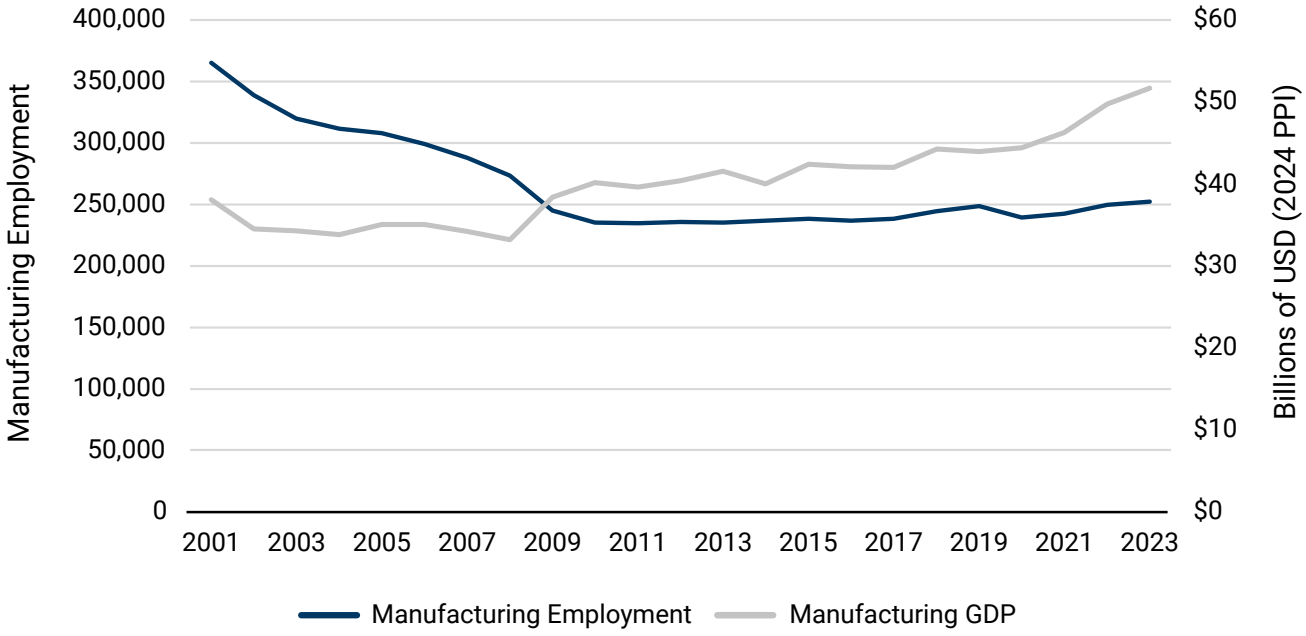
Manufacturing in Virginia

Manufacturing is a broad collection of businesses engaged in the physical production of finished or intermediate goods. In 2023, the Manufacturing industry contributed $51.7 billion to Virginia's GDP, representing 7% of Virginia's total GDP. In 2024, approximately 258,000 Virginians worked in Manufacturing, representing 6% of the state's total workforce.[2]

While Manufacturing employment declined significantly from 2001–2011, that trend has reversed in recent years. Since 2020, Manufacturing employment has grown by 8% — both in Virginia and nationally — adding 18,000 jobs in Virginia and 1,000,000 jobs nationwide.[3] Although Manufacturing employment in Virginia has decreased overall since 2001, the contribution of Virginia's Manufacturing industry to the state's GDP has increased by 35% over the same period.[4]

Since 2020, Manufacturing employment has grown by 8% in Virginia, adding 18,000 jobs.

Figure 1
Change in Manufacturing Industry Employment and Contribution to Virginia's GDP, 2001–2023



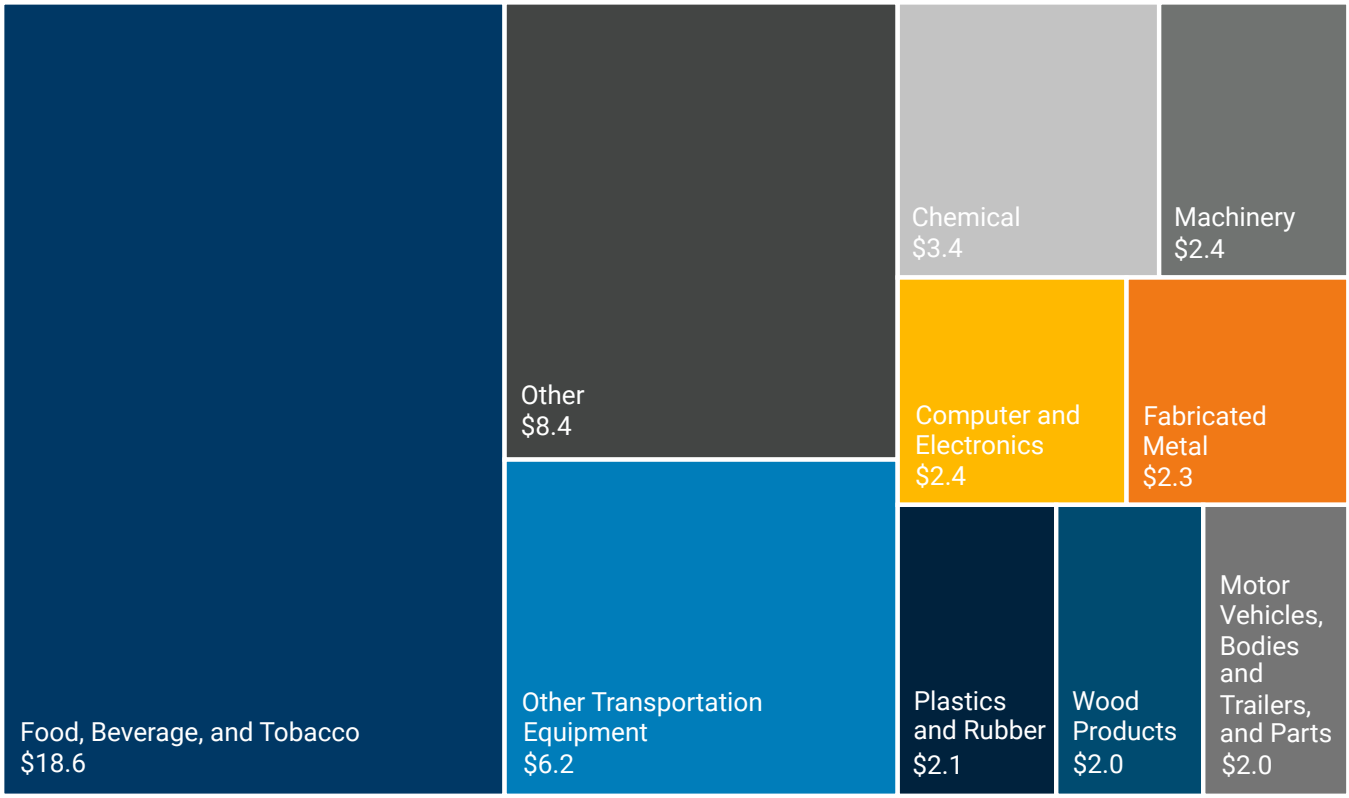
Source: Bureau of Economic Analysis. (2024, June). *Gross domestic product by state and personal income by state, 2nd quarter 2024.* https://www.bea.gov/news/2024/gross-domestic-product-state-and-personal-income-state-1st-quarter-2024

The Manufacturing industry comprises several subsectors. The largest subsectors by contribution to state GDP are Food, Beverage, and Tobacco ($18.6 billion); Non-Motor Vehicle Transportation Equipment ($6.2 billion); and Chemicals ($3.4 billion).

[2]Lightcast. (2024). *2024 Q3 datarun.* https://lightcast.io/
[3]Lightcast. (2024). *2024 Q3 datarun.* https://lightcast.io/
[4]Bureau of Economic Analysis. (2024, June). *Gross domestic product by state and personal income by state, 1st quarter 2024.* https://www.bea.gov/news/2024/gross-domestic-product-state-and-personal-income-state-1st-quarter-2024

Figure 2

Constituents of Manufacturing Industry's Contributions to Virginia's GDP in 2022, in Billions of 2024 USD



Source: Bureau of Economic Analysis. (2024, June). *Gross domestic product by state and personal income by state, 2nd quarter 2024.* https://www.bea.gov/news/2024/gross-domestic-product-state-and-personal-income-state-1st-quarter-2024

The Manufacturing Workforce

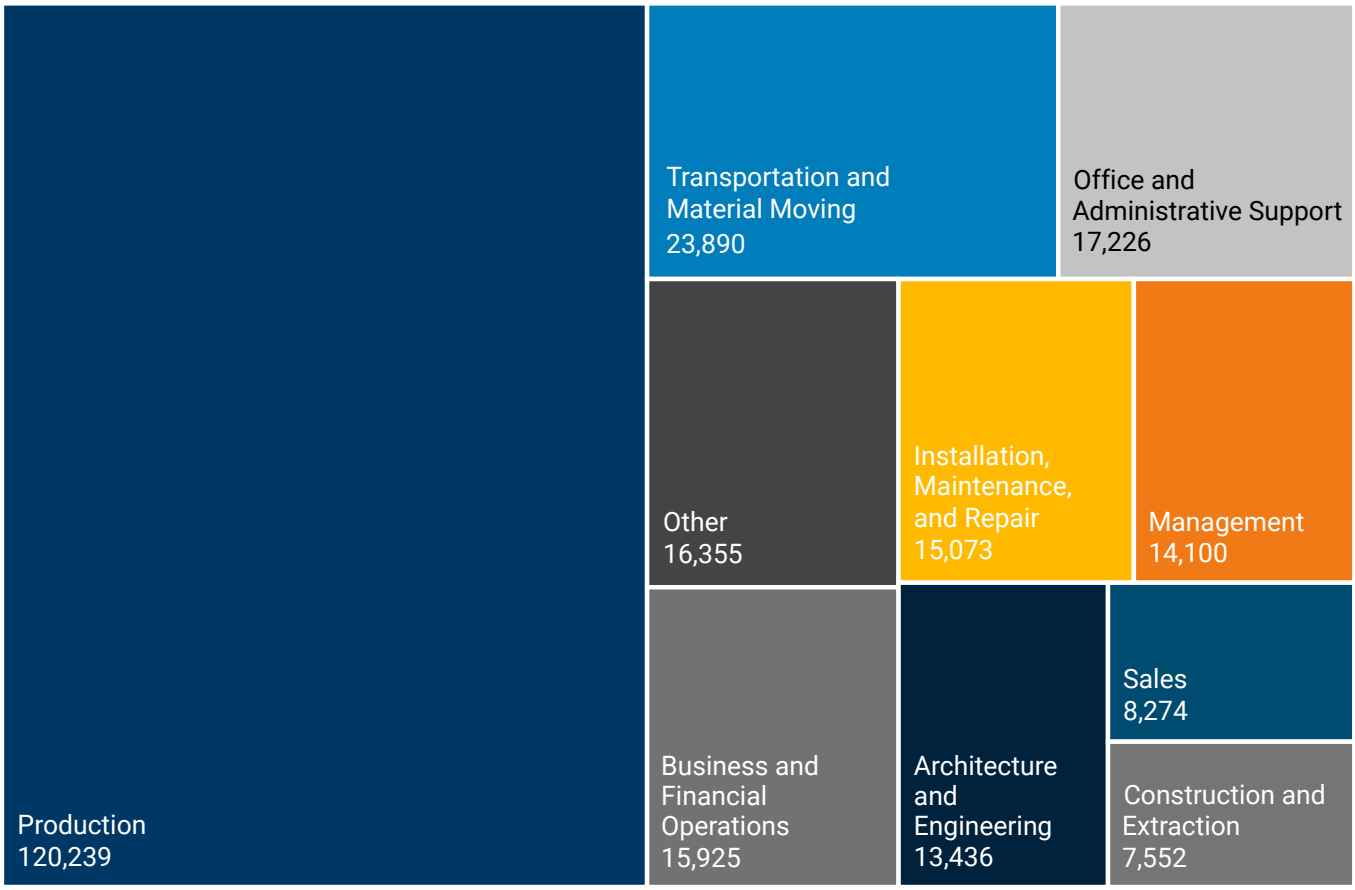
Manufacturing workers are employed in a diverse array of occupations. While many workers are involved in production, others provide support services required by most businesses and industries. The largest occupational group in the Manufacturing industry is Production.[5] These workers' primary duties include fabricating and assembling products, often with the use of industrial tools and machinery.[6] Transportation and Material Moving occupations are the second-largest occupational group. This group includes Freight and Stock Movers, Truck Drivers, and Packers and Stockers. Office and Administrative Support occupations comprise the third largest occupational group. These workers serve as Clerks, Customer Service Representatives, and Administrative Assistants.

[5]Lightcast. (2024). *2024 Q3 datarun.* https://lightcast.io/

[6]U.S. Bureau of Labor Statistics. (2018). *2018 standard occupational classification users guide.* Office of Occupational Statistics and Employment Projections. https://www.bls.gov/soc/2018/soc_2018_user_guide.pdf

Figure 3

Manufacturing Industry Employment in Virginia by Major Occupational Group, 2024

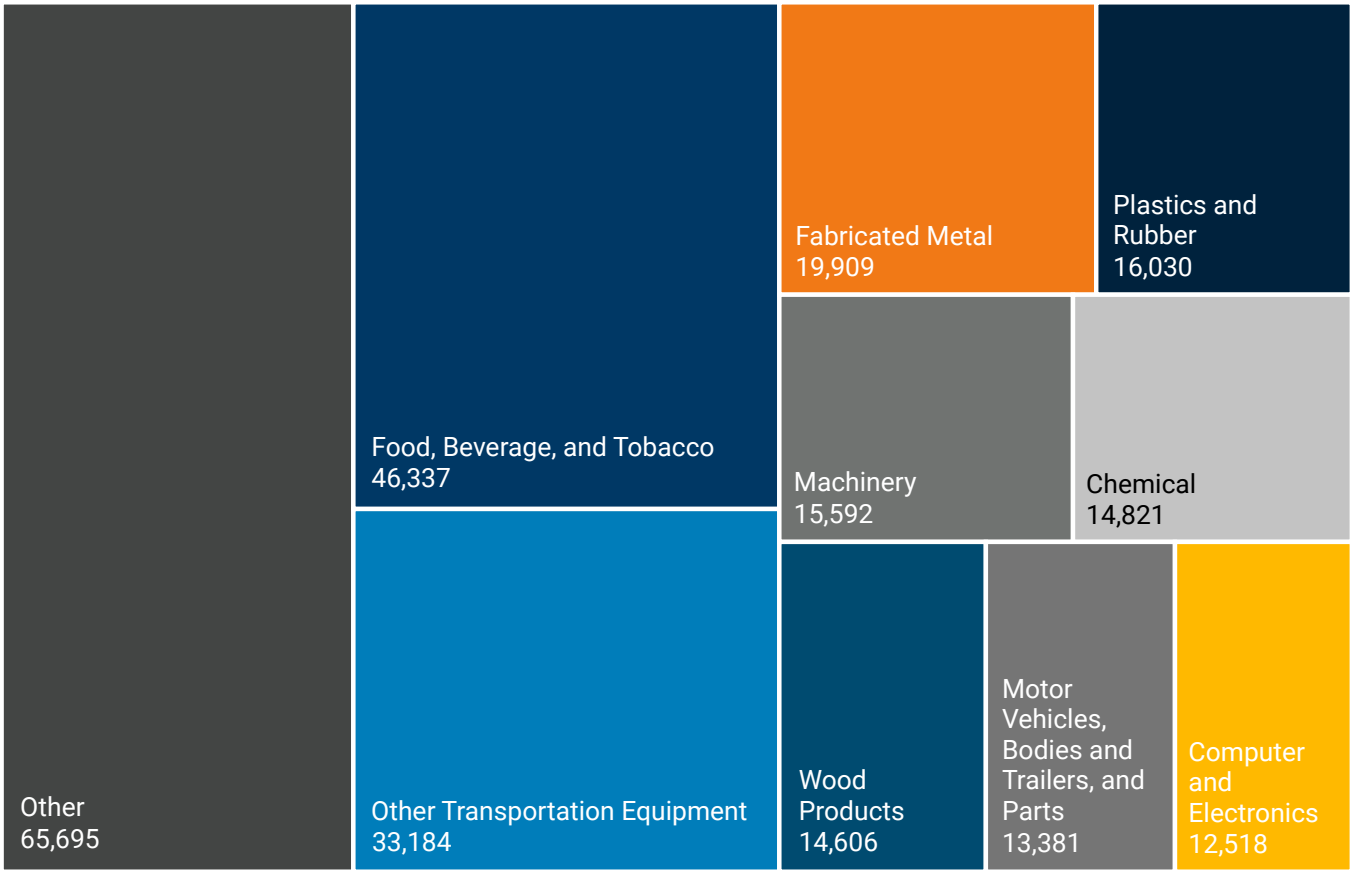


Source: Lightcast. (2024). *2024 Q3 datarun*. https://lightcast.io/

Employment within Manufacturing industry subsectors is generally proportional to subsectors' contribution to GDP. The exception is the Food, Beverage, and Tobacco subsector, which constitutes 37% of the Manufacturing industry by GDP but only 18% by employment.

Figure 4

Employment of Virginians in Manufacturing Industry by Industry Subsector, 2023



Source: Lightcast. (2024). *2024 Q3 datarun*. https://lightcast.io/

According to a recent study by Deloitte and the Manufacturing Institute, the US Manufacturing industry is expected to create 43.8 million jobs nationwide from 2024–2033, approximately half of which could remain unfilled due to skills gaps and a lack of applicants.[7] While many of these jobs will be in production, higher skilled occupations are also expected to experience shortages. For instance, the demand for mechanical and industrial engineers is expected to increase by almost 11% between 2022 and 2032. These trends emphasize the importance of understanding the pathways between higher education and the Manufacturing industry.

According to Deloitte, the US Manufacturing industry is expected to experience significant job growth, including in higher skilled occupations. Many of these positions could remain unfilled due to skills gaps and a lack of applicants.

[7]Deloitte Research Center for Energy and Industrials (2024). *2024 Manufacturing Industry Outlook.* https://www2.deloitte.com/us/en/insights/industry/Manufacturing/Manufacturing-industry-outlook.html

Data and Methods

VOEE College and Career Outcomes Dataset

The analyses in this brief primarily rely on VOEE's College and Career Outcomes Dataset. Developed in partnership with Lightcast and the State Council of Higher Education for Virginia (SCHEV), this unique dataset contains information about the skills and career pathways of over 640,000 graduates from Virginia postsecondary institutions. By matching SCHEV data with students' professional social profiles and Unemployment Insurance (UI) wage information, the dataset tracks graduates as they progress from their programs of study into their first jobs and beyond (up to 15 years). This novel dataset includes information about graduates from a wide range of fields from academic and noncredit cohorts spanning 2008–2022. The data include each individual's degrees and credentials, occupations, and employers as reported on social profiles; employer industries; location (as of 2022); wages reported to the Virginia Employment Commission for UI purposes; and skills.

Of the almost 1.7 million total graduates from Virginia institutions during the 2008–2022 period, approximately 38% were matched to social media by workforce analytics firm Lightcast, using names, education, and employment history. Table 1 includes information about match rates for all graduates. Match rates were higher for graduates at the bachelor's degree level and higher, indicating that the College and Career Outcomes dataset is more representative of these groups.

Table 1
Representation of Graduates in the College and Career Outcomes Dataset by Award Level in All Programs at All Institutions (2008–2022)

Award Level	Total Graduates	Graduates in Dataset	Graduates in Dataset (%)
Certificate	217,148	41,126	19
Associate	271,445	60,879	22
Bachelor's	805,120	377,500	47
Master's	304,044	127,892	42
First Professional	45,263	20,009	44
Doctorate	42,070	19,574	47
Total	**1,685,090**	**646,980**	**38**

This report makes use of the National Center for Education Statistics' Classification of Instructional Programs (CIP) framework to categorize the academic degrees and certificates held by workers in the Manufacturing industry.[8] CIP codes are used by colleges and universities to classify degrees and certificates by subject matter area. Graduates were identified as working in Manufacturing if their firm of employment was classified as belonging to the Manufacturing industry (Codes 31-33) under the North American Industry Classification System (NAICS).

[8]National Center for Education Statistics. (2020). *CIP: The classification of instructional programs.* U.S. Department of Education. https://nces.ed.gov/ipeds/cipcode/

Other Data Sources

Analyses in this report also rely on staffing pattern data sourced from Lightcast. These data include national Occupational Employment Statistics staffing pattern data, projections from the National Industry-Occupation Employment Matrix,[9] and Lightcast's proprietary employment data.

Data Limitations

While the College and Career Outcomes dataset includes records for a substantial portion of graduates, the sample may not be representative of the overall population of graduates. Graduates from different programs and institutions have different rates of labor force participation and engagement with social media profiles.

Degrees earned outside of Virginia present another limitation of the data. A large minority (39%) of Virginia graduates in the dataset listed additional degrees earned in other states in their professional profiles. Out-of-state degrees are not considered in this brief because VOEE does not have the means to independently verify degrees from institutions that do not report to SCHEV. Also, career data are based on self-attested job titles, and how people describe their jobs on social media may not be consistent.

Finally, as described in the next section, the analyses in this report only apply to the 18% of the Manufacturing workforce in occupations that typically require a bachelor's degree.

[9]U.S. Bureau of Labor Statistics. (2024). *Industry-occupation matrix data, by industry.* Office of Occupational Statistics and Employment Projections. https://www.bls.gov/emp/tables/industry-occupation-matrix-industry.htm

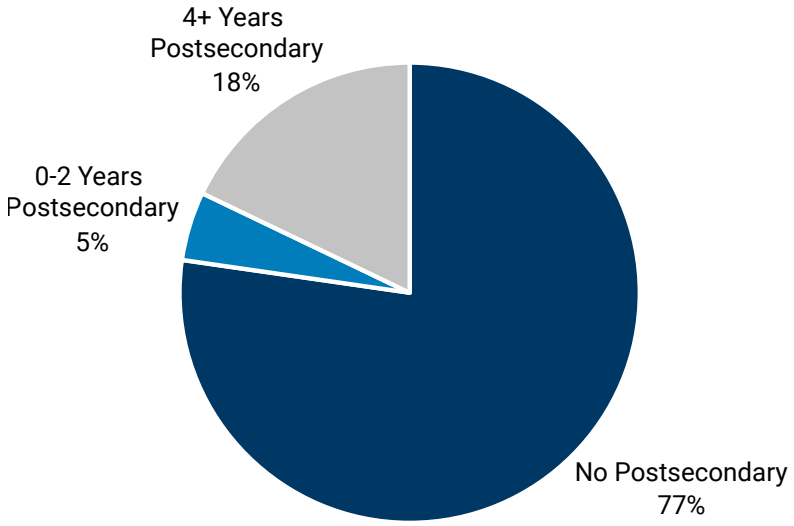
Occupations in Manufacturing Requiring a Bachelor's Degree

Approximately 18% of Manufacturing workers are in occupations that typically require a bachelor's degree. The remaining 82% of workers are in positions that do not typically require postsecondary education or that require a certificate or associate degree. Nonetheless, many incumbents of these jobs do have some form of higher education, and many of these occupations require significant on-the-job training, including apprenticeships and other forms of medium- to long-term training.

Approximately 18% of Manufacturing workers are in occupations that require a bachelor's degree or higher.

Figure 5 shows the breakdown of Virginia's Manufacturing workforce by typical required entry-level education.

Figure 5
Typical Entry-Level Education Required for Occupations in Virginia's Manufacturing Industry, 2023



Note: No Postsecondary-Typically requires no formal education or high school diploma. 0-2 Years Postsecondary-Typically requires short-term credential or associate degree. 4+ Years Postsecondary-Typically requires a bachelor's degree. Based on 2023 employment and O*NET workforce characteristics.

Source: Lightcast. (2024). *2024 Q3 datarun*. https://lightcast.io/

The 18% of workers in positions that require a bachelor's degree are employed in a variety of occupations. Table 2 lists the top occupation groups of workers in Manufacturing based on industry staffing data from 2024. Occupations are classified at the 2-digit level of the Standard Occupational Classification (SOC) System. The third column indicates the number of graduates in the College and Career Outcomes dataset who worked in the Manufacturing industry in the given occupational group. The dataset is over-representative of some occupational groups (e.g., Computer and Mathematical) and under-representative of others (e.g., Business and Financial Operations).

Table 2

Comparison of Employment in the Virginia Manufacturing Industry by Major Occupational Group

2-Digit SOC Major Group	Employment in SOC Requiring Postsecondary Degree (2024)	Unique Postsecondary Degree Holders in Occupation, 2008–2022 (College & Career Outcomes dataset)
Business and Financial Operations	16,211	8,241
Management	14,303	11,054
Architecture and Engineering	13,814	8,724
Computer and Mathematical	5,632	11,353
Life, Physical, and Social Science	1,913	2,154
Arts, Design, Entertainment, Sports, and Media	1,756	2,152
Sales and Related	452	4,350
Installation, Maintenance, and Repair	94	643
Healthcare Practitioners and Technical	87	868
Legal	67	301
Office and Administrative Support	67	4,420
Farming, Fishing, and Forestry	14	24
Education, Training, and Library	11	382
Production	-	2,207
Protective Service	-	478
Transportation and Material Moving	-	426
Food Preparation and Serving Related	-	401
Community and Social Service	-	342
Construction and Extraction	-	226
Personal Care and Service	-	187
Healthcare Support	-	65
Building and Grounds Cleaning and Maintenance	-	25
Military Specific	-	14
Total	**54,421**	**45,982**

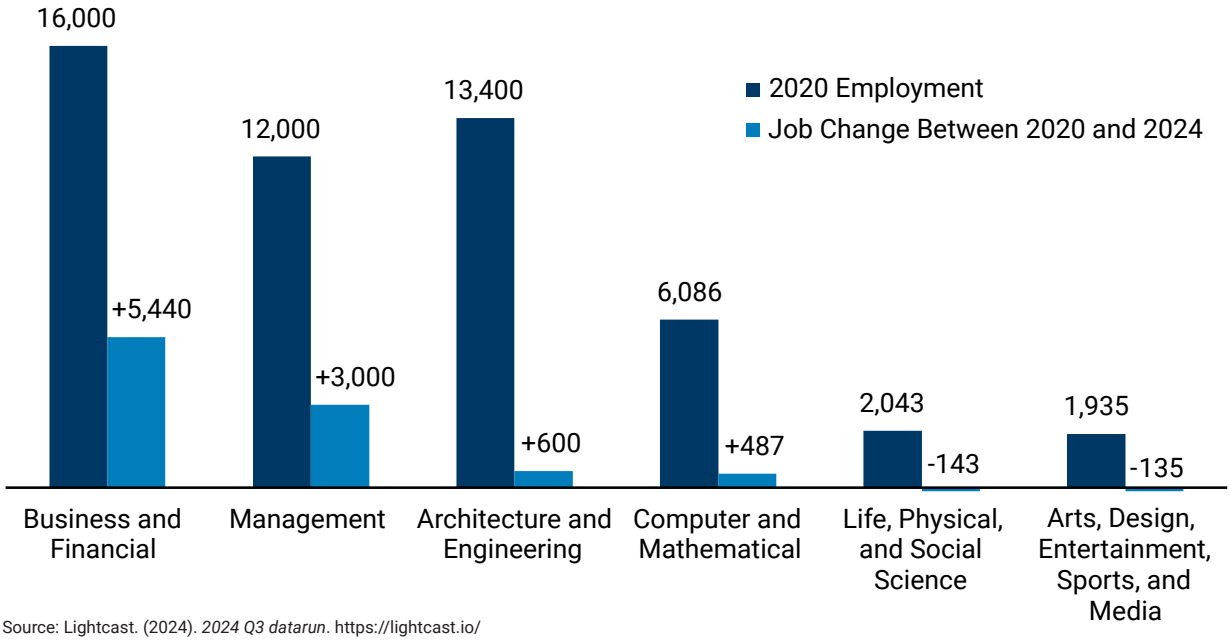
Sources: Lightcast. (2024). *2024 Q3 datarun.* https://lightcast.io/; College and Career Outcomes Dataset

This brief focuses on the six occupational groups that are the largest employers of bachelor's degree holders in the Virginia Manufacturing industry based upon 2024 staffing pattern data.

1. Business and Financial Operations
2. Management
3. Architecture and Engineering
4. Computer and Mathematical
5. Life, Physical, and Social Science
6. Arts, Design, and Media

Figure 6 and Table 3 show employment changes in each of these groups overall and in the top occupations from 2020–2024. The Business and Financial; Management; Architecture and Engineering; and Computer and Mathematical occupational groups experienced growth over this period. Although Life, Physical, and Social Science and Arts, Design, and Media experienced small declines in employment from 2020–2024, they remain among the largest bachelor's-level occupational groups in Manufacturing.

Figure 6
Employment Changes in Bachelor's-Level Manufacturing Occupational Groups in Virginia



Source: Lightcast. (2024). *2024 Q3 datarun*. https://lightcast.io/

Table 3

Employment Changes in Bachelor's-Level Manufacturing Occupations in Virginia

Occupations	2020 Employment	New jobs 2020–2024	Growth 2020–2024 (%)
Business and Financial Operations	**12,054**	**4,157**	**34**
Buyers and Purchasing Agents	2,924	551	19
Project Management Specialists	1,069	1470	138
Accountants and Auditors	1,775	523	29
Management	**11,436**	**2,867**	**25**
General and Operations Managers	3,958	1,564	40
Industrial Production Managers	1,746	456	26
Sales Managers	1,697	228	45
Architecture and Engineering	**13,212**	**602**	**5**
Industrial Engineers	2,807	-10	0
Marine Engineers and Naval Architects	1,153	1,136	99
Mechanical Engineers	1,939	-79	-4
Computer and Mathematical	**5,202**	**431**	**8**
Software Developers	2,523	326	13
Network and Computer Systems Administrators	638	-74	-12
Computer Systems Analysts	527	19	4
Life, Physical, and Social Sciences	**2,057**	**-144**	**-7**
Occupational Health and Safety Specialists	391	134	34
Chemical Technicians	428	-47	-11
Chemists	410	-98	-24
Arts, Design, and Media	**1,888**	**-131**	**-7**
Graphic Designers	796	83	10
Commercial and Industrial Designers	516	-349	-68
Technical Writers	182	-32	-18

Source: Lightcast. (2024). *2024 Q3 datarun*. https://lightcast.io/

Graduates in the College and Career Outcomes Dataset Working in Manufacturing

The following analyses examine the graduates in the College and Career Outcomes dataset who worked in one of the six identified occupational groups that employ the greatest number of Manufacturing workers in bachelor's-level occupations. In contrast to the staffing pattern data, this sample of graduates includes Manufacturing workers across a 14-year period in and outside Virginia. The dataset is also over-representative of some bachelor's-level occupations in the Manufacturing industry and under-representative of others, compared to the staffing pattern data discussed previously. See the Data section for additional data limitations.

With roughly 16,000 employees and 34% growth since 2020, Business and Financial Operations occupations is the largest category for bachelor's-level Manufacturing workers in Virginia. The most frequently observed occupation for graduates was Management Analysts.

Business and Financial Operations Occupations

Business and Financial Operations occupations are the largest bachelor's-level occupation category in the 2024 staffing pattern. In 2024, manufacturers in Virginia employed roughly 16,000 people in Business and Financial jobs that typically require a postsecondary degree. Employment in these roles has increased by 34% since 2020, the largest job growth for an occupational category.[10] Much of that growth was driven by Project Management Specialists (140% growth, 1,500 new jobs), Business Operations Specialists (160% growth, 680 new jobs), Accountants and Auditors (29% growth, 520 new jobs), and Buyers and Purchasing Agents (19% growth, 550 new jobs).

Top Observed Business and Financial Operations Occupations

The College and Career Outcomes dataset includes nearly 5,500 graduates from Virginia institutions working in Business and Financial Operations careers in the Manufacturing industry from 2008-2022. Table 4 lists the most common occupations for these graduates. According to the Occupational Information Network (O*NET), a nationwide network of occupational information, Management Analysts study and evaluate organizations; design systems and procedures; and measure, document, and streamline work processes. Market Research Analysts and Marketing Specialists research market conditions and competitions and plan marketing and advertising campaigns. Accountants and Auditors analyze records to prepare financial statements; audit and evaluate financial statements; and implement systems of recording financial and budgetary data. Business Operations Specialists oversee diverse functions, including business continuity, sustainability, and security management.[11]

[10]Lightcast. (2024). *2024 Q3 datarun.* https://lightcast.io/
[11]National Center for O*Net Development. (2024). *O*Net online*. U.S. Department of Labor. https://www.onetonline.org/

Table 4

Employment of Graduates in College and Career Outcomes Dataset in Business and Financial Operations Occupations, by Occupation (5-digit SOC)

Occupation	Individuals Employed
Management Analysts	1,768
Market Research Analysts and Marketing Specialists	1,441
Accountants and Auditors	1,055
Business Operations Specialists, All Other	1,043
Financial Analysts	917
Purchasing Agents, Except Wholesale, Retail, and Farm Products	678
Human Resources Specialists	625
Training and Development Specialists	509
Logisticians	457
Compliance Officers	170

Top Observed Employers

The top employers of Virginia graduates in Business and Financial Operations roles in the Manufacturing industry are in the subsectors of Computer and Electronics Manufacturing (IBM, Northrop Grumman, BAE Systems, L3Harris, Apple), Transportation Equipment (General Dynamics, Lockheed Martin, Huntington Ingalls, Boeing), and Tobacco Manufacturing (Altria).

Table 5

Top Employers of Virginia Graduates in Business and Financial Operations Occupations (2004–2022)

Employer	Individuals Employed
IBM	521
Northrop Grumman	414
General Dynamics	389
Lockheed Martin	224
BAE Systems	192
L3Harris Technologies	180
Altria Group	163
Huntington Ingalls Industries	122
Apple	121
Boeing	104

Top Observed Educational Programs

Unsurprisingly, Business Administration and Management is the most common program area of degrees earned by Virginia graduates working in Business and Financial Operations careers in the Manufacturing industry. The field also employs many graduates who majored in Psychology and the social sciences.

Table 6
Top Programs of Study for Virginia Graduates in Business and Financial Operations Occupations (2004–2022)

Occupation	Individuals Employed
52.0201 Business Administration and Management, General	1,253
52.0101 Business/Commerce, General	676
52.0301 Accounting	604
52.0801 Finance, General	397
52.1401 Marketing/Marketing Management, General	355
42.0101 Psychology, General	286
45.0601 Economics, General	271
45.0901 International Relations and Affairs	161
09.0101 Speech Communication and Rhetoric	149
45.1001 Political Science and Government, General	148

Top Observed Colleges and Universities

Many Virginia institutions produced graduates who went on to work in Business and Financial Operations occupations in the Manufacturing industry. The two largest producers were Virginia Tech and Liberty University.

Table 7
Top Institutions of Study for Graduates in Business and Financial Operations Occupations (2004–2022)

Institution	Individuals Employed
Virginia Tech	978
Liberty University	828
James Madison University	603
Virginia Commonwealth University	537
George Mason University	513
University of Virginia	427
Old Dominion University	326
Radford University	226
William & Mary	217
Christopher Newport University	132

Top Observed Skills

The self-attested skills among workers in Business and Financial Operations are focused on marketing, analysis, finance and accounting, and project management.

Table 8
Top Self-Attested Skills of Virginia Graduates in Business and Financial Operations Occupations (2004–2022)

Skill	Individuals Attesting Skill
Marketing	2,356
Data Analysis	2,226
Financial Analysis	1,645
Accounting	1,611
Finance	1,541
Event Planning	1,346
Project Management	1,343
Auditing	1,239
Process Improvement	1,213
Financial Statements	1,039

Management Occupations

Management and Business and Financial Operations occupations frequently deal with similar business processes, but the roles of managers focus on planning, directing, and coordinating the execution of business processes.[12] Management occupations in Manufacturing requiring a bachelor's degree grew over 25% from 2020-2024, adding nearly 3,000 new jobs. Growth in this occupational group was led by General and Operations Managers (40% growth, 1,500 new jobs), Industrial Production Managers (26% growth, 460 new jobs), and Sales Managers (45% growth, 230 new jobs).

Management occupations in Manufacturing requiring a bachelor's degree grew by over 25% from 2020-2024, adding nearly 3,000 new jobs. As for Business and Financial Operations occupations, most graduates working in these occupations completed programs in business or management.

Top Observed Occupations

The College and Career Outcomes dataset includes over 11,000 graduates working in Management occupations in the Manufacturing industry from 2008-2022. The most common occupations for these graduates are shown in Table 9. According to O*NET, Marketing Managers plan and direct marketing and pricing strategies and oversee product and service development. Sales Managers plan and direct sales strategies and product distribution and align inventory with consumer demand. General and Operations Managers plan and direct firms' operations and formulate policies, usually through subordinate supervisors. Architectural and Engineering Managers coordinate technical project activities, direct project design, and consult with clients on project specification. The occupational category "Managers, All Other" encompasses workers who manage areas including regulatory affairs, compliance, and loss prevention.

[12]U.S. Bureau of Labor Statistics. (2024, August). *Occupational outlook handbook.* Office of Occupational Statistics and Employment Projections. https://www.bls.gov/ooh/

Table 9
Employment of Virginia Graduates in Management Occupations, by Occupation (5-digit SOC)

Occupation	Individuals Employed
Managers, All Other	2,449
Marketing Managers	2,199
Sales Managers	1,680
General and Operations Managers	1,296
Architectural and Engineering Managers	826
Financial Managers	693
Computer and Information Systems Managers	642
Human Resources Managers	610
Industrial Production Managers	599
Purchasing Managers	427

Top Observed Employers

The top employers of Virginia graduates in Management roles for Manufacturing firms are in the subsectors of Computer and Electronics Manufacturing (Northrop Grumman, IBM, L3Harris, Dell), Transportation Equipment (General Dynamics, Lockheed Martin), Machinery Manufacturing (General Electric), and Beverage and Tobacco Manufacturing (PepsiCo, Altria).

Table 10
Top Employers of Virginia Graduates in Management Occupations (2004–2022)

Employer	Individuals Employed
Northrop Grumman	301
General Dynamics	261
IBM	201
General Electric	197
PepsiCo	195
L3Harris Technologies	178
Altria Group	163
Lockheed Martin	155
Sherwin-Williams	153
Dell Technologies	143

Top Observed Educational Programs

As with Business and Financial Operations careers, the top educational programs of graduates in Management in the Manufacturing industry are from business and management programs. However, many hold degrees in technical fields such as engineering and biology.

Table 11
Top Programs of Study for Virginia Graduates in Management Occupations (2004–2022)

Program	Individuals Employed
52.0201 Business Administration and Management, General	1,814
52.0101 Business/Commerce, General	795
52.1401 Marketing/Marketing Management, General	560
14.1901 Mechanical Engineering	335
42.0101 Psychology, General	281
52.0301 Accounting	262
09.0101 Speech Communication and Rhetoric	248
26.0101 Biology/Biological Sciences, General	211
52.0801 Finance, General	208
14.3501 Industrial Engineering	187

Top Observed Colleges and Universities

As observed among those employed in Business and Financial Operations occupations, Virginia Tech and Liberty University were the top producers of graduates working in Management occupations in the Manufacturing industry.

Table 12
Top Institutions of Study for Virginia Graduates in Management Occupations (2004–2022)

Institution	Individuals Employed
Virginia Tech	1,455
Liberty University	1,305
Virginia Commonwealth University	743
James Madison University	659
University of Virginia	615
Old Dominion University	561
George Mason University	544
University of Virginia Darden School of Business	359
Radford University	282
William & Mary	220

Top Observed Skills

The top self-attested skills of workers in Management occupations are similar to the top skills among workers in Business and Financial Operations occupations. Marketing, data analysis, finance, event planning, project management, and process improvement are among the top 10 skills in both occupational groups.

Table 13
Top Self-Attested Skills of Virginia Graduates in Management Occupations (2004–2022)

Skill	Individuals Attesting Skill
Marketing	3,601
Project Management	2,320
Data Analysis	2,169
Business Development	1,817
Event Planning	1,681
Process Improvement	1,667
Operations Management	1,523
New Product Development	1,353
Marketing Strategies	1,262
Finance	1,229

Architecture and Engineering

Workers in Architecture and Engineering fields use scientific and mathematical principles in the design and production of goods, structures, and systems. Engineers use specialized scientific knowledge of materials and forces and advanced mathematics to design products and systems, while technicians in engineering roles work with specialized equipment involved in these processes. The Manufacturing industry is the second-largest employer of engineers (after Professional, Scientific, and Technical Services[13]).

Nearly 14,000 Virginia Manufacturing workers were employed in Architecture and Engineering occupations requiring a bachelor's degree in 2024. The top observed occupations for graduates were Industrial Engineers and Mechanical Engineers. Virginia Tech produced over half of these graduates.

Nearly 14,000 Virginia Manufacturing workers were employed in Architecture and Engineering occupations requiring a bachelor's degree in 2024. Occupations in this area experienced a lower rate of job growth from 2020–2024 (5% growth, 600 new jobs) compared to that of occupations in Management and Business and Financial Operations.

The most common Architecture and Engineering roles in the Manufacturing sector are Industrial Engineers (2,800 jobs), Marine Engineers (2,300 jobs), Mechanical Engineers (1,900 jobs), and Electrical Engineers (1,200 jobs). Employment of Marine Engineers in the Manufacturing sector has nearly doubled since 2020, adding 1,100 new jobs. Chemical Engineers and Aerospace Engineers, employing 460 and 280 respectively, have grown by about 25% since 2020. The Architecture and Engineering field also employs 2,500 technicians, but employment of Engineering Technicians in Manufacturing firms has declined by 9% since 2020.

[13]U.S. Bureau of Labor Statistics. (2024, August). *Occupational outlook handbook.* Office of Occupational Statistics and Employment Projections. https://www.bls.gov/ooh/

Top Observed Occupations

The College and Career Outcomes dataset includes over 8,700 graduates working in Architecture and Engineering occupations in the Manufacturing industry from 2008–2022. The top occupations are shown in Table 14. According to O*NET, Industrial Engineers design and evaluate industrial production processes, including cost control, quality control, and production coordination. Mechanical Engineers design engines and machines and oversee the installation and operations of heat, gas, and water systems, among others. The "Engineers, All Other" category includes engineers in the fields of energy, mechatronics, robotics, and nanosystems.

Table 14
Employment of Virginia Graduates in Architecture and Engineering Occupations, by Occupation (5-digit SOC)

Occupation	Individuals Employed
Industrial Engineers	2,969
Mechanical Engineers	2,252
Engineers, All Other	1,697
Electrical Engineers	907
Electronics Engineers, Except Computer	441
Aerospace Engineers	348
Industrial Engineering Technicians	257
Computer Hardware Engineers	255
Engineering Technicians, Except Drafters, All Other	202
Civil Engineers	200

Top Observed Employers

The top employers of engineers in the Manufacturing sector are in the subsectors of Computer and Electronics (Northrop Grumman, Intel, General Dynamics, L3Harris, Honeywell), Transportation Equipment (Lockheed Martin, Boeing, Huntington Ingalls, General Motors), and Machinery (General Electric).

Table 15
Top Employers of Graduates in Architecture and Engineering Occupations (2004–2022)

Employer	Individuals Employed
Northrop Grumman	570
Lockheed Martin	483
Boeing	240
General Electric	230
Intel	226
General Dynamics	215
Huntington Ingalls Industries	197
L3Harris Technologies	164
Honeywell International	154
General Motors	151

Top Observed Educational Programs

The educational backgrounds of engineers are unsurprisingly concentrated in engineering-related programs of study.

Table 16
Top Programs of Study for Virginia Graduates in Architecture and Engineering Occupations (2004–2022)

Program	Individuals Employed
14.1901 Mechanical Engineering	2,071
14.1001 Electrical and Electronics Engineering	1,006
14.0701 Chemical Engineering	618
14.0101 Engineering, General	539
14.0201 Aerospace, Aeronautical, and Astronautical/Space Engineering, General	418
14.3501 Industrial Engineering	373
14.0901 Computer Engineering, General	224
15.9999 Engineering/Engineering-Related Technologies/Technicians, Other	217
52.0201 Business Administration and Management, General	210
14.1801 Materials Engineering	203

Top Observed Colleges and Universities

Virginia Tech was by far the largest producer of graduates working in Architecture and Engineering occupations in Manufacturing.

Table 17
Top Institutions of Study for Virginia Graduates in Architecture and Engineering Occupations (2004–2022)

Institution	Individuals Employed
Virginia Tech	3,276
University of Virginia	747
Old Dominion University	729
Virginia Commonwealth University	616
George Mason University	360
Liberty University	271
James Madison University	201
Virginia Polytechnic Institute and State University	97
Virginia State University	89
Virginia Military Institute	72

Top Observed Skills

The primary self-attested skills of workers in Architecture and Engineering occupations include specific computer programming environments and languages (MATLAB, C++) and computer-assisted design applications (AutoCAD, SolidWorks).

Table 18
Top Self-Attested Skills of Virginia Graduates in Architecture and Engineering Occupations (2004–2022)

Skill	Individuals Attesting Skill
MATLAB	3,149
AutoCAD	1,882
Data Analysis	1,836
Mechanical Engineering	1,782
SolidWorks (CAD)	1,587
Systems Engineering	1,550
C++ (Programming Language)	1,303
Process Engineering	1,273
Project Management	1,271
New Product Development	1,198

Computer and Mathematical Occupations

The Computer and Mathematical group comprises a range of occupations that interact with computers and data. Workers in this field develop and maintain software and websites; create and manage databases and networks; and analyze information using advanced quantitative methods.

Approximately 5,600 people worked in bachelor's-level Computer and Mathematical occupations in the Manufacturing sector in 2024. Employment in these roles has grown by 8% since 2020.

Approximately 5,600 people worked in bachelor's-level Computer and Mathematical occupations in the Manufacturing industry in 2024. The most common occupation among graduates was Software Developers, Applications. The most frequent program among graduates was Computer and Information Sciences, followed by Business Administration and Management.

Top Observed Occupations

The College and Career Outcomes dataset includes over 11,000 graduates working in Computer and Mathematical occupations in the Manufacturing industry from 2008–2022. The top occupations for these graduates are listed in Table 19. Software Developers design computer applications and interact with databases using techniques from computer science and mathematics. Computer User Support Specialists provide hardware, software, and network support to end users, often in a corporate setting. Computer Systems Analysts manage and assess computer systems and develop computer software, hardware, and network solutions to business and engineering challenges. The category "Computer Occupations, All Other" includes occupations focused on administration, geographic information systems, and digital forensics.

Table 19

Employment of Virginia Graduates in Computer and Mathematical Occupations, by Occupation (5-digit SOC)

Occupation	Individuals Employed
Software Developers, Applications	3,589
Computer User Support Specialists	1,705
Computer Occupations, All Other	1,646
Computer Systems Analysts	1,220
Network and Computer Systems Administrators	1,069
Software Developers, Systems Software	966
Information Security Analysts	826
Operations Research Analysts	470
Web Developers	353
Computer and Information Research Scientists	352

Top Observed Employers

The top employers of Virginia graduates in Computer and Mathematical roles in the Manufacturing industry are in the subsectors of Computer and Electronics Manufacturing (Northrop Grumman, IBM, L3Harris, Apple, BAE Systems, RTX, Cisco), and Transportation Equipment (General Dynamics, Lockheed Martin).

Table 20

Top Employers of Virginia Graduates in Computer and Mathematical Occupations (2004–2022)

Employer	Individuals Employed
Northrop Grumman	960
General Dynamics	916
Lockheed Martin	724
IBM	669
L3Harris Technologies	428
Apple	401
Epic	336
BAE Systems	311
RTX Technologies	303
Cisco	261

Top Observed Educational Programs

The top program of study among graduates in Computer and Mathematical occupations in the Manufacturing industry is Computer and Information Sciences, followed by engineering and business programs.

Table 21
Top Programs of Study for Virginia Graduates in Computer and Mathematical Occupations (2004–2022)

Program	Individuals Employed
11.0101 Computer and Information Sciences, General	1,136
52.0201 Business Administration and Management, General	685
14.0901 Computer Engineering, General	649
11.0701 Computer Science	616
14.1001 Electrical and Electronics Engineering	519
14.1901 Mechanical Engineering	504
11.0103 Information Technology	345
52.0101 Business/Commerce, General	324
11.0401 Information Science/Studies	319
14.0101 Engineering, General	307

Top Observed Colleges and Universities

Virginia Tech was the largest producer of graduates working in Computer and Mathematical occupations, followed by George Mason University.

Table 22
Top Institutions of Study for Virginia Graduates in Computer and Mathematical Occupations (2004–2022)

Institution	Individuals Employed
Virginia Tech	2,197
George Mason University	1,307
University of Virginia	866
Virginia Commonwealth University	715
Liberty University	658
Old Dominion University	579
James Madison University	551
Northern Virginia Community College	270
William & Mary	202
Radford University	198

Top Observed Skills

The top self-attested skills among workers in Computer and Mathematical occupations in the Manufacturing industry are centered on programming languages and operating systems. The skills of workers in Computer and Mathematical occupations are similar to those of engineers: data analysis, C++, project management, and MATLAB are among the top 10 self-attested skills in both major occupational groups.

Table 23
Top Self-Attested Skills of Virginia Graduates in Computer and Mathematical Occupations (2004–2022)

Skill	Individuals Employed
Java	2,772
Software Engineering	2,606
Data Analysis	2,411
Python	2,300
SQL	2,278
C++	2,118
Software Development	2,003
Linux	1,844
Project Management	1,844
MATLAB	1,779

Life, Physical, and Social Science Occupations

Workers in Life, Physical, and Social Science occupations specialize within their fields of study, which require expert scientific knowledge of the underlying discipline. While some of these occupations have conceptual overlap with engineering disciplines, occupations in this field generally focus on fundamental research rather than industrial applications.

Approximately 2,000 Virginians were employed in bachelor's-level Life, Physical, and Social Science occupations in the Manufacturing industry in 2024. Graduates work in a variety of occupations, including Medical Scientists, and they completed an array of programs at institutions across the Commonwealth.

Life, Physical, and Social Science occupations employ approximately 2,000 scientists and technicians in the Manufacturing industry in roles that typically require a bachelor's degree at the entry level. While this occupational group is the sixth-largest employer of college graduates in the Manufacturing industry, overall employment has declined 7% since 2020. Prominent occupations in this group include Occupational Health and Safety Specialists, Chemists and Chemical Technicians, and Food Science Technicians.

Top Observed Occupations

The College and Career Outcomes dataset includes over 2,100 graduates from Virginia institutions working in Life, Physical, and Social Science careers in the Manufacturing industry from 2008–2022. Medical Scientists study diseases and health through clinical and laboratory research. Chemists perform analysis and experiments to better understand chemical and physical properties, both as primary research and as part of industrial processes. Technicians in this field assist scientists in conducting tests, operating scientific equipment, and performing quality control functions.

Table 24
Employment of Virginia Graduates in Life, Physical, and Social Science Occupations, by Occupation (5-digit SOC)

Occupation	Individuals Employed
Medical Scientists, Except Epidemiologists	509
Chemists	432
Life, Physical, and Social Science Technicians, All Other	332
Biological Technicians	179
Chemical Technicians	149
Food Scientists and Technologists	119
Environmental Science and Protection Technicians, Including Health	113
Biochemists and Biophysicists	99
Environmental Scientists and Specialists, Including Health	92
Materials Scientists	55

Top Observed Employers

The top employers of Virginia graduates in Life, Physical, and Social Science occupations in the Manufacturing industries are in the subsectors of Chemical and Pharmaceutical Manufacturing (GlaxoSmithKline, Merck, Pfizer, AstraZeneca, Afton Chemical, Novartis), Computer and Electronics Manufacturing (Thermo Fisher), Tobacco (Altria), and Aerospace (General Dynamics).

Table 25
Top Employers of Virginia Graduates in Life, Physical, and Social Science Occupations (2004–2022)

Employer	Individuals Employed
GlaxoSmithKline	90
Merck	89
Pfizer	79
Thermo Fisher Scientific	52
Abbott Laboratories	51
AstraZeneca	51
Afton Chemical	46
Altria Group	34
Novartis	33
General Dynamics	30

Top Observed Educational Programs

The top programs of study among graduates in Life, Physical, and Social Science occupations in the Manufacturing industry align closely with the occupations themselves. The two most common programs were Chemistry and Biology/Biological Sciences.

Table 26
Top Programs of Study for Virginia Graduates in Life, Physical, and Social Science Occupations (2004–2022)

Program	Individuals Employed
40.0501 Chemistry, General	428
26.0101 Biology/Biological Sciences, General	375
14.0701 Chemical Engineering	79
26.0202 Biochemistry	70
51.2001 Pharmacy	53
38.0101 Philosophy	51
52.0201 Business Administration and Management, General	50
14.0501 Bioengineering and Biomedical Engineering	50
01.1001 Food Science	45
14.0101 Engineering, General	36

Top Observed Colleges and Universities

Once again, Virginia Tech was the largest producer of graduates working in Life, Physical, and Social Science occupations in Manufacturing, followed by Virginia Commonwealth University and the University of Virginia.

Table 27
Top Institutions of Study for Virginia Graduates in Life, Physical, and Social Science Occupations (2004–2022)

Institution	Individuals Employed
Virginia Tech	421
Virginia Commonwealth University	247
University of Virginia	202
James Madison University	114
George Mason University	97
Liberty University	60
Old Dominion University	50
Radford University	37
William & Mary	36
Shenandoah University	35

Top Observed Skills

Many of the top self-attested skills among workers in Life, Physical, and Social Science occupations in the Manufacturing industry are highly specialized to individual occupations, but foundational skills such as data analysis and principles of good manufacturing were also reported.

Table 28
Top Self-Attested Skills of Virginia Graduates in Life, Physical, and Social Science Occupations (2004–2022)

Skill	Individuals Attesting Skill
Data Analysis	655
Chemistry	509
Good Manufacturing Practices	356
High-Performance Liquid Chromatography	353
Analytical Chemistry	306
Cell Cultures	306
Pharmaceuticals	301
Biology	291
Spectroscopy	279
Polymerase Chain Reaction	272

Arts, Design, and Media Occupations

Workers in Arts, Design, and Media occupations contribute to written and visual works. In the Manufacturing industry, these workers' output contributes to product and process documentation, product design, and marketing and public relations.

Virginia's Manufacturing industry employs approximately 1,800 workers in occupations typically requiring a bachelor's degree within the occupational group of Arts, Design, and Media, half of whom work as Graphic Designers. While employment of Graphic Designers in the Manufacturing industry has grown 10% since 2020, employment in Arts, Design, and Media occupations overall has declined 7% over the same time period.

Virginia's Manufacturing industry employed approximately 1,800 workers in Arts, Design, and Media occupations typically requiring a bachelor's degree in 2024. Employment of graphic designers has grown by 10% since 2020, but overall employment in these occupations declined by 7% over the same time period. The top two occupations among graduates were Public Relations Specialists and Graphic Designers.

Top Observed Occupations

The College and Career Outcomes dataset includes over 2,100 graduates from Virginia institutions working in Arts, Design, and Media occupations in the Manufacturing industry from 2008–2022. Public Relations Specialists work with leadership and marketers to promote a firm's public image through written, spoken, and visual media. Graphic Designers create visual works for commercial or marketing purposes. Technical Writers create and design written works including operating instructions and process manuals.

Table 29
Employment of Virginia Graduates in Arts, Design, and Media Occupations, by Occupation (5-digit SOC)

Occupation	Individuals Employed
Public Relations Specialists	648
Graphic Designers	537
Technical Writers	222
Producers and Directors	99
Editors	79
Writers and Authors	69
Commercial and Industrial Designers	63
Merchandise Displayers and Window Trimmers	60
Coaches and Scouts	53
Designers, All Other	48

Top Observed Employers

The top employers of Virginia graduates in Arts, Design, and Media roles in the Manufacturing industry are in the subsectors of Apparel and Leather Manufacturing (Nike, Custom Ink, Under Armour), Computer and Electronic Products (Apple, Northrop Grumman, L3Harris, BAE Systems, IBM), and Transportation Equipment (General Dynamics, Huntington Ingalls).

Table 30
Top Employers of Virginia Graduates in Arts, Design, and Media Occupations (2004–2022)

Employer	Individuals Employed
Nike	65
Apple	55
General Dynamics	53
Custom Ink	52
Northrop Grumman	39
L3Harris Technologies	30
Huntington Ingalls Industries	28
BAE Systems	27
IBM	26
Under Armour	23

Top Observed Educational Programs

The top programs of study among workers in Arts, Design, and Media occupations in the Manufacturing industry are in the program areas of communications, visual arts, and English.

Table 31
Top Programs of Study for Virginia Graduates in Arts, Design, and Media Occupations (2004–2022)

Program	Individuals Employed
09.0101 Speech Communication and Rhetoric	172
50.0701 Art/Art Studies, General	137
23.0101 English Language and Literature, General	130
50.0409 Graphic Design	96
52.0201 Business Administration and Management, General	91
52.1401 Marketing/Marketing Management, General	85
09.0102 Mass Communication/Media Studies	82
50.0401 Design and Visual Communications, General	55
50.0101 Visual and Performing Arts, General	53
24.0101 Liberal Arts and Sciences/Liberal Studies	47

Top Observed Colleges and Universities

Virginia Commonwealth University, Virginia Tech, and James Madison University produced the most graduates working in Arts, Design, and Media occupations in Manufacturing.

Table 32
Top Institutions of Study for Virginia Graduates in Arts, Design, and Media Occupations (2004–2022)

Institution	Individuals Employed
Virginia Commonwealth University	257
Virginia Tech	228
James Madison University	203
Liberty University	144
George Mason University	123
Old Dominion University	104
University of Virginia	100
Radford University	73
Longwood University	37
William & Mary	37

Top Observed Skills

The top self-attested skills among workers in Arts, Design, and Media occupations in the Manufacturing industry include foundational skills such as marketing, graphic design, event planning, and public relations, as well as specialized software skills for creating visual products for mass distribution, especially applications within the Adobe Creative Suite.

Table 33
Top Self-Attested Skills of Virginia Graduates in Arts, Design, and Media Occupations (2004–2022)

Skill	Individuals Attesting Skill
Marketing	1,007
Adobe Photoshop	752
Adobe Illustrator	578
Graphic Design	576
Adobe InDesign	553
Adobe Creative Suite	542
Event Planning	492
Photography	405
Public Relations	389
Social Media Marketing	387

Career Progression in the Manufacturing Industry

The College and Career Outcomes dataset also includes longitudinal data about graduates, allowing for the examination of career pathways and progression.

Occupational Transitions

The most prominent career transitions for graduates working in Manufacturing appear to be lateral transitions between occupations with similar education and experience requirements, although the data could obscure possible changes to salary, benefits, and managerial responsibilities. Common transitions include transitions between engineering disciplines; from engineering to supervisory roles; between managerial occupations; and from software development to engineering positions. Tables 34 and 35 list the most prominent transitions in the dataset. In these tables, if an individual changes occupations multiple times, each transition is counted. In some cases, the observed transitions to and from an occupation may be greater than the number of individuals who held that occupation at some point during the period of study.

Most graduates working in Manufacturing made lateral transitions between occupations with similar education and experience requirements.

Table 34

Most Frequent Occupation Changes of Virginia Graduates Employed in the Manufacturing Industry, 2008–2022

Occupation Held in Manufacturing	Observed Transitions from Occupation	Next occupation (All Industries)	Transitions Observed	Transitions Observed (%)
Industrial Engineers	4,020	Mechanical Engineers	266	6.6
		Engineers, All Other	213	5.3
		First-Line Supervisors of Production and Operating Workers	180	4.5
Software Developers, Applications	3,686	Computer Occupations, All Other	143	3.9
		Mechanical Engineers	112	3.0
		Software Developers, Systems Software	110	3.0
Marketing Managers	2,837	Sales Managers	180	6.3
		Market Research Analysts and Marketing Specialists	150	5.3
		General and Operations Managers	118	4.2
Managers, All Other	2,820	General and Operations Managers	168	6.0
		Computer Occupations, All Other	107	3.8
		Marketing Managers	105	3.7
Computer User Support Specialists	2,446	Network and Computer Systems Administrators	240	9.8
		Software Developers, Applications	109	4.5
		Computer Systems Analysts	95	3.9
Mechanical Engineers	2,408	Industrial Engineers	253	10.5
		Engineers, All Other	145	6.0
		Software Developers, Applications	130	5.4
Sales Managers	2,014	Marketing Managers	220	10.9
		General and Operations Managers	109	5.4
		Sales Representatives, Services, All Other	75	3.7
Management Analysts	1,901	Computer Systems Analysts	125	6.6
		Managers, All Other	103	5.4
		Market Research Analysts and Marketing Specialists	82	4.3

Note: If an individual changed occupations multiple times, each transition is counted. Consequently, the observed transitions to and from an occupation may be greater than the number of individuals who held that occupation at some point during the period of study.

Table 35

Most Frequent Previous Occupations Held by Virginia Graduates in the Manufacturing Industry, 2008–2022

Occupation Held in Manufacturing	Observed Transitions from Occupation	Previous occupation (All Industries)	Transitions Observed	Transitions Observed (%)
Industrial Engineers	4,393	Mechanical Engineers	292	6.6
		Engineers, All Other	220	5.0
		Life, Physical, and Social Science Technicians, All Other	185	4.2
Software Developers, Applications	4,207	Life, Physical, and Social Science Technicians, All Other	208	4.9
		Web Developers	161	3.8
		Industrial Engineers	133	3.2
Marketing Managers	3,428	Market Research Analysts and	334	9.7
		Sales Managers	206	6.0
		Managers, All Other	135	3.9
Managers, All Other	3,195	General and Operations Managers	115	3.6
		Computer Occupations, All Other	101	3.2
		Marketing Managers	90	2.8
Mechanical Engineers	2,868	Industrial Engineers	238	8.3
		Engineers, All Other	152	5.3
		Life, Physical, and Social Science Technicians, All Other	125	4.4
Computer User Support Specialists	2,420	Network and Computer Systems Administrators	128	5.3
		Customer Service Representatives	66	2.7
		Retail Salespersons	58	2.4
Sales Managers	2,395	Marketing Managers	179	7.5
		Sales Representatives, Wholesale and Manufacturing, Except	166	6.9
		Sales Representatives, Services, All Other	113	4.7
Computer Occupations, All Other	2,091	Software Developers, Applications	133	6.4
		Managers, All Other	109	5.2
		Computer Systems Analysts	93	4.4

Wage Progression

Workers in Manufacturing experience substantial wage growth in the years following graduation. The data in this section represent the wages earned by workers in Manufacturing in the five years following graduation. Data are only available for workers who worked in Virginia for the entire calendar year in question, and only wages earned in occupations in the Manufacturing industry are considered in the median calculation.

Workers in Manufacturing experience substantial wage growth in the years following graduation, and they have the third-highest wages among bachelor's degree holders in the five years following graduation.

Table 36
Median Wage of Virginia Graduates Employed in the Manufacturing Industry in the Third Year after Graduation, by Major Occupational Group (CPI-Adjusted June 2023 Dollars)

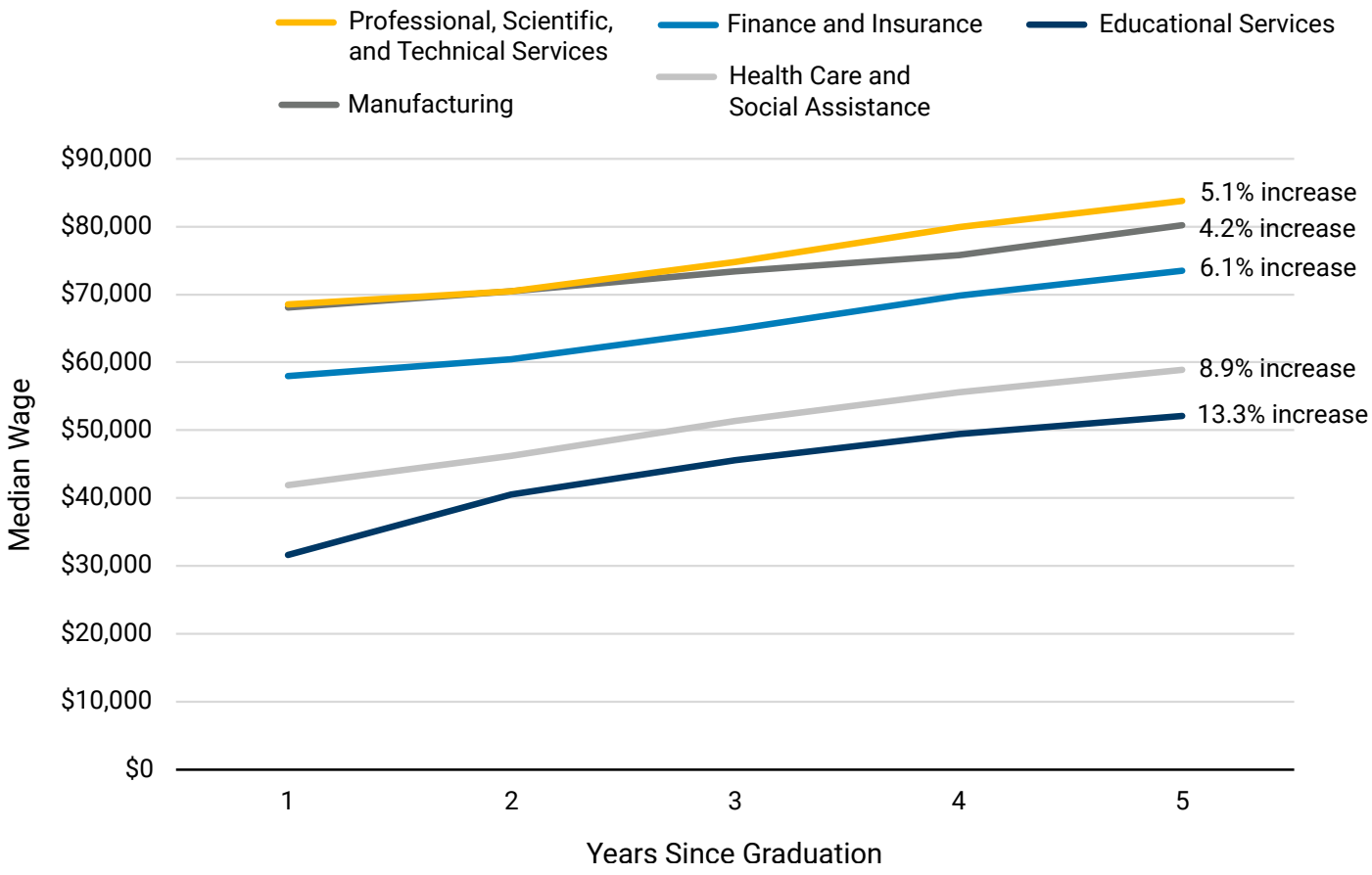
Occupation	Median Wage
Management	$74,421
Business and Financial Operations	$69,586
Computer and Mathematical	$84,717
Architecture and Engineering	$84,599
Life, Physical, and Social Science	$60,791
Community and Social Service	$45,964
Education, Training, and Library	$52,573
Arts, Design, and Media	$54,921
Healthcare Practitioners and Technical	$64,072
Protective Service	$70,226
Food Preparation and Serving Related	$31,769
Sales and Related	$64,443
Office and Administrative Support	$55,251
Construction and Extraction	$65,971
Installation, Maintenance, and Repair	$61,143
Production	$65,078
Transportation and Material Moving	$70,867

Note: Median wages omitted where fewer than 10 wage observations exist.

Among all workers for whom full-year wage data are available, workers in the Manufacturing sector have the third-highest wages among bachelor's degree holders in the five years following graduation and the second-highest among industries with more than 1,000 wage observations. Figure 7 shows the median wage and annualized growth rate for the five years following graduation for workers in the top five industries represented in the College and Career Outcomes dataset.

Figure 7

Wage Growth and Annual Growth Rate of Virginia Bachelor's Degree Holders in College and Career Outcomes Dataset, Select Industries (CPI-Adjusted June 2023 Dollars)



Pre-Degree Manufacturing Workers

Many occupations within the Manufacturing industry do not require a bachelor's degree. While the College and Career Outcomes dataset only includes students with postsecondary degrees or certificates who maintain professional social profiles, the longitudinal nature of the dataset sometimes allows for the exploration of these workers' career and educational trajectories before pursuing higher education. Table 37 shows the occupations of individuals in the dataset who worked in the Manufacturing industry before earning a post-secondary degree or credential. This sample differs from the sample in the previous analyses, which were restricted to bachelor's degree holders. In some cases, data for awards earned before 2008 or earned out of state may be missing. To account for this, workers in occupations that typically require a bachelor's degree are excluded from the analysis. The most popular occupations listed were Retail Salespersons (1,004), Computer User Support Specialists (476), Customer Service Representatives (364), Administrative Workers (306), and Supervisors of Production Workers (234).

Prior to pursuing higher education, the most common occupation in manufacturing for future graduates was Retail Salespersons.

Table 37
Top Occupations of Workers in Career and College Outcomes Dataset Employed in the Virginia Manufacturing Industry Prior to Earning Degree or Credential

Occupation	Employees
Retail Salespersons	1,004
Computer User Support Specialists	476
Customer Service Representatives	364
Secretaries and Administrative Assistants, Except Legal, Medical,	306
First-Line Supervisors of Production and Operating Workers	234
First-Line Supervisors of Office and Administrative Support	205
Sales Representatives, Wholesale and Manufacturing, Except	186
Stock Clerks and Order Fillers	170
Helpers—Production Workers	157
Cashiers	143
Demonstrators and Product Promoters	139
First-Line Supervisors of Retail Sales Workers	127
Bookkeeping, Accounting, and Auditing Clerks	124
Waiters and Waitresses	121
Maintenance and Repair Workers, General	109
Production Workers, All Other	107
Laborers and Freight, Stock, and Material Movers, Hand	102
Inspectors, Testers, Sorters, Samplers, and Weighers	94
Packaging and Filling Machine Operators and Tenders	89
Industrial Engineering Technicians	87

When these workers made career transitions after earning a degree or credential, most remained in Manufacturing, but some moved to different industries. Table 38 shows the industry of the subsequent job of these workers.

Table 38
Industry of Post-Degree/Award Job Among Pre-College Employees in Manufacturing in College and Career Outcomes Dataset

Industry of First Post-Degree Award/Job	Observed Transitions
Manufacturing	893
Professional, Scientific, and Technical Services	631
Educational Services	446
Retail Trade	258
Health Care and Social Assistance	248
Finance and Insurance	233
Construction	140
Wholesale Trade	127
Administrative and Support and Waste Management and Remediation Services	124
Other Services (except Public Administration)	118
Accommodation and Food Services	117
Information	112
Real Estate and Rental and Leasing	81
Transportation and Warehousing	75
Arts, Entertainment, and Recreation	64
Utilities	23
Mining, Quarrying, and Oil and Gas Extraction	10
Management of Companies and Enterprises	9
Agriculture, Forestry, Fishing, and Hunting	3

Table 39 shows the top programs of study chosen by graduates who worked in the Manufacturing industry prior to earning a post-secondary degree or credential. These data suggest that the educational choices of individuals who worked in Manufacturing before pursuing higher education are similar to the educational backgrounds of those who worked in the industry after graduation.

Table 39

Top Program Areas and Degrees Earned by Individuals Working in Manufacturing Prior to Pursuing Higher Education (Virginia Institutions Only)

Program of Study	Award Type	Graduates
Business, Management, Marketing, and Related Support Services	Bachelor's	1,020
Engineering	Bachelor's	505
Social Sciences	Bachelor's	406
Business, Management, Marketing, and Related Support Services	Associate	345
Liberal Arts and Sciences, General Studies, and Humanities	Associate	329
Psychology	Bachelor's	248
Communication, Journalism, and Related Programs	Bachelor's	247
Computer and Information Sciences and Support Services	Bachelor's	219
Visual and Performing Arts	Bachelor's	202
Biological and Biomedical Sciences	Bachelor's	163
Multi/Interdisciplinary Studies	Bachelor's	151
Business, Management, Marketing, and Related Support Services	Master's	148
Computer and Information Sciences and Support Services	Associate	132
Homeland Security, Law Enforcement, Firefighting, and Related Protective Services	Bachelor's	130
English Language and Literature/Letters	Bachelor's	124
Liberal Arts and Sciences, General Studies, and Humanities	Certificate	124
Health Professions and Related Programs	Bachelor's	100
Parks, Recreation, Leisure, Fitness, and Kinesiology	Bachelor's	95
Multi/Interdisciplinary Studies	Associate	93
Liberal Arts and Sciences, General Studies, and Humanities	Bachelor's	89

Summary of Findings

Virginia's Manufacturing sector is experiencing a notable resurgence, growing by 8% since 2020 and adding 18,000 new jobs. To sustain this growth, Virginia must continue to cultivate a skilled workforce that can meet the emerging demands of this sector. This report highlights the important, but often overlooked, pathways between bachelor's degree programs and the Manufacturing workforce.

Bachelor's-level occupations in the Manufacturing industry are concentrated in six occupational groups, including Business and Financial Operations (e.g., Management Analysts), Management (e.g., Managers), and Architecture and Engineering (e.g., Industrial Engineers). Virginia graduates working in these occupations received their degrees from institutions across the Commonwealth, but Virginia Tech produced the most graduates for five out of the six occupational groups. Graduates generally completed programs of study aligned with their occupational group, with graduates in more diverse occupational groups (e.g., Life, Physical, and Social Science) completing more diverse programs.

Upon entering the labor market, graduates in the Manufacturing industry received high wages, earning the second-highest median wage in the five years after graduation compared to other industries with a high concentration of graduates. Graduates who were observed changing jobs usually made lateral transitions based on education and experience requirements.

Next Steps

By understanding the educational backgrounds and career progressions of those working in Manufacturing, policymakers, educators, and workforce professionals can better align training programs with industry demands, ensuring a steady pipeline of skilled talent to support the sector's growth. This report has explored the top bachelor's-level occupations in the Manufacturing industry as well as the educational backgrounds and career and wage progression of its workers to inform workforce strategies that will enhance Virginia's position as a leader in modern Manufacturing.

It is important to note this analysis has focused primarily on the observed employment of Virginia graduates in Manufacturing occupations which typically require a bachelor's degree. Most positions in Manufacturing, however, are in occupations with educational requirements that range from a high school diploma to an associate degree. VOEE aims to produce a follow-up report that explores the broader Manufacturing workforce in Virginia, ensuring that all workers, regardless of their source of training, are better understood and supported by the state's education and training systems.

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