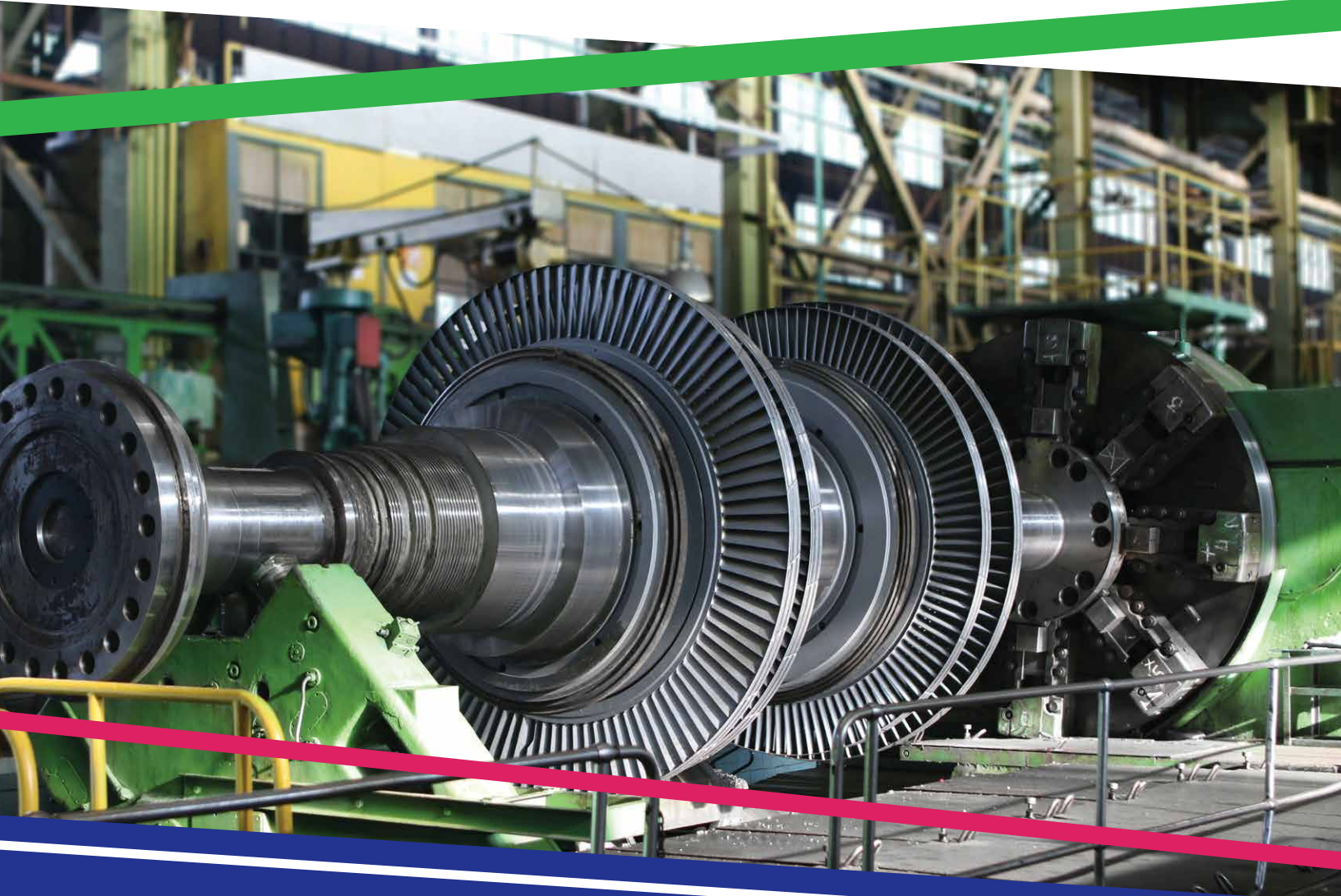# Talent Pathways Initiative

GO Virginia Region 6 and
Bay Consortium Workforce Development Board

JANUARY 2024

Acknowledgements

WORKED.
CONSULTING

Table of Contents

Executive Summary

The GO Virginia Region 6 Talent Pathways Report is designed to conduct an analysis of the demand for, and supply of, labor in key sectors, understand the workforce needs of regional businesses, and identify the skills and training needed to match workers more effectively to jobs. Three regional priority clusters were chosen for examination and strategic understanding based upon growth potential in GO Virginia Region 6:

❶ Aquaculture in the Northern Neck and Middle Peninsula subregions

❷ Information technology in the greater Fredericksburg subregion

❸ Manufacturing throughout the Region 6 area

Themes and Strategic Recommendations serve as a roadmap for workforce, economic development, educators, and elected officials to develop initiatives and focus resources that address critical opportunities for supporting job and economic growth in the region.

Themes

Three themes underlie the analysis within the Report and the recommendations contained herein.

Theme 1: Finding the Right Talent

GO Virginia Region 6 is challenged with having enough workers to fill jobs, a smaller working age population as a proportion of the overall population, and the availability of skilled workers aligned to priority cluster employment.

Theme 2: A Small Business Economy

GO Virginia Region 6 is primarily a small and mid-size business economy with firms that need skilled workers but not always at a scale where educational programs at individual institutions can be justified. Additionally, small businesses in Region 6 are struggling with the rapid wage growth experienced since the COVID-19 pandemic and cannot keep up with larger chain operations or franchises that have a larger resource base from which to pay higher wages.

Theme 3: Residents of Region 6 Work Outside the Area

Employers within Region 6 struggle to find enough workers, and one reason is the net job flow of workers to places outside the region. For example, 56% of workers living in Planning District 16 commute outside of the area for work.

Strategic Recommendations

Commensurate with GO Virginia's overall effort to foster business collaboration to develop, retain, and attract skilled talent, strategic recommendations highlight specific opportunities to bolster the connection between businesses needing skilled workers and the education and training those workers need for long term labor force attachment.

Strategic Recommendation 1: Implement a Sector Partnership Framework to Support Business-Led Education Initiatives

Creating formal sector partnerships and utilizing GO Virginia Region 6 and the BCWDB as regional conveners can improve communications, plan activities, highlight strategic priorities with sector employers, and work with all partners to efficiently align education and training service delivery.

Strategic Recommendation 2: Expand Creative Work-Based Learning Alternatives as a Primary Means of Improving Worker Skills and Supporting Small Businesses

Work-based learning is a growing training modality that incorporates many different options:

- On-the-Job Training (OJT) provides wage subsidies to employers while they upskill incumbent workers, so those workers are exposed directly to the knowledge and skills needed by that employer.

- Registered Apprenticeship is a long-standing model of work-based learning that incorporates seven elements and standards are approved by the Virginia Department of Labor.

- Unregistered Apprenticeships incorporate the elements of the Registered model but may provide more flexibility for employers to adapt to their particular workplaces.

- Paid Internships provide shorter-term workplace exposure while giving both the employer and worker an opportunity to explore a more permanent employment arrangement.

Creative work-based learning alternatives can meet two primary goals for Region 6 employers—(1) provide employer-led training solutions for people needing skills upgrades, and (2) provide starting wage assistance for small employers as they invest in workers.

Strategic Recommendation 3: Align and Support Stackable Credentials Tied Directly to High-Demand Employment

Industry-recognized credentials are critical elements to hiring, particularly for information technology jobs. Industry-recognized credentials are portable, recognized credentials developed and offered by industry associations at the national and/or regional/state level. Within industries such as information technology, they are a prerequisite for employment at livable or high wages.

Because Region 6 is primarily small and mid-size employer-based, education and training providers can more productively serve a sector versus individual employers. As part of the Sector Partnership development, stackable credential pathways can be validated, and community colleges and other training providers can serve the regional sector partnership at a scale that might not be available employer by employer. Additionally, the stackable credential pathways can incorporate digital skills badges and employability skills badges from recognized national providers of such credentials.

Strategic Recommendation 4: Leverage and Braid Resources to Provide Worker Training Accounts for Stackable Credential Training

Using the Sector Partnership model, BCWDB GO Virginia Region 6, community college partners, and planning district partners, should develop a priority occupation list and leverage public and private sector investments to support worker training accounts for high demand occupations.

To receive an account, the individual student would commit to completing a program, test to receive the appropriate industry-recognized credential, and maintain employment within the sector for which training occurred. Worker training account funds could be used for work-based learning or classroom-based options.

Strategic Recommendation 5: Target and Develop All Talent Pools to Address Shortages in Region 6

Region 6 has both a shortage of overall workers and skilled workers for specific occupations. As a result, all sources of talent must be explored. Those sources include high school graduates, veterans, older workers, nontraditional workers, and English as a Second Language (ESL) learners.

Nontraditional worker populations can provide opportunities for addressing worker shortages. For instance, manufacturing continues to lag with regard to the number of women in those jobs and careers. Manufacturing jobs often pay better than fields where women traditionally work. Finding opportunities to engage different talent pools for occupations is a strategy for developing skilled workers.

Introduction

The United States is facing a critical shortage of the workers needed to fill jobs in numerous economic sectors, such as healthcare, manufacturing, and information technology. The shortage of workers is due, in part, to the aging of the U.S. population and the Baby Boom generation retiring. Another factor is the "Great Resignation" where in 2022 alone, over 50 million U.S. workers quit their jobs, leaving the workforce altogether or participating in a "churn" of jobs as people seek more favorable workforce conditions.[1]

Just as importantly, businesses throughout the U.S. and in regional labor markets continue to report that a lack of "skilled workers" to fill jobs is prevalent and problematic. For example, the Manufacturing Institute estimates that 2.1 million U.S. manufacturing jobs will go unfilled by 2030 due to the lack of skilled workers needed to fill those jobs.[2] Recent estimates show that there are roughly 9.6 million open jobs across all sectors with approximately 6.4 million unemployed workers available to fill them.[3]

The extent to which open job positions are due to "skills gaps, mismatches, or shortages" is of some debate among labor economists. University of Maryland economist Katherine Abraham found little evidence of skills gaps or mismatches being the reason for staffing shortages despite the ongoing narrative to the contrary.[4] Rather, skeptics of the skills gap explanation attribute "job quality" as a more pronounced reason for labor shortages, characterized by factors such as job conditions, earnings, and benefits workers receive.

While economic explanations for labor shortages are debated, regional economies such as GO Virginia Region 6 experience the "real world" challenges of limited economic growth due to the lack of workers needed for key industries. Thus, this GO Virginia Region 6 Talent Pathways Report is designed to conduct an analysis of the demand for, and supply of, labor in key sectors, understand the workforce needs of regional businesses, and identify the skills and training needed to match workers more effectively to jobs.

Report Design and Methodology

To support the strategic vision of GO Virginia throughout the state, and in Region 6 specifically, the Talent Pathways Initiative has been undertaken to develop foundational baselines and understanding of the employment and education picture of key industries driving economic growth. While GO Virginia Region 6 has six (6) priority economic clusters, for its Talent Pathways Initiative, three regional priority clusters were chosen for examination and strategic understanding based upon growth potential in the region:

❶ Aquaculture in the Northern Neck and Middle Peninsula subregions

❷ Information technology in the greater Fredericksburg subregion

❸ Manufacturing throughout the Region 6 area

The GO Virginia Region 6 Talent Pathways Initiative Report is structured to provide regional stakeholders with a set of concrete recommendations to inform future initiatives, activities, and resource priorities.

Through an examination of regional economic assets and the development of a labor market situational analysis centered on these three priority clusters, this Talent Pathways Initiative Report offers Strategic Recommendations that serve as a barometer for activities to undertake going forward. Importantly, this report serves as a roadmap for workforce, economic development, educators, and elected officials to develop initiatives and focus resources that address critical opportunities for supporting job and economic growth in the region.

The GO Virginia Region 6 Talent Pathways Initiative Report is structured to provide regional stakeholders with a set of concrete recommendations to inform future initiatives, activities, and resource priorities. Recommendations are based on data collected to accomplish the following:

❶ Develop a **Situational Analysis** that:

    a) Examines the **Demand** for labor in the region, including an understanding of jobs, skills and competencies needed for jobs, and career pathways within aquaculture, information technology, manufacturing,

    b) Examines the **Supply** of labor in the region, including a look at the socio-economic factors influencing the availability of labor, such as educational attainment and poverty, and

    c) Conducts an **Inventory** of education and training resources designed to understand the capacity of regional education providers to address the skill levels needed for employment in the three priority sectors.

❷ Provide a **Gap Analysis** that utilizes an understanding of the region's current situational outlook and focuses on strategies and activities that support strong and effective cluster talent pipelines.

❸ Incorporate an **Asset Map** that provides a geographical representation and a catalog of education and training regional resources, including related university and community college programs, high school career and technical education (CTE) programs, and work-based learning opportunities provided by employers.

The data collection process incorporated a wide variety of resources, including both quantitative and qualitative sources. The report methodology utilized these sources to provide a well-rounded understanding of the factors impacting talent availability within the three priority clusters while creating a consistent framework for understanding talent pathways and highlighting opportunities for positively impacting the availability of skilled workers.

Initial data were collected and analyzed to provide a baseline picture of the labor demand and supply for aquaculture, information technology, and manufacturing. Sources included federal and state reports on the three priority clusters to establish a foundational understanding and definition of the three priority clusters. This involved examining how GO Virginia defines these clusters.

Quantitative data were collected and analyzed to provide insight into labor supply, business demand, and demographic landscape of Region 6:

- A literature review of GO Virginia reports, and other state and federal documents, developed a foundational understanding and definition of the three priority industry clusters of aquaculture, information technology, and manufacturing (specific definitions are discussed later). Gazelle data informed establishment-level company information for the three priority industry clusters, including the number of employees and yearly revenue.

- Supply data (including education and occupation data) was collected from the U.S. Bureau of Labor Statistics (BLS) and Lightcast (formerly EMSI/Burning Glass). Occupational data was used to depict job projections and job postings over time to analyze the availability of jobs. Educational data were paired with occupational data to assess the alignment of skills and educational requirements for employment.

- Demographic data was gathered from the U.S. Census Bureau and Lightcast to better understand who the residents and workers of the region are. Specifically, Lightcast (using American Community Survey data) gleaned information on the race, gender, age, ethnicity, educational attainment, and employment status of Region 6 residents. Longitudinal Employer-Household Dynamics data was extracted from the U.S. Census Bureau's On The Map tool to identify the commuting patterns of Region 6 residents and workers.

Qualitative data collection consisted of four onsite regional industry and education roundtables attended by employer, education, and community organization representatives. Roundtables were designed to gather new information while validating trends seen through the quantitative data collection.

Approximately 30 stakeholder interviews were held virtually and in-person with regional employers, educators, planning directors and staff, workforce professionals, and industry experts to gain a wide array of perspectives on talent opportunities and challenges within the regional priority clusters. Interviewees represented a broad array of voices across the aquaculture, information technology, and manufacturing sectors, and, due to the rural nature of the region, provided important and helpful perspectives on the "real-time" issues facing Region 6 communities—information that often does not show up in quantitative data analysis. Interviews were conducted using a standard questionnaire, and informal questions during the interviews were tailored to the interviewee based on professional expertise and issues raised during the interview.

The qualitative data gathering process provided context and perspective around the quantitative data, including issues impacting employment, such as the availability of affordable housing, the changing demographics of certain communities (particularly the "greying" of many communities in Region 6), and COVID pandemic impacts still reverberating on small businesses and residents.

Limitations

A report containing quantitative and qualitative data has inherent limitations. The data and conclusions contained within this Talent Pathways Initiative Report are offered within the following parameters:

- By using the specific NAICS codes that align with GO Virginia's Regional Priority Industry Clusters, a complete picture of the firms and talent situation of these clusters may be missing if additional related NAICS codes are not included. In instances where the authors believe that the priority industry clusters are narrowly defined, additional data and context are provided to understand how different occupations and industries interconnect.

- Labor reporting for the aquaculture industry is difficult due to (1) the way the Census Bureau and Bureau of Labor Statistics (BLS) categorize agriculture/aquaculture jobs, and (2) small-scale oyster aquaculture is conducted in conjunction with other business lines at many companies.[5]

- Data systems are limited in capturing "real-time" data on employment and hiring. For instance, several data centers are migrating into Region 6, whereby planning development directors are working to strategically deploy recruiting and staffing assistance. While information is being gathered through qualitative interviews and roundtables, ultimately, there is a level of information that is unknown.

- Private sector employers are often careful in offering data regarding their recruiting, hiring, and retention practices. If established relationships with public sector organizations are not present, private sector employers may prefer to remain silent on certain topics to safeguard what they view as proprietary practices.

- For this report, the authors focused on the education pathways that directly align with the identified priority industry clusters. The authors note that general education and liberal arts degrees are also pathways to many of the jobs in the target industries.

- Company data used for Asset Mapping is based on NAICS definitions. If a company conducts business in one of the priority clusters but does not have a NAICS aligned to the cluster, it is not included in the analysis.

Talent Pathway Themes

Data collection and stakeholder engagement provided key themes to consider when deploying assets and resources aimed at fostering better connections between employers and workers through talent pathways support. The following themes underlie the analysis within the report and the recommendations contained herein.

Theme 1: Finding the Right Talent

Like most geographic areas in the United States, GO Virginia Region 6 is challenged with finding enough workers to fill jobs. The GO Virginia Region 6 unemployment rate of 3.14% is below the national average of 3.94%. The GO Virginia Region 6 population is also aging where 31% of Planning District 17 residents and 23.2% of Planning District 18 residents are age 65 or older. In contrast, 17.3% of the U.S. population is age 65 or older. (See page 16 for Planning District Map.)

Further, with a smaller working age population in Region 6 as a proportion of the overall population, an additional factor exacerbating the talent shortage is the availability of skilled workers aligned to priority cluster employment. The graphic below substantiates this issue. Overall, Region 6 has workers with lower educational attainment than the U.S. average, particularly within Planning Districts 17 and 18 as demonstrated by lower shares of bachelor's and graduate degree attainment and higher shares of high school diplomas and some college.

Educational Attainment by Planning District, 2022
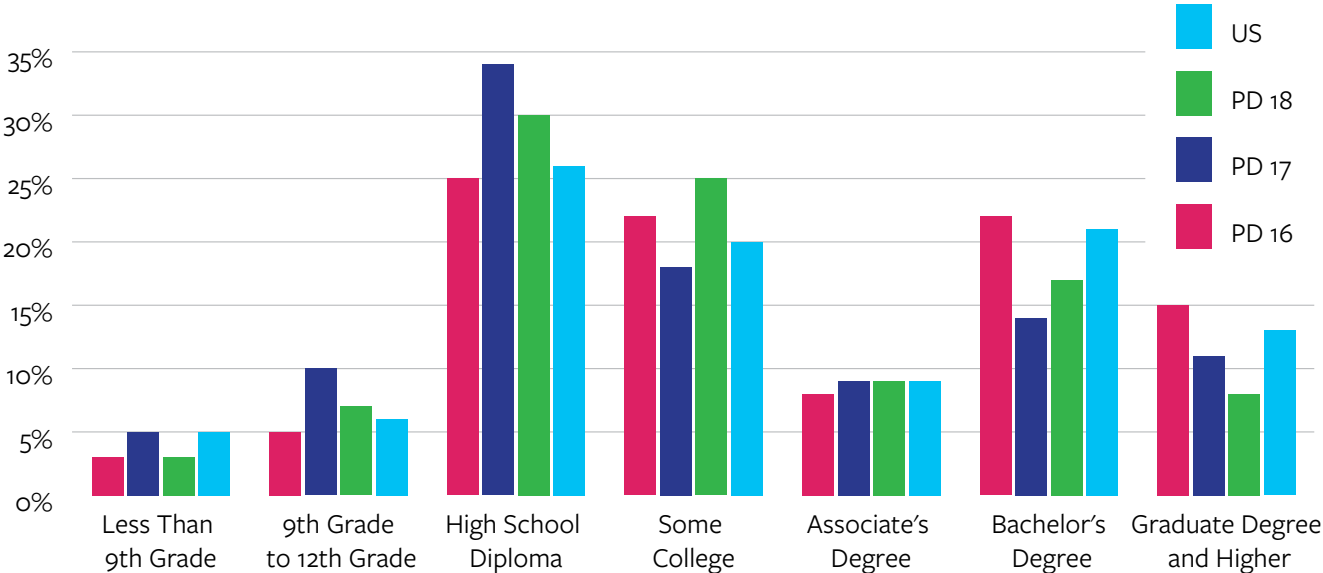
Theme 2: A Small Business Economy

GO Virginia Region 6 is primarily a small and mid-size business economy with firms that need skilled workers but not always at a scale where educational programs at individual institutions can be justified. Additionally, small businesses in Region 6 are struggling with the rapid wage growth experienced since the COVID-19 pandemic and cannot keep up with larger chain operations or franchises that have a larger resource base from which to pay higher wages. The pie charts below demonstrate the strong small business base that makes up the three priority clusters. For purposes of this background, small firms have less than 50 employees and mid-size firms have 50 to 99 employees.

For the aquaculture cluster, all firms measured are small or mid-sized.

Number of Aquaculture Establishments, by Number of Employees

50-99 employees, 4

Less than 50 employees, 15
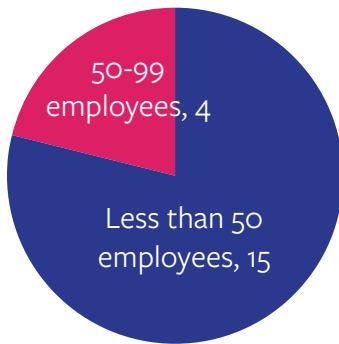
Source: Gazelle

For the information technology cluster, 105 out of 116 firms are small (90%) with only six firms being large with over 100 employees.

Number of IT Establishments, by Number of Employees

100 or more employees, 6
50-99 employees, 5

Less than 50 employees, 105
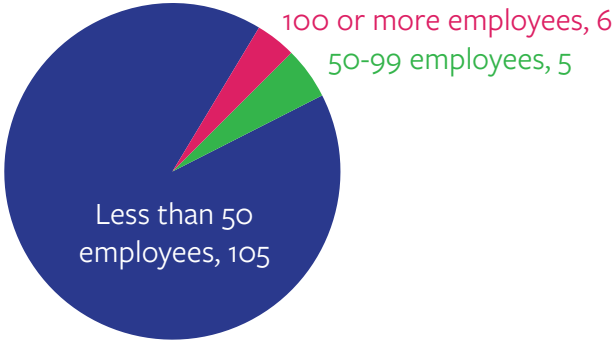
Note: 17 establishments have an unknown number of employees
Source: Gazelle

For the manufacturing cluster, 124 out of 138 firms are small (90%) with only six firms being large with over 100 employees.

Number of Manufacturing Establishments, by Number of Employees

100 or more employees, 6
50-99 employees, 8

Less than 50 employees, 124
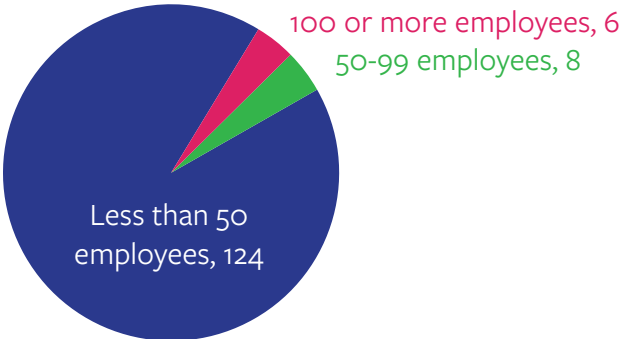
Note: 14 establishments have an unknown number of employees
Source: Gazelle

Theme 3: Residents of Region 6 Work Outside the Area

Employers within Region 6 struggle to find enough workers as a result of different factors. One of the more pronounced factors is the net job flow of workers to places outside the region. For example, Fredericksburg has become a "bedroom community" for workers in Washington, DC and Northern Virginia, with 56% of workers living in Planning District 16 commuting outside of the area for work. This has a significant impact on talent availability for the three priority clusters. The table below shows job flow by planning district. Of the 213,091 workers who live in the region, 58% (123,812) are commuting outside of the region for work. Additionally, over 50,000 workers from outside of the region commute into Region 6. However, when factoring in commuters from outside the region, a net 71,570 jobs are flowing out of the region to work in surrounding areas.

Job Flow by Planning District, 2020

	PD 16	PD 17	PD 18	Region 6 Overall
In-Area Labor Force Efficiency				
Living in Region	147,868	22,931	42,292	213,091
Living and Employed in Region	64,461	7,208	11,023	89,279
Living in Region, Employed outside Region	83,407	15,723	9,958	123,812
In-Area Employment Efficiency				
Employed in Region	108,455	12,085	20,981	141,521
Employed and Living in Region	64,461	7,208	11,023	89,279
Employed in Region, Living outside Region	43,994	4,877	9,958	52,242
Overall Labor Market Size				
Employed in Region	108,455	12,085	20,981	141,521
Living in Region	147,868	22,931	42,292	213,091
Net Job Flow	-39,413	-10,846	-21,311	-71,570

Strategic Recommendations

Commensurate with GO Virginia's overall effort to foster business collaboration to develop, retain, and attract skilled talent, these strategic recommendations utilize the data collected and contained within this report to inform GO Virginia Region 6 partners on specific opportunities to bolster the connection between businesses needing skilled workers and the education and training those workers need for long term labor force attachment. To the extent possible, these Strategic Recommendations are informed by evidence-based practices in workforce development and education.

Strategic Recommendation 1: Implement a Sector Partnership Framework to Support Business-Led Education Initiatives

A proven strategy for aligning the talent development needs of businesses with workforce development services, education providers, and community resources is Sector Partnerships. Throughout the Region 6 Talent Pathways Roundtables and individual interviews, business representatives called for greater collaboration and opportunities to work together as a sector—versus tackling talent deficits and challenges as individual organizations.

To implement an effective Sector Partnership Framework for each of the three priority clusters, a Regional Convener must be established that can develop communications strategies, conduct planning activities, highlight strategic priorities with sector employers, and work with all partners to efficiently align education and training service delivery. In one of the roundtables, employer representatives suggested that they should be talking with one another more to coordinate hiring practices and understand trends, and one interviewee suggested that the Bay Consortium Workforce Development Board might develop and offer a menu of services among public and nonprofit organizations for employers who need skilled workers. The menu would be tailored to include a

WHAT'S A SECTOR PARTNERSHIP?

Sector partnerships convene multiple employers in an industry with education, training, labor, and community-based organizations to close skill gaps. An organization with industry expertise, capacity, and credibility among partners is chosen to play a convener role. While employers do not typically convene partnerships, their leadership and engagement are critical for developing strategies that respond to the industry's workforce needs.

Source: National Skills Coalition

Industry Members
(Representatives from firms in a single industry)

K-12
Adult Basic Education
Community Colleges
Universities
Community-Based Organizations
Human Services Organizations
Organized Labor
Convener
Economic Development Organizations
Workforce Boards, One-Stops

Strategic Partners
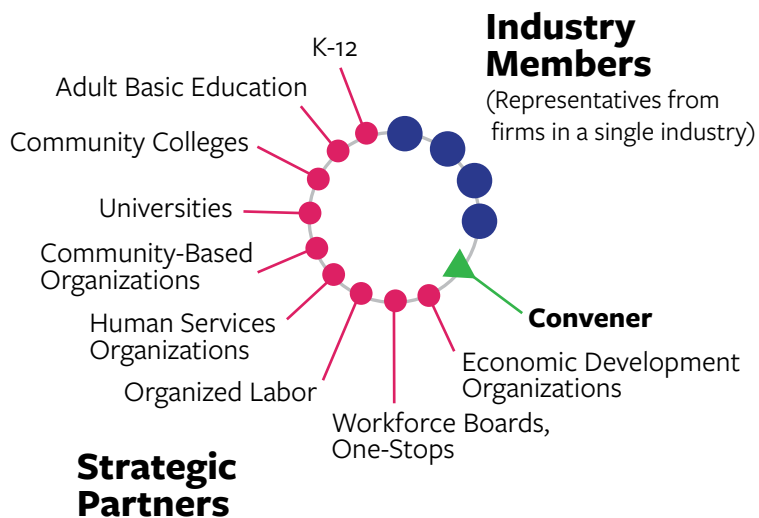
Source: https://www.maine.gov/swb/sector_strategies/sector_partnerships.shtml

'quick response' mechanism to deploy talent strategies and actions when sector employers need specific assistance.

The BCWDB is in a position to partner with GO Virginia Region 6 to serve as the sector convener for the three priority clusters and the businesses looking for skilled workers. For the aquaculture industry, in September 2023, BCWDB was awarded a $500,000 Critical Job Sectors grant from the U.S. Department of Labor to work with employers to enhance job quality, including developing training strategies that promote upward mobility within the industry. This planning grant supplements the work underway in Region 6 and positions BCWDB and partners to support the industry with needed talent development strategies.

Strategic Recommendation 2: Expand Creative Work-Based Learning Alternatives as a Primary Means of Improving Worker Skills and Supporting Small Businesses

The U.S. Department of Education defines work-based learning as "the alignment of classroom and workplace learning; application of academic, technical, and employability skills in a work setting; and support from classroom or workplace mentors."

Alignment of Classroom and Workplace Learning

Application of Academic, Technical, and Employability in a Work Setting

Support from Classroom or Workplace Mentors
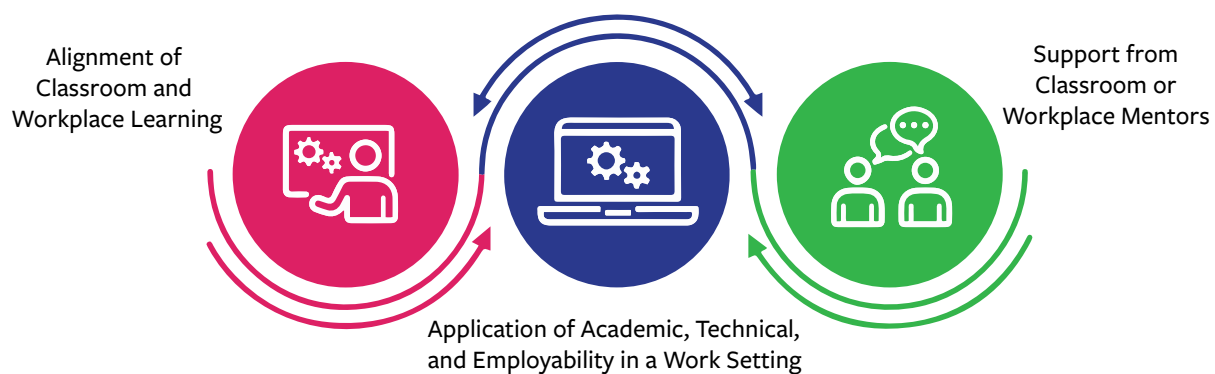
Source: Department of Education. Work-Based Learning Framework. Retrieved December 12, 2023: https://cte.ed.gov/wbltoolkit/.

Work-based learning is a growing training modality that incorporates many different options:

- On-the-Job Training (OJT) provides wage subsidies to employers while they upskill incumbent workers, so those workers are exposed directly to the knowledge and skills needed by that employer.

- Registered Apprenticeship is a long-standing model of work-based learning that incorporates seven elements and standards are approved by the Virginia Department of Labor.

- Unregistered Apprenticeships incorporate the elements of the Registered model but may provide more flexibility for employers to adapt to their particular workplaces.

- Paid Internships provide shorter-term workplace exposure while giving both the employer and worker an opportunity to explore a more permanent employment arrangement.

In addition to providing skills-building solutions to Region 6 employers, work-based learning options, if used creatively, address an additional burgeoning problem for small businesses—wage inflation.

Region 6 is a small business-based economy. Coming out of the COVID-19 pandemic, to attract talent, larger businesses in the U.S. have raised wages and increased benefit packages. In many interviews and roundtables, Region 6 small employers explained that they are struggling to pay entry-level wages to attract the skilled workers they need to fill jobs. In particular, small businesses in manufacturing and information technology explained that job applicants are likely to have a high school diploma or less, yet they expect a starting wage as high as $25.00 per hour. This has been attributed to the fact that fast food and other lower-skill jobs are starting at $16-18 per hour.

Creative work-based learning alternatives can meet two primary goals—(1) provide employer-led training solutions for people needing skills upgrades, and (2) provide starting wage assistance for small employers as they invest in workers. While helping small businesses with straight wage subsidies using public funds is challenging due to rules and regulations, work-based learning programs can be a means to assist small employers who are financially limited in paying certain entry-level wages. In return for work-based learning assistance, employers can develop career pathway maps for workers so they can transparently see how skills development leads to increased wages and progression in companies and sectors.
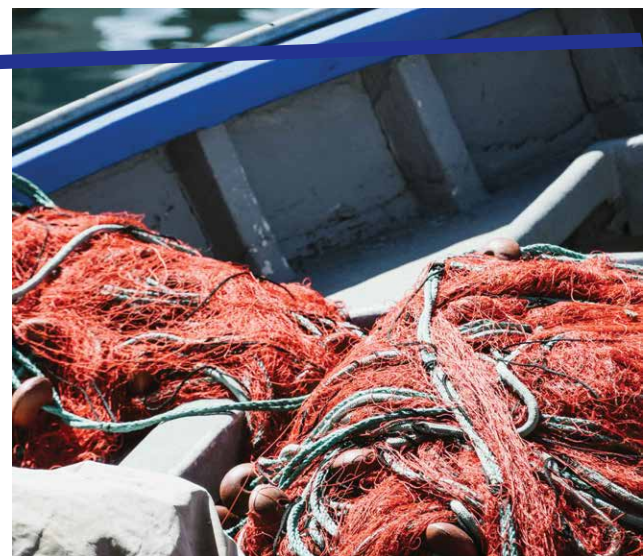
Strategic Recommendation 3: Align and Support Stackable Credentials Tied Directly to High-Demand Employment

Industry-recognized credentials are critical elements to hiring, particularly for information technology jobs. Industry-recognized credentials are portable, recognized credentials developed and offered by industry associations at the national and/or regional/state level. Within industries such as information technology, they are a prerequisite for employment at livable or high wages.

Information technology employers who participated in roundtables and interviews stressed that job applicants cannot be hired if they do not have the industry-recognized credentials required for particular jobs. Further, the alignment of credentials is important—a person cannot just start work in a cybersecurity job without a basic understanding of computer networks, systems, and software applications. Therefore, providing clear access to key information technology credentials is fundamental to talent development strategies for this priority cluster.

Further, in manufacturing, a credential, such as the Manufacturing Skills Standards Council's (MSSC) Certified Production Technician (CPT) certification, indicates to an employer that a job applicant has exhibited competency in foundational manufacturing processes. Customized or individual corporate training can build upon the CPT foundation. For other manufacturing-related occupations such as welding, machining, and mechatronics, industry-recognized credentials are available to demonstrate attainment of skills and knowledge.

While individual credentials can qualify someone for employment, "stacking" multiple credentials aligned to a career pathway can promote upward mobility and higher-skill employment. A recent study published in 2022 conducted a comparative analysis of Virginia community college programs and found positive employment and wage returns with stacking credentials.[6] The researchers observed an approximately four percent increase in employment and a $380 quarterly wage increase for those who stacked credentials. This increase was approximately four percent higher than those students who did not stack credentials. Importantly, students whose first stacked credential was a short- or longer-term certificate had better returns than those whose first credential was an associate degree.

Another factor for developing stackable credential pathways among a host of education providers is the skills-based hiring movement. Skills-based hiring centers on recruiting and hiring workers based on specific technical and employability skills, rather than degrees. This puts less emphasis on the use of a degree as a proxy for job readiness and replaces it with some other type of instrument. The instrument best positioned to support skills-based hiring is industry-recognized credentials that can be stacked.

Because Region 6 is primarily small and mid-size employer-based, education and training providers can more productively serve a sector versus individual employers. As part of the Sector Partnership development, stackable credential pathways can be validated, and community colleges and other training providers can serve the regional sector partnership at a scale that might not be available employer by employer. Additionally, the stackable credential pathways can incorporate digital skills badges and employability skills badges from recognized national providers of such credentials.

Strategic Recommendation 4: Leverage and Braid Resources to Provide Worker Training Accounts for Stackable Credential Training

Low-income families and individuals struggle with the resources needed to upskill and partake in the education and training needed for higher-wage employment. Additionally, federal subsidies for shorter-term training are lacking as Congress has debated alternatives, such as short-term Pell grants. State-based programs like Tennessee Promise and West Virginia Invests have sought to fill the gaps in funding shorter-term credentialed training programs.

In more sparsely populated areas like Region 6, developing creative solutions to resourcing priority cluster manufacturing, information technology, and aquaculture training is needed. Particularly, using the Sector Partnership model as described in Recommendation 1, BCWDB, GO Virginia Region 6, community college partners, and planning district partners, should develop a priority occupation list using the data from this report and leverage public and private sector investments to support worker training accounts for high demand occupations.

The worker training account model can build upon the Individual Training Account framework and incorporate a set of accountability measures for outcomes.[7] To receive an account, the individual student would commit to completing a program, test to receive the appropriate industry-recognized credential, and maintain employment within the sector for which training occurred. Worker training account funds could be used for work-based learning or classroom-based options.

The key component to the Region 6 worker training account model is that as many federal and state funding sources as possible be braided and leveraged on behalf of workers to prioritize strategic talent development outcomes thus reducing the current skills gap for employers in the priority clusters.

Strategic Recommendation 5: Target and Develop All Talent Pools to Address Shortages in Region 6

56,280 Veterans

(nearly two times the amount of veterans than the national average for an area of similar size)[8]

165,932 People 55 or Older[9]

6,418 High School Diploma Graduates and Completers[10]

27,927 People Aged 18 and Over for Whom English is a Second Language[11]

104,161 Millennials Aged 25-39[12]
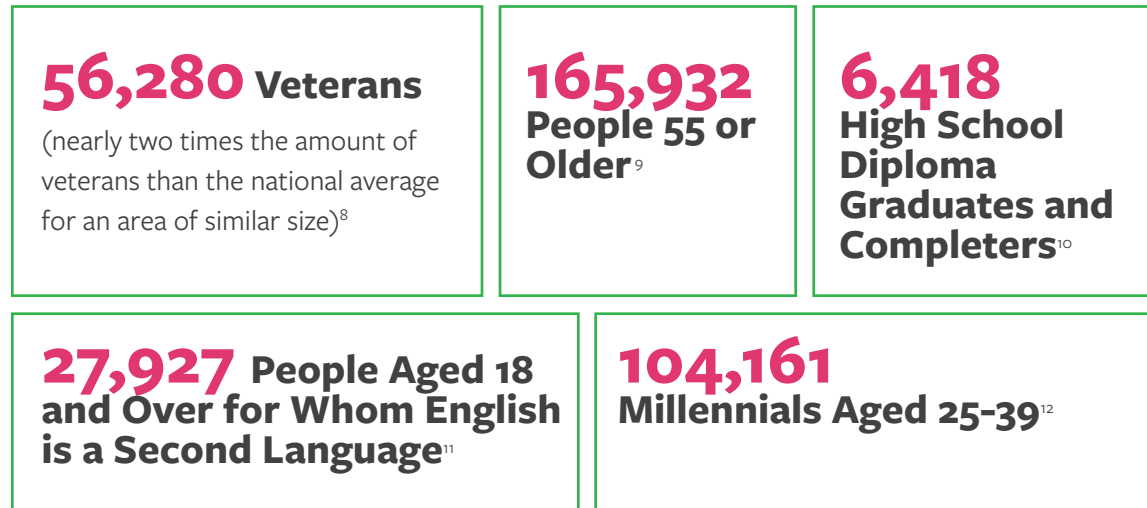
Region 6 has both a shortage of overall workers and skilled workers for specific occupations. As a result, all sources of talent must be explored. Those sources include high school graduates, veterans, older workers, nontraditional workers, and English as a Second Language (ESL) learners.

Region 6 has 6,418 high school graduates each year. Data demonstrate that 1,149 plan to go to work, 4,701 plan to pursue further education (1,587 attending 2-year college; 2,623 attending 4-year college; 491 attending other continuing education), 281 plan to enlist in the military, and 287 have no plans. Particularly for the information technology field, exposure to programming at the middle school level and continued exposure throughout high school is important. With the growing integration of technology into manufacturing, this same level of exposure and application of information technology in manufacturing throughout middle and high school could address perception problems in the manufacturing field.

Virginia has a high number of veterans as a percentage of the population (56,280 veterans). One planning director said that active recruitment of veterans for jobs is a strategy that works. Creating more transparent opportunities for veterans to translate their skills from military service to the civilian workforce creates a talent pool for priority cluster jobs.

Approximately 7% of the region's residents 18 years or older speak a language other than English at home. Notably, 74% of these ESL residents are located in two of the region's 15 counties – Stafford and Spotsylvania. These two counties serve as specific targets for engaging ESL individuals for work in the priority cluster's growth occupations.

With the increasing inflow of older residents into Region 6, the age of the population is growing. As a result, fewer working age adults are available for employment. Older workers, particularly ages 55-70, present a talent pool where supports and other strategies can benefit the region through a combination of work experience and work ethic.

One state that is seeing the effects of an aging workforce is Vermont, where more than 20% of the population is 65 years or older, and where more than 35% of the population is over 54.[13] Companies in Vermont have undertaken innovative approaches to employing older members of the workforce, including:

- Increasing wages
- Upskilling incumbent workers into in-demand roles
- Bringing in temporary workers from other areas
- Investing in automation
- Providing nontraditional incentives, like ski passes or other products

Nontraditional worker populations can provide opportunities for addressing worker shortages. For instance, manufacturing continues to lag with regard to the number of women in those jobs and careers. Manufacturing jobs often pay better than fields where women traditionally work. Finding opportunities to engage different talent pools for occupations is a strategy for developing skilled workers.

Go Virginia Region 6 Background

GO Virginia is a statewide effort to utilize collaborative partnerships between businesses, public sector agencies, and educational institutions to foster private sector job growth and creation. Regionalism is a key feature of the GO Virginia approach, and the state is divided into nine (9) regions, each governed by a regional council.

GO Virginia Region 6 incorporates three sub-regions of Virginia: (1) the greater Fredericksburg area; (2) the Northern Neck; and (3) the Middle Peninsula. Region 6 is comprised of the city of Fredericksburg plus fourteen counties: Caroline, Essex, Gloucester, King and Queen, King George, King William, Lancaster, Mathews, Middlesex, Northumberland, Richmond, Spotsylvania, Stafford, and Westmoreland.[14]

GO Virginia Region 6 Counties

While Fredericksburg is a growing, middle-size city, much of Region 6 is rural and sparsely populated throughout. Both the Northern Neck and Middle Peninsula subregions are large peninsulas surrounded by large rivers and the Chesapeake Bay, which limits transportation options and the movement of exported goods to other places.

According to the Virginia Housing and Community Development website,[15] Virginia has 21 total planning district commissions (Planning District or PD), which are "voluntary associations of local governments intended to foster intergovernmental cooperation by

bringing together local elected and appointed officials and involved citizens to discuss common needs and determine solutions to regional issues. Another purpose of planning district commissions is to encourage and facilitate local government cooperation in addressing, on a regional basis, problems of greater than local significance."

Region 6 is comprised of three **Planning Districts:**

- Planning District 16 (George Washington)
- Planning District 17 (Northern Neck)
- Planning District 18 (Middle Peninsula)

GO Virginia Region 6 Planning Districts
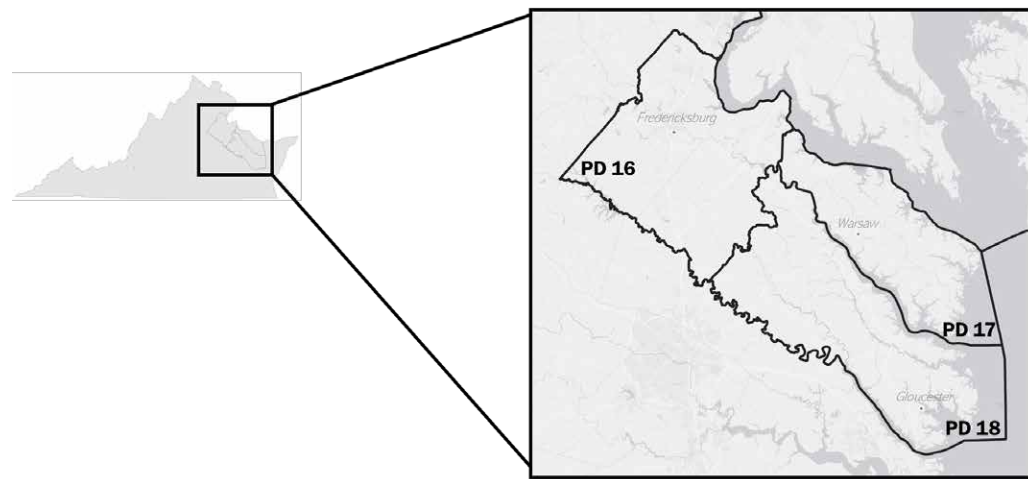
*George Washington (**PD 16**)* is anchored by Fredericksburg and is located in the Washington DC Metropolitan Statistical Area. As one might expect based on its proximity to a metropolitan core, PD 16 is the most populous Planning District in Region 6. Fredericksburg's growth seems also to be emanating to nearby areas. Caroline County (uppermost county in the Middle Peninsula) and King George County (uppermost county in the Northern Neck) are both very proximate to Fredericksburg. And both counties are experiencing growth.

*Northern Neck (**PD 17**)* is a peninsula with numerous creeks, inlets, and bays dotting its coastline. Tourism is a big industry given the area's historical significance (Civil War historical sites and the "birthplace of our nation's first presidents"), scenic beauty and tranquility, opportunities for water-based activities, vineyards & wineries, and renowned oysters and seafood. Agriculture is a traditional way of life, as the fertile land supports various crops, including corn, soybeans, wheat, and peanuts. Additionally, the area is known for its historic and thriving tobacco culture. There are many ongoing conservation efforts underway to protect the region's water quality, wildlife habitats, and scenic landscapes.

The *Middle Peninsula (**PD 18**)* is part of the larger Tidewater region of Virginia, which is known for its low-lying coastal terrain. It is defined by its proximity to various water bodies,

including the Chesapeake Bay, the Rappahannock River, the York River, and numerous smaller creeks and tributaries. This makes it a region of particular importance for boating, fishing, and other water-related activities, including tourism. The region has a strong connection to the culture of watermen, who make their living by harvesting seafood such as crabs, oysters, and fish. This culture has deep historical roots in the region. Agriculture is an important part of the Middle Peninsula's economy and character. Fertile land in the region supports a variety of crops, including soybeans, corn, peanuts, and produce. Farming has been a traditional way of life for many residents. While rural, the Middle Peninsula is accessible by several major highways and bridges, making it relatively easy to reach from other parts of Virginia and nearby states.

Migration into the region is driven mostly by urban sprawl from surrounding metropolitan regions, including Washington D.C. The graphic below depicts where residents moved from, and former residents moved to.
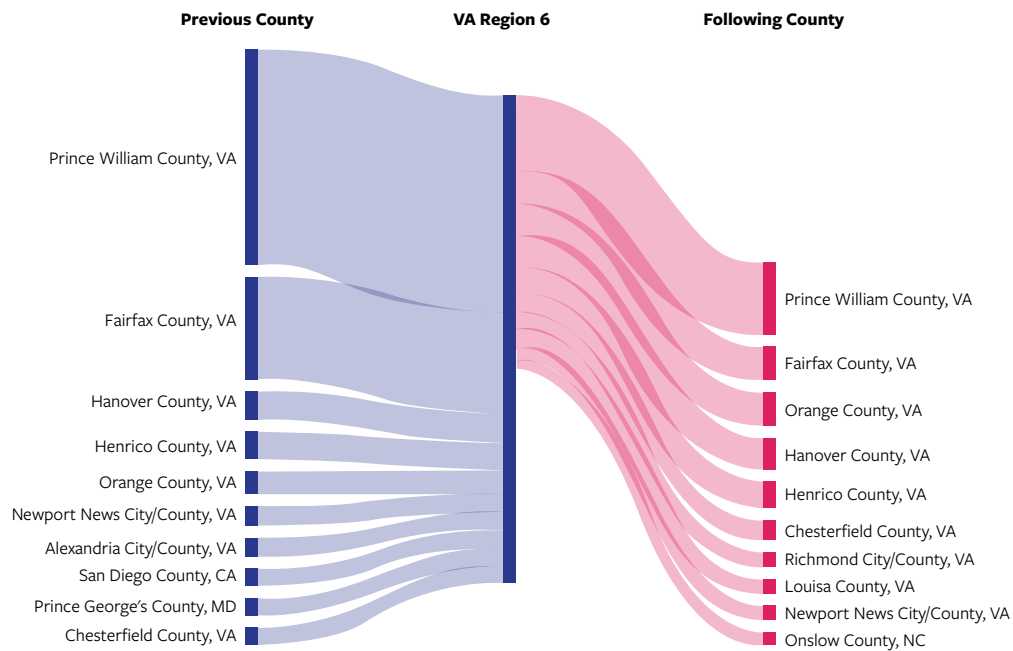
Source: Lightcast, 2020 Migration Data

Regional Demographic Information

The population of Region 6 is 544,248 people, an increase of 6.2% over the last five years. It is projected that this growth will continue over the next three years, adding over 30,000 people across the three PDs. PD 16, which includes Fredericksburg, is the most populous, with just under 425,000 people. Outside of Fredericksburg, the region is quite rural, though realized modest population growth, with 3.2% growth for PD 18, and 2.4% growth for PD 17.

GO Virginia Region 6 Population, 2018 - 2025
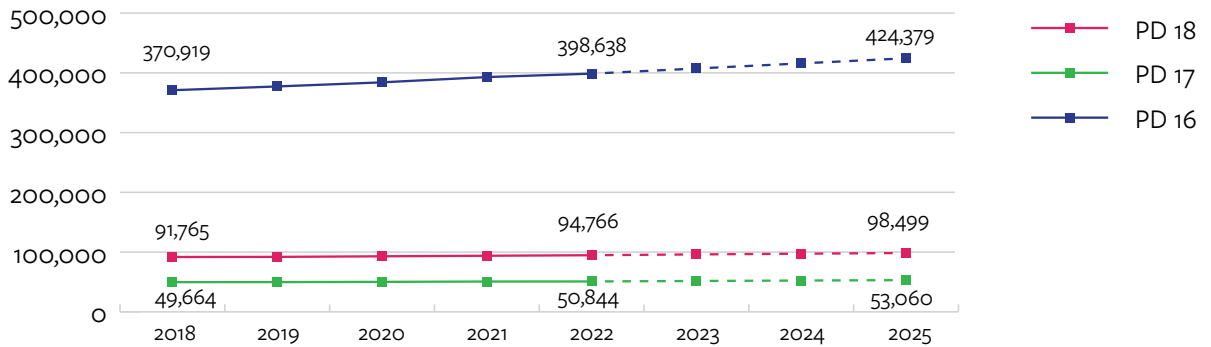
Source: Lightcast

While the Region 6 population has seen steady growth, jobs in the region have fluctuated but remained relatively stable. Any fluctuations can likely be attributed to the COVID-19 pandemic impacts in the region and across the country. Across all Planning Districts, employment levels are back to above pre-pandemic numbers, totaling 184,146 jobs in 2022. In each of the three Planning Districts, employment levels are projected to increase, indicating the ongoing need for workers across multiple sectors.

GO Virginia Region 6 Jobs, 2018 - 2025
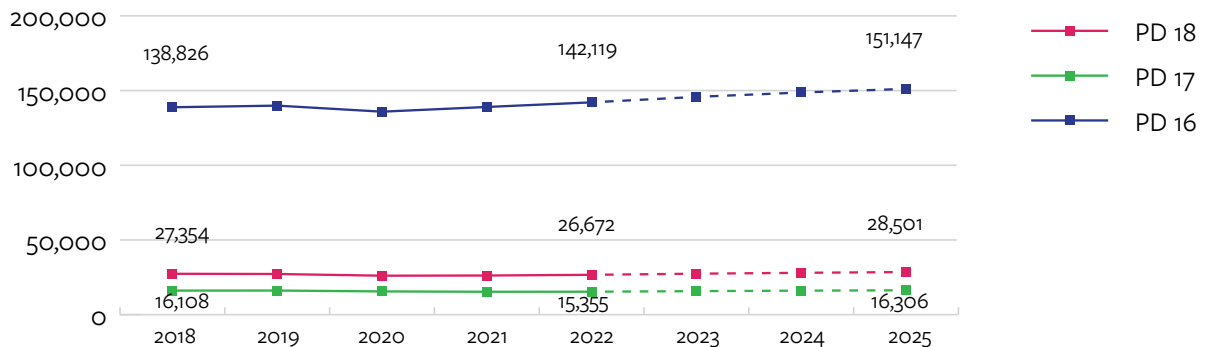
Source: Lightcast

The labor force participation rate in Region 6 is 63.77%, which is 0.73% higher than the national average of 63.04%. The labor force participation rate is 64.27% in PD 16 (1.23% higher than the national average), PD 17 is 60.36% (2.68% lower than the national average), and PD 18 is 63.63% (0.59% higher than the national average). The lower labor force participation rate may indicate opportunities to engage working- age adults in training opportunities for manufacturing as a priority cluster in that region.

GO Virginia Region 6 Labor Force Participation, August 2023
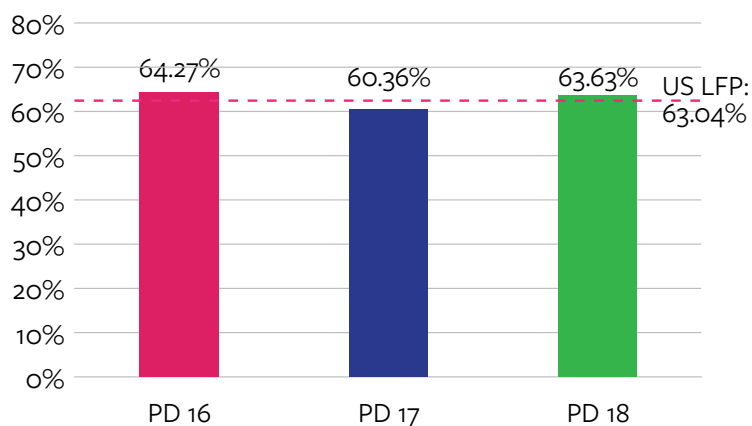
Source: Lightcast

GO Virginia Region 6 has an unemployment rate of 3.14%, lower than the U.S. unemployment rate of 3.94%. When looking at the individual Planning Districts, each is below the national average, with PD 18 having the lowest unemployment rate (2.87%). This level of unemployment indicates that demand for employment exceeds supply in Region 6.

Unemployment Rate by Planning District, August 2023
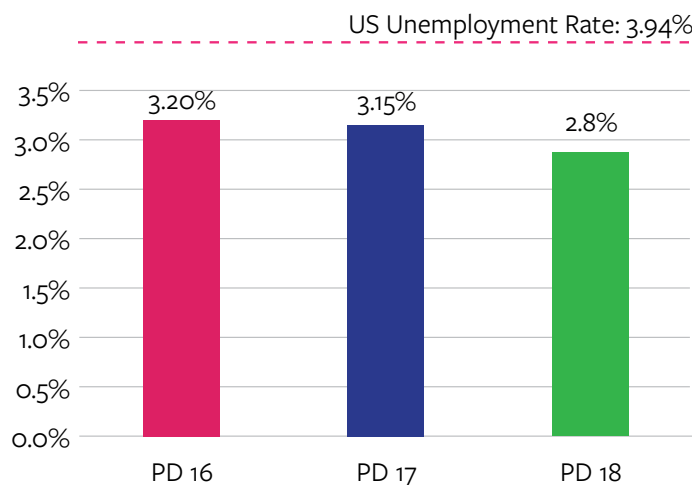
Source: Lightcast

The age distribution is quite different in each region. PD 16 is relatively similar to the U.S. population overall but skews younger. PD 17 is strikingly "old", with far fewer young people and far more older people than the average U.S. population. PD 18 also has an older population, though not as drastic as PD 17.

PD 16 Population, by Age Cohort, 2022-2032
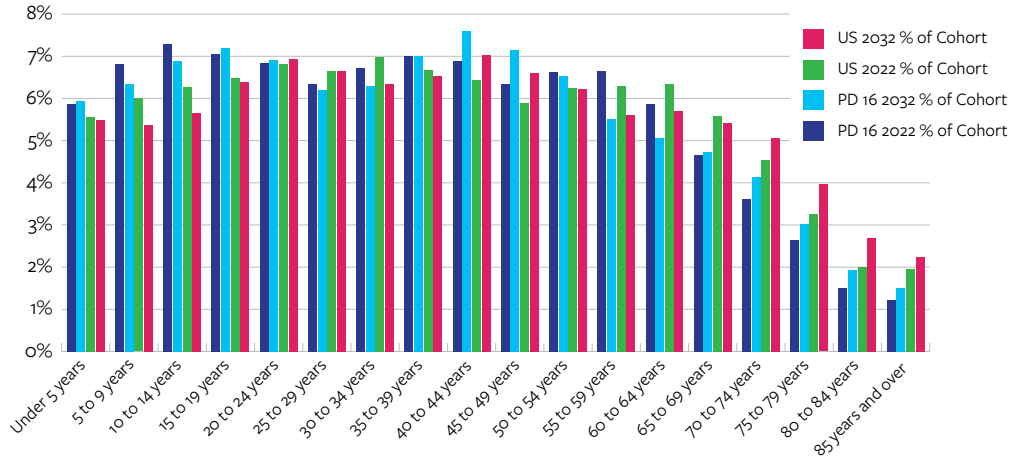
Legend:
- US 2032 % of Cohort
- US 2022 % of Cohort
- PD 16 2032 % of Cohort
- PD 16 2022 % of Cohort

PD 17 Population, by Age Cohort, 2022-2032

Legend:
- US 2032 % of Cohort
- US 2022 % of Cohort
- PD 17 2032 % of Cohort
- PD 17 2022 % of Cohort

PD 18 Population, by Age Cohort, 2022-2032

Legend:
- US 2032 % of Cohort
- US 2022 % of Cohort
- PD 18 2032 % of Cohort
- PD 18 2022 % of Cohort
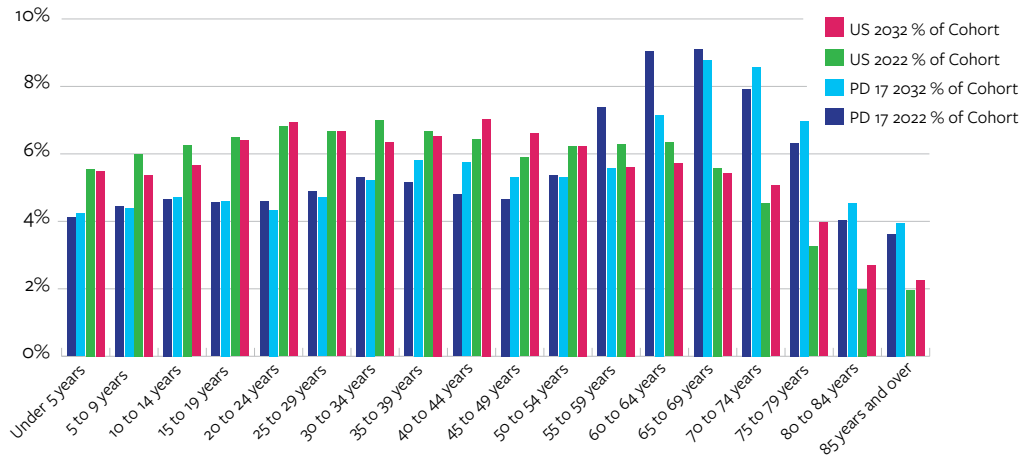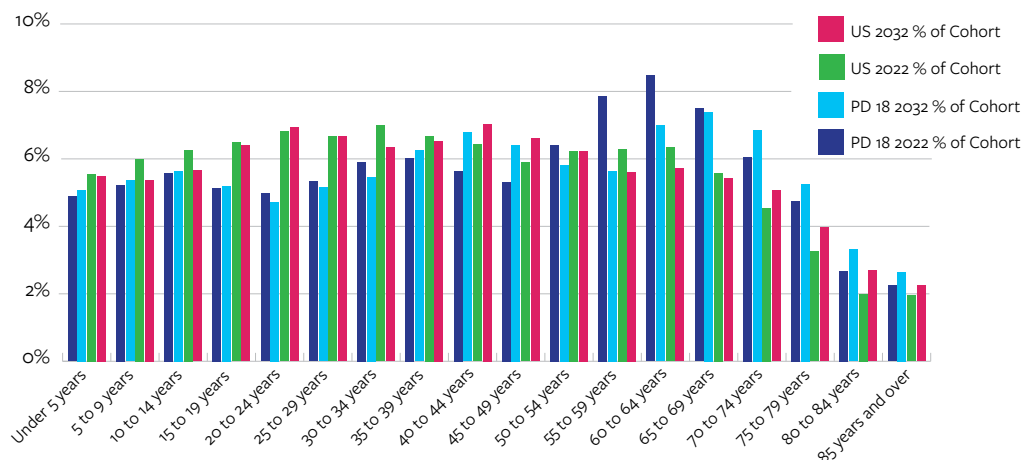
Source: Lightcast

In Region 6, the majority of the population identifies as White (72.1%), followed by Black (20.3%), and Two or More Races (4.1%). The share of Black population is slightly higher in the region than the U.S. overall (17.6%).

Race by Planning District, 2022

Legend:
- PD 16
- PD 17
- PD 18
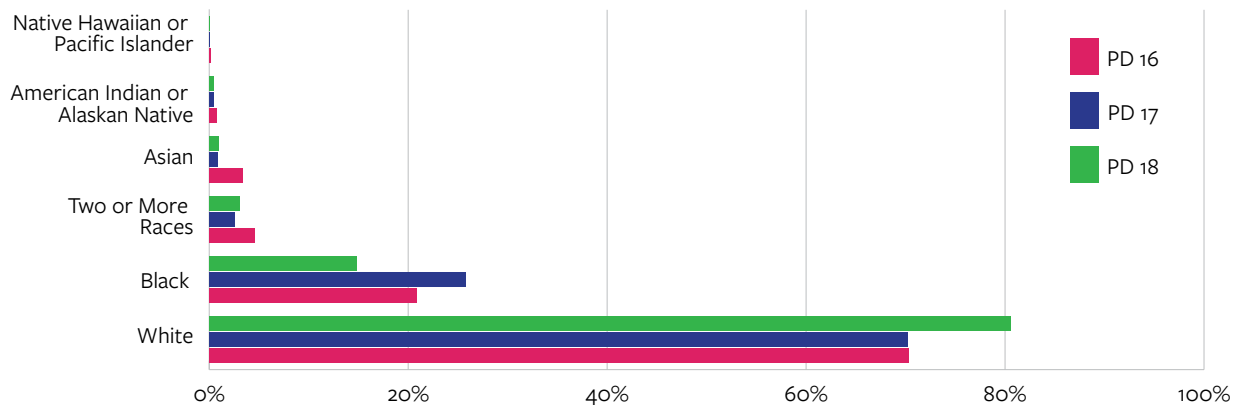
Source: Lightcast

Region 6 has a slightly higher share of the Hispanic population (21.2%) than the national average (19.1%). PD 17 has the largest share of Hispanic persons, at 26.3%. PD 18 has 15.4% of persons identifying as Hispanic.

Ethnicity by Planning District, 2022
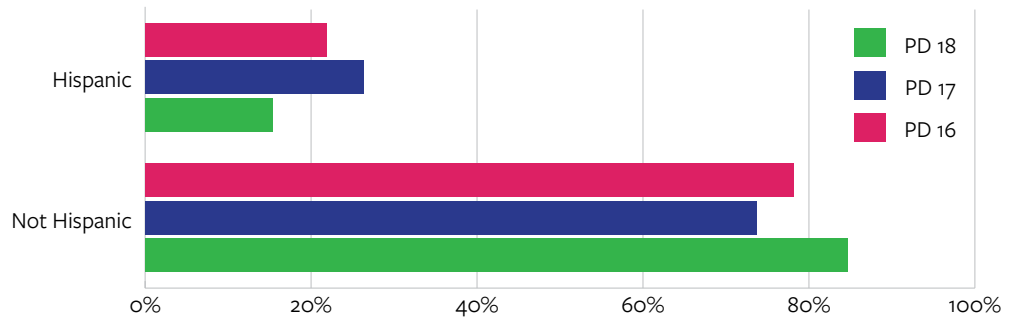
Source: Lightcast

In 2022, the highest educational attainment for over one-quarter of the population (27%) was obtaining a high school diploma. About one-third of the population obtained a bachelor's degree or higher, which is comparable to the national average. PD 16, which includes Fredericksburg, is closest to the educational attainment national averages across categories. PD 17 has the highest share of the population with a high school diploma or less (49%). PD 18 stands out with respect to the number of people with "some college" (but not an associate degree). These figures present strategic opportunities for talent development. The lack of educational attainment in PD17 corresponds with information gleaned from employer interviews where job applicants are overwhelmingly lacking education beyond high school.

Educational Attainment by Planning District, 2022
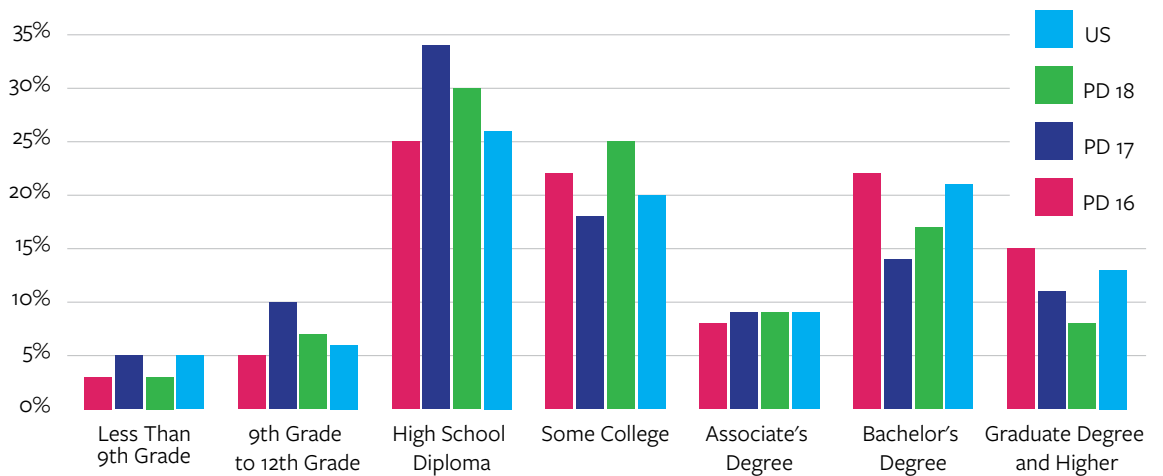
Source: Lightcast

It is common for Region 6 residents to commute outside of the region for work. Of the 213,091 workers living in Region 6, 58.1% are employed outside of the region. With that said, there are over 50,000 workers who live outside of Region 6 commuting into the region. Even considering inflow, the net job flow is a loss of 71,570 workers. The Planning District

with the highest number of workers employed outside the region is PD 18, with 31,269 of their 42,292 workers commuting elsewhere for work (73.9%).

Job Flow by Planning District, 2020

	PD 16	PD 17	PD 18	Region 6 Overall
In-Area Labor Force Efficiency				
Living in Region	147,868	22,931	42,292	213,091
Living and Employed in Region	64,461	7,208	11,023	89,279
Living in Region, Employed outside Region	83,407	15,723	9,958	123,812
In-Area Employment Efficiency				
Employed in Region	108,455	12,085	20,981	141,521
Employed and Living in Region	64,461	7,208	11,023	89,279
Employed in Region, Living outside Region	43,994	4,877	9,958	52,242
Overall Labor Market Size				
Employed in Region	108,455	12,085	20,981	141,521
Living in Region	147,868	22,931	42,292	213,091
Net Job Flow	-39,413	-10,846	-21,311	-71,570

Source: U.S. Census Bureau Longitudinal Employer-Household Dynamics, 2020

Industry Clusters and Employment

As defined by GO Virginia Region 6, the table below provides a summary of growth projections using the NAICS for the priority clusters. The sections below provide additional context for understanding what the talent needs of these industries entail.

Job Projections, by Industry Cluster

GO Virginia Industry Cluster	2022 Jobs	2032 Jobs	2022 – 2032 % Change	Avg. Earnings Per Job	2022 Hires	2022 Separations
Aquaculture	684	655	(4%)	$62,158	523	490
Information Technology	336	383	14%	$92,012	150	133
Manufacturing	1,096	1,120	2%	$95,076	398	487

Sources: Lightcast; U.S. Bureau of Labor Statistics

Go Virginia Region 6 Situational Analysis – Aquaculture

Aquaculture, Seafood, Commercial Fishing, and Marine Industries:

2022 Jobs:	2032 Jobs:	2022 - 2032 % Change:
684	**655**	**-4%**

Avg. Earnings Per Job:	2022 Hires:	2022 Separations:
$62,158	**523**	**490**
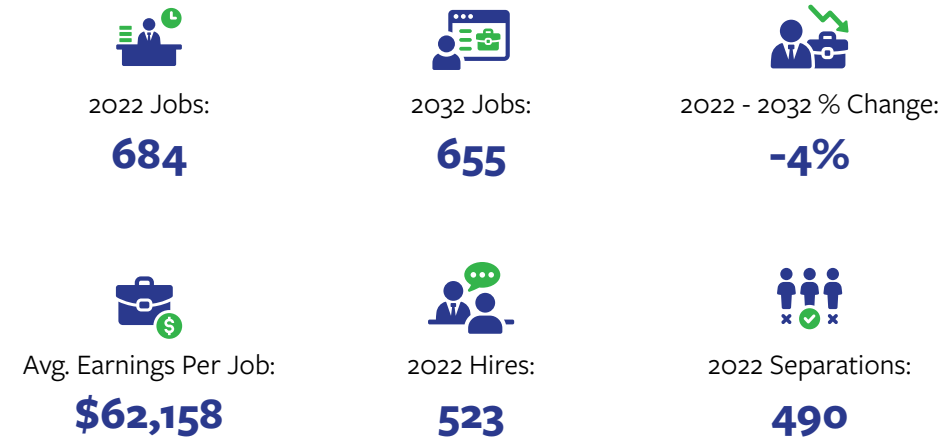
Aquaculture, also known as aquafarming, is the practice of cultivating and farming aquatic organisms in controlled environments such as ponds, tanks, or enclosures in natural water bodies. It is a form of agriculture that involves the breeding, rearing, and harvesting of various aquatic species, including fish, shellfish (such as oysters, mussels, and clams), crustaceans (like shrimp and crayfish), and aquatic plants.

A global population projected to reach over 9 billion in 2025 is exacerbating the demand for seafood products. In response, the U.S. Department of Agriculture is leading efforts to ensure that a healthy, competitive, and sustainable aquaculture sector can produce an abundant, safe, and affordable supply of seafood products. The Food and Agriculture Organization of the United Nations is also committed to supporting the growth of aquaculture. Its 2021 *Declaration for Sustainable Fisheries and Aquaculture* commits to intensifying and expanding aquaculture, improving fisheries management, and innovating fisheries and aquaculture value chains.
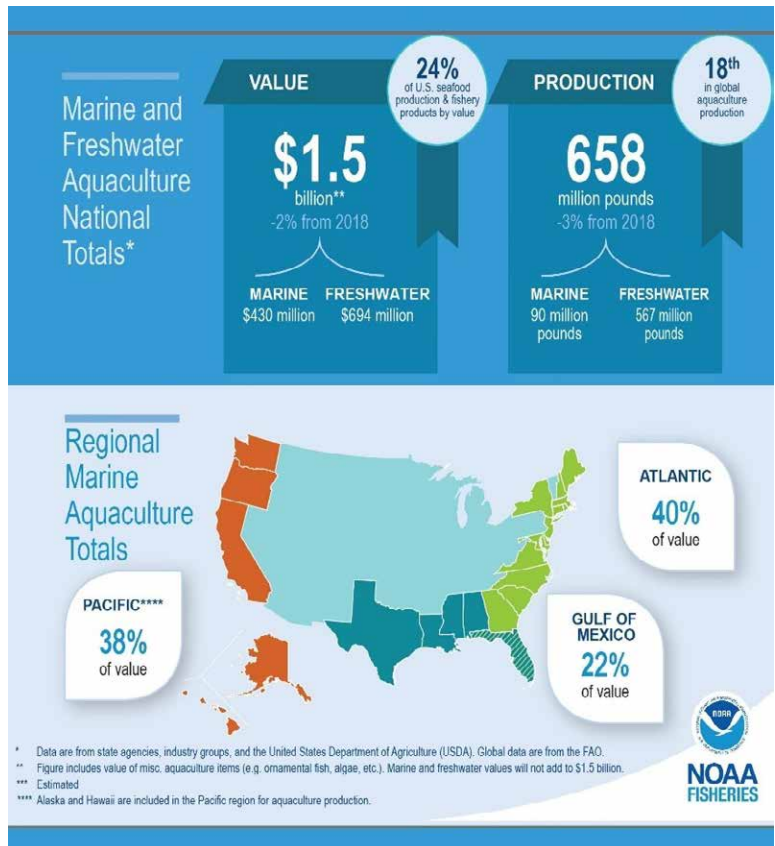
Snapshot of aquaculture data from 'Fisheries of the United States, 2020.

In addition to helping ease global food supply burdens, aquaculture can play a significant role in coastal resiliency efforts by contributing to the protection, restoration, and sustainable management of coastal ecosystems. Oyster reefs can act as natural breakwaters that help reduce the impact of waves and storm surges, which then helps prevent coastal erosion. Seaweed farming can contribute to carbon sequestration and reduce atmospheric carbon dioxide levels. Aquaculture can also be used as a tool for restoring already degraded coastal habitats, as cultivating native species can help rebuild important ecosystems. Additionally, oysters and other filter-feeding shellfish remove nitrogen and phosphorous from the water as they feed, reducing the risk of harmful algal blooms and low-oxygen "dead zones," thus improving water quality and overall ecosystem health. Oyster farming is one of the only forms of farming that leaves the surrounding area cleaner than it would be otherwise.

Aquaculture in Virginia

Aquaculture in Virginia has a longstanding history and tradition. The industry is centered around the Chesapeake Bay, which is the largest estuary in the United States with shorelines including parts of Maryland, Delaware, and Virginia. In the 1960s, Virginia was known as the "Oyster Capital of the World." Currently, oyster populations in the Bay are a small fraction of their historical population. Decades of overharvesting, pollution, and disease have contributed to this decline.

According to a 2019 study by Virginia Tech, Virginia is the third-largest seafood producer in the United States.[16] In 2019, Virginia seafood landings accounted for 393,065,090 pounds, with a dockside value of over $184.2 million. Similarly, the Virginia aquaculture industry has continued to grow, with 191 aquaculture farms responsible for $112.6 million in total sales. In 2019, Virginia was the largest producer of hard clams nationwide and the largest producer of oysters along the U.S. Atlantic coast.

All levels of the seafood supply chain, from producers, processors, wholesalers, distributors, retailers, and consumers, are found in Virginia. Many of these businesses engage in commercial activities with one another and rely on additional goods and services provided by other entities in Virginia for their continued survival and success. It is exactly this interconnected nature of the seafood industry that helps to contribute to the Commonwealth's overall economy.

The Virginia Marine Resources Commission (VMRC) plays a vital role in regulating and managing the aquaculture industry in the state, ensuring sustainable practices and environmental protection. The Virginia Institute of Marine Science (VIMS) is one of the largest marine research and education centers in the United States. VIMS is unique among marine science institutions in its legal mandate to provide research, education, and advisory services to government, citizens, and industry. The Marine Advisory Program (MAP) at VIMS has been a leader in marine aquaculture initiatives across the Commonwealth. Efforts in past years have focused on the production of soft-shell blue crabs and the culture of marine finfish for food, stock enhancement, and live bait. The

current focus of MAP aquaculture is supporting the sustainable growth of molluscan shellfish culture.

Asset Map of Aquaculture Employers and Education Providers
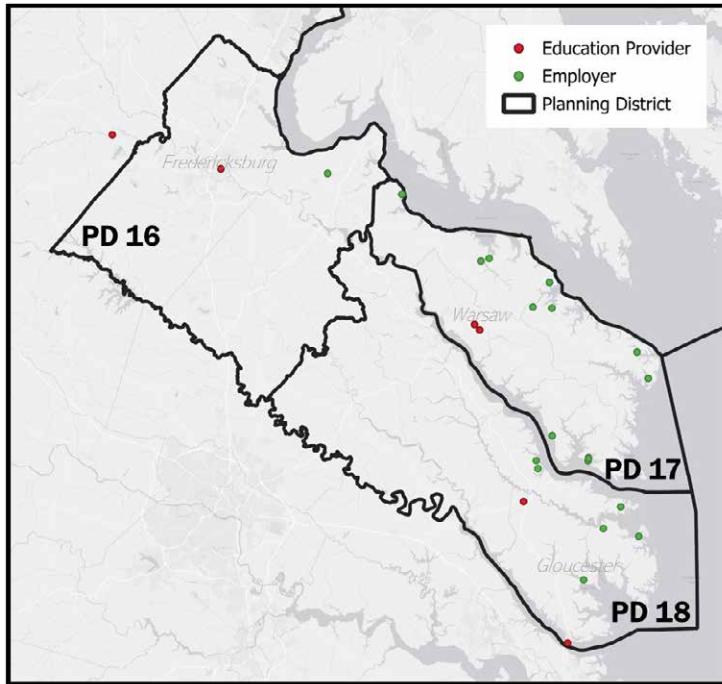
Factors Influencing Employment

Region 6 Aquaculture has a high industry "location quotient" or "LQ", meaning the region's competitive advantage is strong. The location quotient measures a region's specialization in an industry compared to the rest of the nation. (For futher explanation of LQ, see page 41.) In addition to direct economic benefits from the region's production of seafood via aquaculture, there are also some indirect economic benefits such as oyster tourism and seafood restaurants. Finally, there are environmental benefits provided by the aquaculture industry.

This combination of economic and environmental benefits is noteworthy and provides opportunities. Over the years, overharvesting, habitat loss, disease, and pollution led to a decline in oyster populations and the health of the Chesapeake Bay. Rising water temperatures, sea level rise, altered precipitation patterns, and ocean acidification are altering habitats and ecosystems. Expanded aquaculture in the region can help to correct and combat these matters. An adult oyster can purge 50 gallons of water per day[17], helping to clean the water. Additionally, some aquaculture projects incorporate habitat restoration efforts, such as the creation of artificial reefs to revitalize damaged coastal areas.

The Chesapeake Bay Foundation is leading significant efforts to restore the oyster populations and oyster farming in the Chesapeake Bay to levels seen in the past. (In the late

1800s and early 1900s, the Chesapeake Bay region was referred to as the "Oyster Capital of the World.") If significant progress is made, the potential for economic development may increase even more.

The Virginia Marine Resources Commission strongly encourages the gardening and farming of oysters and clams.[14] There is also growing interest in seaweed/kelp farming in Virginia given its potential economic and environmental benefits. Additionally, there is federal support for building out the aquaculture industry. NOAA and USDA support aquaculture expansion for its ability to provide economic development opportunities while at the same time contributing to sustainable seafood production, reduction of reliance on imported seafood, and conservation and environmental responsibility. ***Opportunities for further federal investments in Virginia's aquaculture industry and workers through both an economic and environmental lens provide a competitive advantage and potential employment growth.***

Through roundtables and interviews, several challenges exist for the aquaculture industry in Virginia:

Worker Availability. The existing workforce was cited by many interviewees as one of the most critical issues for the industry. Aquaculture farming is difficult work in a cold, wet environment. Shucking oysters happens in the rain, snow, and sun. Additionally, the work is fairly seasonal, occurring for five to six months of the year. Shifts are often in the middle of the night (1:00 AM shift starts).

Greater access to postsecondary educational attainment or credentials reduces the number of younger workers available and willing to accept lower-wage jobs with high levels of physical exertion. Young workers are pursuing information technology jobs or other fields. Older workers avoid the aquaculture industry due to the physical demands of the labor. Further exacerbating labor shortages in aquaculture is the demand for manual labor is currently high, so workers with a high school diploma or less pursue jobs in landscaping, hospitality, or manufacturing before aquaculture.

Reliance on Temporary Immigrant Labor. Employers have indicated that with the lack of a domestic workforce in the region, the federal H-2B program has been a key alternative that has allowed some employers to maintain a level of production. The H-2B program allows U.S. employers meeting specific requirements to bring nonimmigrant foreign nationals to the U.S. to fill temporary nonagricultural jobs. The employment must be temporary in nature and for a limited period. For some firms, H-2B visa workers have provided labor for over 20 years.

However, employers compete nationally for limited H-2B slots through a lottery process. Additionally, uncertainties in the U.S. visa and immigration system means employers are not sure if they can rely on the level of H-2B workers needed to fill jobs. Finally, when an employer hires a domestic worker, their visa allotment is reduced. If that domestic worker does not stay attached to the employer, not only does the employer not have a worker needed, but their visa allotment is also reduced—a "double jeopardy" situation for recruiting and hiring domestic workers.

Limited Long-Term Employment Growth. As defined by GO Virginia, while support for the regional aquaculture industry is abundant, job growth is projected to be limited. With many of the jobs engaging in manual labor, continued technological adoption may reduce the need for workers. Some small employers indicated that they are strategically utilizing technology. While needing less workers, the workers needed are more highly educated and skilled. A community college educator who was interviewed noted that they had an aquaculture program but ended it because the wages resulting from the training did not justify continuing the program.

Oyster Licensing and Start-up Costs for New Farms. Expansion of employment through business growth in aquaculture may be limited due to barriers to entry for firms. The initial start-up cost is roughly $125,000 and leasing shoreline is a difficult and long process. Leases are limited, and it can take several years to get a new lease approved. Further, due to expanded recreational use and purchase of shorelines by homeowners in Region 6 shoreline areas, oyster harvesting is increasingly challenging to begin.

Opportunities in Water Management. While not part of the defined GO Virginia aquaculture cluster, related to aquaculture is the "Clean Water Economy." According to the Chesapeake Bay Foundation,[18] coastal Virginia has seen the highest rate of relative sea-level rise along the Atlantic coast. The Middle Peninsula Chesapeake Bay Public Access Authority (PAA)[19] is a unique special-purpose political subdivision enabled by the Virginia General Assembly to address public water access issues within the participating jurisdictions in the PD18 Middle Peninsula. To date, just under $4 million in federal, state, and private grants for the authority have been leveraged. The PAA has established itself as a regional, state, and national leader in addressing public access issues.

The PAA is viewing sea-level rise as an ***opportunity*** for Virginia. The PAA is leading the *Fight the Flood* plan, providing flood mitigation solutions, and addressing septic space, among other initiatives. As part of this effort, the PAA is developing a business innovation hub in King & Queen County with over 30 water management and manufacturing companies associated with this work.

As part of a Coastal Resiliency industry effort, in support of aquaculture, developing career pathways and educational programs within water management provides local economic opportunities for residents of Region 6. Career pathways and educational landscape reports such as the Environmental Protection Agency's Decentralized Wastewater Workforce issuances provides a baseline of information for consideration by regional stakeholders: https://www.epa.gov/septic/decentralized-wastewater-treatment-workforce.

Employment Opportunities in Aquaculture

Jobs in the Region 6 aquaculture cluster typically lack the need for formal educational attainment and work experience. That's because many of the jobs—as validated through employer data collection—are manual labor and require a commitment to the job versus higher-level skills. What the data do not include is the unknown impact of technology adoption over the next few years.

The occupation with the highest growth is Fishing and Hunting Workers at 35%. Production-related jobs are projected to decrease in numbers, possibly due to automation.

Production Workers involved in aquaculture are projected to severely decline, most likely as a result of increased industrial automation. Incumbent workers in these positions may have transferable skills that can be utilized for work in manufacturing or other operational jobs.

Employment Data for Aquaculture NAICS Code

Occupation	Employed in Industry Group (2022)	Employed in Industry Group (2032)	% Change (2022 – 2032)	% of Total Jobs in Industry Group (2022)	Median Hourly Earnings	Typical Entry Level Education	Work Experience Required	Typical On-The-Job Training
Fishing and Hunting Workers	210	284	35%	30.7%	$14.96	No formal educational credential	None	Moderate-term OJT
Meat, Poultry, and Fish Cutters and Trimmers	106	83	(22%)	15.6%	$13.67	No formal educational credential	None	Short-term OJT
Packaging and Filling Machine Operators and Tenders	30	23	(24%)	4.4%	$14.73	High school diploma or equivalent	None	Moderate-term OJT
Packers and Packagers, Hand	29	23	(21%)	4.3%	$14.46	No formal educational credential	None	Short-term OJT
Laborers and Freight, Stock, and Material Movers, Hand	27	22	(17%)	3.9%	$16.74	No formal educational credential	None	Short-term OJT
First-Line Supervisors of Production and Operating Workers	20	15	(26%)	2.9%	$28.65	High school diploma or equivalent	Less than 5 years	None
Industrial Machinery Mechanics	14	11	(18%)	2.0%	$27.24	High school diploma or equivalent	None	Long-term OJT
Food Processing Workers, All Other	11	<10	(21%)	1.6%	$13.98	No formal educational credential	None	Moderate-term OJT
Office Clerks, General	11	<10	(37%)	1.6%	$17.52	High school diploma or equivalent	None	Short-term OJT
General and Operations Managers	<10	<10	(18%)	1.3%	$54.24	Bachelor's degree	5 years or more	None

Sources: Lightcast; U.S. Bureau of Labor Statistics

Career Pathways

In 2021, the Maine Aquaculture Association released a set of Occupational Standards for Maine Aquaculture Training Providers.[20] These standards are being lauded by NOAA as examples for other areas/states. These materials provide a foundational understanding of career pathways within Region 6 aquaculture.

Four main job clusters make up the aquaculture industry:

❶ Marine Shellfish & Sea Vegetables (Farming)

❷ Marine Finfish (Farming)

❸ Land-Based Recirculating Aquaculture Systems (RAS)

❹ Land-Based Shellfish Hatcheries

Land-based Recirculating Aquaculture Systems (RAS) and aquaculture hatcheries are related components within the broader aquaculture industry. Hatcheries support the early stages of aquatic life, producing juvenile organisms for various applications. Land-based RAS facilities take over during the grow-out phase, providing a controlled environment for the efficient production of market-sized fish and seafood.

Hatcheries → Land-Based RAS → **Farming**
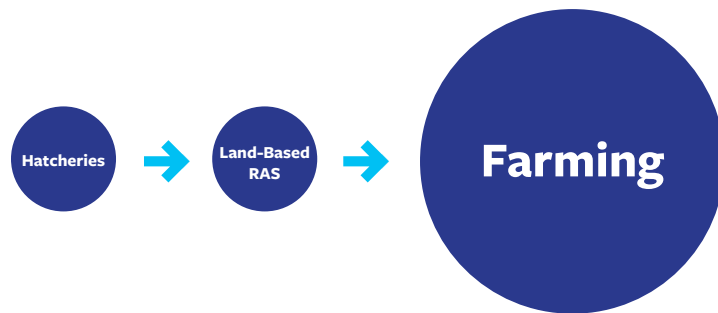
In Virginia, aquaculture jobs are overwhelmingly ***farming*** jobs. Virginia industry experts share that the farm:hatchery ratio is probably around 6:1 (and possibly as high as 10:1). While farm laborers need strength and dexterity, farm managers need to be able to count to 100 and be good with machines, motors, power tools, and other skilled labor. Maine's Hatchery work is higher-skill with workers needing competency in the use of scientific instruments, such as microscopes. Workers in these jobs typically have a bachelor's degree in biochemistry or a related major.

It should be noted that many of the Virginia aquaculture farms are small operations—typically an owner and farmhand while utilizing temporary immigrant labor for harvesting. Additionally, whether "top-culture" or "bottom-culture" farming is used impacts the needed number of workers. Top-culture farming can be less labor-intensive. One farmer noted that top-culture farming that takes five people would need 15-20 in a bottom-culture farming environment.

The figure on the following page shows the typical jobs that exist on an aquaculture **farm**.

Farm Hand (Nontechnical) → Farm Hand (Technical) → Crew Chief → Manager

CTE or 1-Year Certificate
2-Year Associates
4-Year Bachelor's

1-2 yrs. exp   3-5 yrs. exp
1-2 yrs. exp   3-5 yrs. exp
1-2 yrs. exp   3-5 yrs. exp
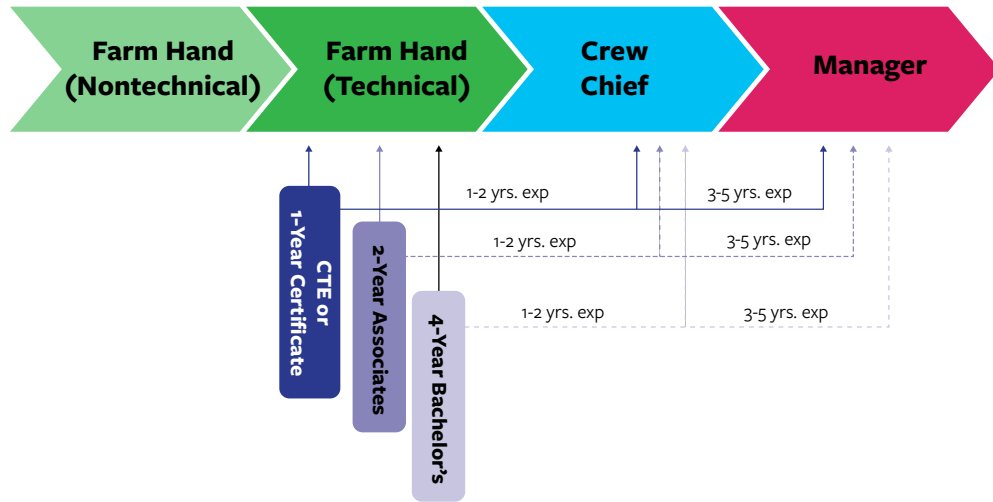
Shellfish Career Pathways[21]

Education and Training Landscape

The Virginia Institute of Marine Sciences (VIMS), a part of the College of William and Mary and located in Gloucester Point, is one of the largest marine research and education centers in the United States. The VIMS Shellfish Aquaculture Program conducts state-of-the-art research, engages in workforce training, and encourages active collaboration among the many VIMS research programs and partnering organizations that are engaged in the multi-disciplinary science of shellfish aquaculture, regionally, nationally, and internationally.

VIMS' Oyster Aquaculture Training (OAT) offers prospective shellfish aquaculturists an opportunity to learn about all aspects of oyster culture, from hatchery to field operations. This two-year certificate program is an oyster culture "boot camp." While the program draws from a national pool, the intention is to provide skilled people to the industry with a priority to Virginia businesses. Companies may contact the program if they anticipate a need for new employees and could benefit from obtaining a trained individual.

Virginia Tech's Seafood Agricultural Research and Education Center is headquartered in Hampton, VA (on the Virginia Peninsula). The Center leads outreach initiatives that aim to disseminate scientific knowledge and agricultural practices to farmers, rural communities, and other stakeholders in the aquaculture industry. Extension specialists work with industry and research partners to identify and respond to emerging needs and provide technical guidance to stakeholders at every level of the seafood supply chain. It is a recognized center of excellence for live feeds and hatchery production technologies and offers various training and workshops.

At the undergraduate level, the University of Mary Washington (in Fredericksburg) offers several bachelor's degree programs that provide students with a strong foundation for a career in aquaculture. These programs include biochemistry, biology, chemistry, and conservation biology.

In 2023, Rappahannock Community College (RCC) joined with Virginia Tech to offer a new career and technical education training program, Promoting Careers in Aquaculture,[22] for local high school juniors and seniors in Essex, Gloucester, Lancaster, Mathews, Middlesex, Northumberland, Richmond, and Westmoreland counties.

Jason Learning (Jason.org), in partnership with VIMS, has developed an online Aquaculture Career Introduction that is being implemented in all Region 6 middle schools.

A full list of educational programs in aquaculture is listed below.

Aquaculture Programming

Education Provider	Institution Type	Programming	Degree/Credentials
Career and Technical Academy in Arlington	Governor's STEM Academies	Animal Science; Biotechnology	HS diploma + IRC
College of William & Mary, Virginia Institute of Marine Science	College/University	Oyster Aquaculture Training Program	Certificate
Fostering Innovations & Relevance through STEM and Trades	Governor's STEM Academies	Aquaculture Infusion Units; Fisheries/Wildlife Management	HS diploma + IRC
Germanna Community College	College/University	Biology; Chemistry; Environmental Science; Geology	AAS
Governor's STEM Academy at Harrisonburg High School	Governor's STEM Academies	Biotechnology; Biology/STEM	HS diploma + IRC
Governor's STEM Academy of Architecture, Environment, and Engineering at Kecoughtan High School	Governor's STEM Academies	Environmental Studies	HS diploma + IRC
Jason Learning (Jason.org)	Training Providers	Aquaculture	K-12 Curriculum
Lynchburg Regional Governor's STEM Academy	Governor's STEM Academies	Biotechnology	HS diploma + IRC
Massanutten Technical Center	CTE Programs	Agriculture Production Technician	HS diploma + IRC
Northern Neck Technical Center Governor's STEM Academy for Agriculture & Maritime Studies	Governor's STEM Academies	Horticulture/STEM	HS diploma + IRC
Pulaski County Public Schools Governor's STEM Academy	Governor's STEM Academies	Agriculture	HS diploma + IRC
Rappahannock Community College & Virginia Tech	Training Providers	Seafood and Shellfish	Specialized course and internship
Rappahannock Community College & Virginia Tech	Training Providers	Seafood and Shellfish	Specialized course and internship
The Blue Ridge Crossroads Governor's Academy for Technical Education	Governor's STEM Academies	Food production and processing systems	HS diploma + IRC
University of Mary Washington	College/University	Biochemistry; Biology; Chemistry; Conservation Biology; Geography/ Geospatial Analysis; Geology; Environmental Geology; GIS	BS; Certificate
Valley Career and Technical Center	CTE Programs	Agriculture	HS diploma + IRC
Virginia Cooperative Extension (Partnership of Virginia Tech, VSU, USDA, and local government)	Training Providers	Aquaculture Development; Fish Health; Youth Aquaculture; Aquaculture Technician	Various Programs and Services

Sources: Lightcast; U.S. Bureau of Labor Statistics

Talent Pathway Summary

Most Region 6 Aquaculture employers are small firms.

Jobs range from manual farmhands requiring a high school diploma to managers and operators who have science-related bachelor's degrees.

Demand for Fishing and Hunting Workers is expected to grow by 35% in Region 6 by 2032.

Aquaculture is part of a larger Coastal Resiliency industry where job opportunities in clean water and environmental mitigation may bolster aquaculture employment.

Employers value industry experience so work-based learning is a viable training modality.

Go Virginia Region 6 Situational Analysis – Information Technology

2022 Jobs:

336

2032 Jobs:

383

2022 - 2032 % Change:

14%

Avg. Earnings Per Job:

$92,012

2022 Hires:

150

2022 Separations:

133

The information technology (IT) industry is a broad and dynamic sector that encompasses various aspects of technology. It includes the creation, management, and application of computer systems, software, hardware, networks, and data. In modern society, the IT sector serves to improve efficiency, productivity, communication, and decision-making across various domains, including business, healthcare, education, entertainment, government, and research.

It is important to note that IT jobs do not exist only in the IT industry. Technology professionals and skills are essential in virtually every industry and sector of the economy. This will only become more pronounced as the impacts of artificial intelligence and automation are realized. The IT field is characterized by constant change, activity, and progress.

Information Technology in Virginia

Virginia has a strong and enterprising IT labor market. Northern Virginia has long been a major tech hub, and the IT footprint has expanded outward to the Fredericksburg area and beyond. Virginia hosts a significant number of federal government agencies and defense contractors, leading to a strong demand for IT professionals who specialize in cybersecurity, IT infrastructure, and software development.

Data centers, long situated in Northern Virginia, are also beginning to emerge in Region 6. This is due to the high demand for data processing and storage by government agencies and defense contractors, its robust fiber infrastructure, its mild climate, and its relatively low risk of natural disasters.

Fredericksburg serves as a tech hub for Region 6. The Fredericksburg Regional Alliance[23] documents 301 technology companies, 3,120 workers, and an average salary of $91,142.[24] Data from Gazelle show 133 IT employers within Region 6, and is the source used for the Asset Map below. Many of these IT companies have contracts with federal agencies and defense organizations, which have created job opportunities in fields like cybersecurity, software development, and IT services.
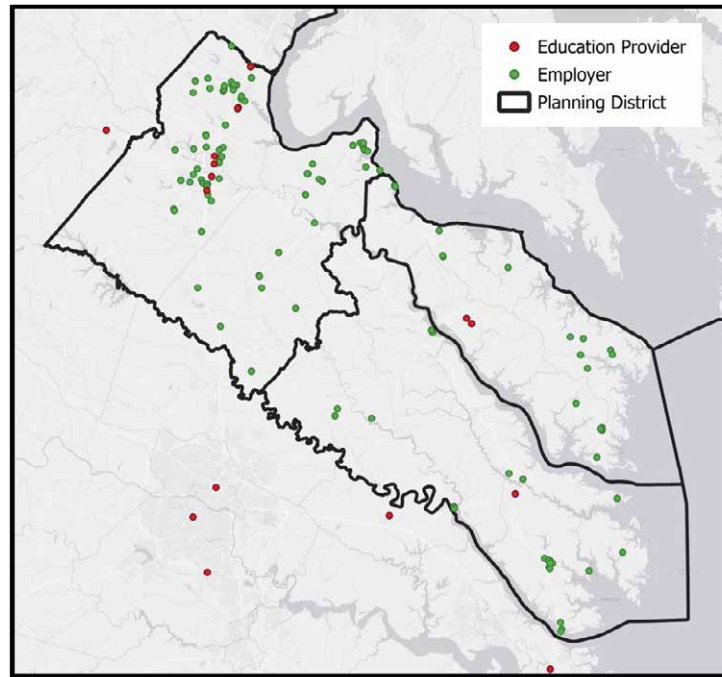
Factors Influencing Employment

A 2021 Fredericksburg Industry Cluster Analysis by Chmura[25] found that wages in the "Information and Communications" cluster were 43.2% higher than the regional average. Additionally, the projected growth rate (2021-2023) was the highest of all clusters at 1.9%.

Data for the Region 6 Information & Communication Cluster:

- The location quotient is 1.07, which is *below* the 1.25 threshold for competitive advantage.

- The average annual wage ($71,404) is above average for all industries ($49,703).

- The Growth forecast for the IT priority cluster is the highest of all clusters at 1.9%.

Location quotient (LQ) is a metric that judges how concentrated a characteristic (in this case, the industries in the Information & Data Centers Industry Cluster) is in a region compared to the nation. A baseline LQ is 1, meaning that a region would have the same specialization in a particular area (in this case, IT industries) as the nation. An LQ of 1.25 means that an area has a 25% higher concentration of the metric being used and is considered the baseline for an industry to have export activity (meaning that services or

products from this industry are exported out of the region, therefore bringing outside dollars into the region and growing the regional economy). Region 6's 1.07 LQ for IT, while being higher than the national average, is still below that threshold for being considered a competitive advantage.

Notably, many of the companies showing up in the Lightcast data are not headquartered in the region. The largest IT employer in Region 6 is likely The Naval Surface Warfare Center Dahlgren Division (Dahlgren) in King George County. There are approximately 4,950 IT employers within King George and Virginia Beach. About 75% of Dahlgren's workforce is classified as "S&E" (Scientists and Engineers), while 25% are non-technical.

Job opportunities in the IT sector are strong, and turnover is high. This is a significant issue for human resources and recruiting professionals but also provides opportunities for job seekers. One challenge in the region is that experienced IT hires are difficult to find. Therefore, employers report that they are offering higher salaries and work-from-home opportunities as key recruiting strategies. While increased wages present opportunities for workers, small IT businesses struggle with competing in the market for experienced labor.

Exacerbating IT employers' hiring pressure within the identified GO Virginia Region 6 priority cluster is that they are competing for talent among many firms in other industries for IT workers. A characteristic of the IT workforce is that analysis based upon using IT-based NAICS codes does not capture firms in other industries that recruit and hire IT workers. IT workers staff retail, healthcare, and manufacturing firms, for example.

According to many IT employers and educators interviewed, the age at which people are exposed to IT as a career is important. Several interviewees suggested that exposure to IT career fields and related curriculum should begin in middle school. At the middle school age level, students are "curious and creative," which can be harnessed to explore various technology-related fields like coding, video production, and graphic design. Additionally, middle school-aged children can grasp complex concepts and problem-solving skills and are exposed to technology which can be translated to the principles and applications of that technology.

Initial middle school exposure then can continue throughout the high school years to that at the postsecondary level, students are not at the beginning of their IT education, but, instead, can obtain credentials needed for employment and begin the stacking of credentials for a variety of translatable skills across related IT fields.

A factor that creates challenges to IT skills development is that the technology itself is changing rapidly, thus the skills and competencies needed are not always known. The top skills change from year to year.[26] Therefore, it is incumbent that talent development strategies for the IT priority cluster focus on skills and shorter-term, stackable credentials attainment to rapidly develop and deploy talent for employers.

The Greater Fredericksburg Region is home to a robust information technology sector, with many companies in the region specializing in cybersecurity, telecommunications, and software development. These sectors are supported by numerous federal and state

government agencies that are within an hour's drive. IT companies are positioned to serve companies with customers in the Washington, DC and Richmond metropolitan areas.

Through roundtables and interviews, several challenges exist for the information technology industry in Virginia's Region 6:

Talent Shortage Due to Evolving Skill Requirements: The IT landscape is dynamic, and the skills in demand are changing rapidly. These changes are outpacing the development of necessary knowledge and skills, leading to a gap between the skills employers seek and those possessed by job seekers. Employers can find it challenging to identify candidates with the specific and up-to-date skills required for their projects and initiatives.

Elaborate Set of Training Offerings: There are a tremendous number of IT degree and certificate offerings from a wide variety of providers (colleges, universities, for-profit companies, non-profit organizations, and community service providers). While there are positive aspects to this, it can result in choice overload and decision paralysis, in which people are overwhelmed by the complexity of the decision-making process and struggle with the decision to enroll in an education program.

Competition for Skilled Candidates: With a high concentration of technology companies and government agencies (with significant IT needs) in the area, there is intense competition for top IT talent. This competition tends to drive up salaries and make it challenging for some organizations to attract and retain skilled individuals. Interviews with large government IT employers revealed that they successfully recruit and hire entry-level IT employees but struggle to hire and retain experienced workers. In part, this is due to private sector employers paying higher salaries and offering job flexibility.

Security Clearance Requirements: IT positions often require security clearances in areas with a strong government presence, such as Virginia. Obtaining and maintaining these clearances can be time-consuming and complex, limiting the pool of eligible candidates.

Discrepancies in Target Age for Training and Hiring: Many IT training programs are targeted at middle school students, who are at a ripe age for acquiring IT skills. Additionally, entry-level technology positions are often considered well-suited for young adults who are technologically fluent. This can leave older adults out of the talent pool. Older workers can successfully transition to IT careers and contribute valuable skills and experience to the field. They may need encouragement to engage in technical skills training. Training programs specifically designed for older adults may also be beneficial. Finally, an inclusive workplace culture incorporating lifelong learning initiatives, mentorship programs, and flexible training options can be beneficial in supporting workers of all ages to acquire new IT skills.

Opportunities in Rural Areas: Information technology jobs that can be done remotely may provide opportunities for those in rural areas to access higher-paying jobs. The paradox is that rural workers are often unable to take advantage of these opportunities due to issues such as a lack of digital literacy and limited or unreliable internet connectivity. Broadband projects to improve digital infrastructure in the region are underway. While the

Virginia Community College System offers many online courses for students to gain new skills, they may need additional training in understanding virtual workplace culture and practices.

Employment Opportunities in Information Technology

Within the Information and Data Centers NAICS code, IT employment in Region 6 captures several job titles and is led by Software Developers. One important caveat: software developers and other IT occupations are characterized by federal labor market data as requiring a bachelor's degree when data and employer input demonstrate that shorter-term stackable credentials are often the prerequisite needed to enter IT career pathways.

Employment Data for Information and Data Centers NAICS Code

Occupation	Employed in Industry Group (2022)	Employed in Industry Group (2032)	% Change (2022 – 2032)	% of Total Jobs in Industry Group (2022)	Median Hourly Earnings	Typical Entry Level Education	Work Experience Required	Typical On-The-Job Training (OJT)
Software Developers	46	59	29%	13.6%	$55.17	Bachelor's degree	None	None
Editors	20	18	(11%)	6.1%	$31.18	Bachelor's degree	Less than 5 years	None
Customer Service Representatives	15	15	3%	4.4%	$16.19	High school diploma or equivalent	None	Short-term OJT
Sales Representatives of Services, Except Advertising, Insurance, Financial Services, and Travel	14	17	24%	4.2%	$29.98	High school diploma or equivalent	None	Moderate-term OJT
General and Operations Managers	13	13	4%	3.8%	$54.24	Bachelor's degree	5 years or more	None
Information Security Analysts	12	17	37%	3.7%	$55.08	Bachelor's degree	Less than 5 years	None
Market Research Analysts and Marketing Specialists	10	13	29%	3.1%	$31.81	Bachelor's degree	None	None
Advertising Sales Agents	10	<10	(8%)	3.0%	$23.41	High school diploma or equivalent	None	Moderate-term OJT
News Analysts, Reporters, and Journalists	10	<10	(26%)	3.0%	$29.19	Bachelor's degree	None	None
Chief Executives	<10	<10	9%	0.4%	$101.59	Bachelor's degree	5 years or more	None

Sources: Lightcast; U.S. Bureau of Labor Statistics

Because the data for Information and Data Centers are limited, the table below offers supplemental information and projections regarding IT jobs in Region 6. This data utilizes expanded NAICS codes related to information technology, as well as staffing patterns for IT jobs.

IT Occupations Using Expanded NAICS Codes

Occupation	2022 Jobs	2032 Jobs	2022 - 2032 % Change	Median Hourly Earnings
Software Developers	1,976	2,541	28.6%	$46.94
Computer and Information Research Scientists	710	883	24.4%	$55.23
Computer Systems Analysts	751	868	15.6%	$44.21
Computer User Support Specialists	614	718	16.9%	$22.22
Information Security Analysts	500	633	26.6%	$46.27

Career Pathways

Coursera's Jobs Sills of 2023 Report, which draws on data from the company's four million enterprise learners across 3,000 businesses, 3,600 higher education institutions, and governments in 100 counties, states:

"The top ten overall fastest-growing skills are digital skills."

"The ongoing evolution of technology means employers are regularly seeking new digital competencies from potential hires while also reskilling existing workers."

Technology skills needed in the workplace are dynamic - characterized by constant change and progress. That means career pathways are changing from year to year. The dynamic nature of skills in information technology means that **certifications** are key built on a set of **Foundational Skills.** The figure below highlights the skills progression needed by workers.

Skills Progression for Advancing in Information Technology Jobs

Advanced

Mastery of a specific area within a field

Professional

For those with experience who are looking to move to the next level of their career

Foundational

Required for entry-level jobs or for early-career professionals

Coursera's IT Certification Roadmap: A Guide[27] gives detailed information on foundational, professional, and advanced certifications for Help Desk, Server & Network, Cloud, Security, and Database career pathways. Coursera also provides a list of 10 Essential IT Certifications for 2023.[28] These certifications are:

❶ **CompTIA A+:** Widely considered one of the go-to certificates for a well-rounded entry-level introduction to IT. After the CompTIA A+, candidates can go on to take other CompTIA certifications like Security+ or Network+, or certifications from other providers like the CCNA.

❷ **Cisco Certified Network Associate (CCNA):** An associate-level certification that covers the fundamentals of IT networking issues.

❸ **CompTIA Security+:** Skills to perform basic security functions. The certification covers subjects like encryption, physical security, and wireless security.

❹ **Microsoft Fundamentals:** Core technology skills.

❺ **Amazon Web Services (AWS) Cloud Practitioner:** The most entry-level of the AWS certifications. AWS is the most-used cloud platform in the world. (And cloud computing, along with security, is one of the most in-demand fields in IT.

❻ **CompTIA IT Fundamentals (ITF+):** A beginning-level certification designed for students and career switchers who want to see whether IT is the right career path for them. (Note: This is an exploratory certificate and often needs to be paired with another certificate.)

7. **CompTIA Network+:** A foundational, vendor-neutral certification in networking principles. (More basic than the CCNA.)

8. **GIAC Information Security Fundamentals (GISF):** A foundational certification for security and related concepts like networking, cryptography, and cybersecurity technologies. Often recommended for those new to cybersecurity who want a fundamental introduction to the field, as well as those who can benefit from cybersecurity knowledge such as system administrators and non-IT security managers.

9. **Google Cloud Digital Leader:** Google's foundational cloud certification.

10. **Certified Associate in Project Management (CAPM):** A certification designed to prepare learners for entry-level project management positions. Not an IT certification; good for those with a technical background and hoping to move into a project management-oriented role.

While the Bureau of Labor Statistics' IT Occupational Outlook shows nine of ten occupational groups requiring a bachelor's degree for entry-level roles,[29] this is not supported by national reports and regional interviews.

While a bachelor's degree signals a comprehensive and well-rounded education, encompassing theoretical knowledge and critical thinking skills, a short-term certificate signals focused and practical skills training tailored for specific job requirements. The preference for degrees or short-term certificates varies among employers and industries. The IT industry's rate of change makes it one industry in which certificates are particularly relevant and valued. However, some employers within the IT industry still value and require degrees.

Career Clusters

Career clusters within IT vary depending on the framework. O*Net, a Department of Labor database, uses four overarching IT Career Clusters: Information & Support Services, Network Systems, Programming & Software Development, and Web & Digital Communications.[30] The Bureau of Labor Statistics shows (the above) ten IT Occupation Groups. It should be noted that, depending on the level of a specific role, some of these clusters may overlap.

Coursera outlines seven key IT Career Paths[31] for 2023. Those clusters are shown below:

1. **Computer Support**
2. **Cybersecurity**
3. **Networks & Systems**
4. **Software Development**
5. **Web Development**
6. **Data**
7. **Cloud Computing**

Computer Support is noted by BLS and Coursera as key for entry-level roles that workers can use as a launchpad to other careers. Given the Fredericksburg area's volume of IT services companies, Computer Support serves as a foundational occupation for workers entering the regional IT cluster.

Cybersecurity is notable nationally as a key field within IT due to its critical role in protecting digital systems, networks, and sensitive data from evolving cyber threats, ensuring the continuity of business operations, safeguarding public safety, and maintaining the trust and integrity of the interconnected global digital landscape. Cybersecurity employment is projected to grow 35% by 2032 according to the Bureau of Labor Statistics.[32] Region 6's geographical proximity to the nation's capital and U.S. Department of Defense headquarters makes cybersecurity a particularly relevant field.

Cloud Computing and **Software Development** also have notably high projected growth rates.

Regional interviews revealed increased demand for software coders, as well as a steady need for hard engineering, mechanical engineers, and mathematicians.

Finally, the growth of the data center industry provides an opportunity for talent development and worker connections. Northern Virginia has long been the data center hub of the world. With the broadband superhighway running from Northern Virginia through Spotsylvania and Caroline Counties, and with strong tax incentives for data centers in Virginia, Region 6 is well-positioned for this sub-industry. Though not currently showing up in the data, Amazon is planning 10 million square feet of data center development[33] (among four campuses) in Spotsylvania and Caroline Counties. The four projects will be built out in phases until 2035. A fifth proposal, known as Hunter's Ridge, has also been filed. Planning directors interviewed noted the need to ensure workers are trained for these roles. Stafford County also has numerous data centers in various phases of construction. **These projects provide new opportunities for new job entrants and those looking to make a career change.**

Education and Training Landscape

There are many education and training opportunities in IT. In addition to courses at physical campuses, online offerings through the Virginia Community College System (VCCS) are vast. This provides an opportunity for the region's rural population, but there is likely a role for the BCWDB to help students understand which courses and certifications are best suited for their interests.

As noted in the Career Pathways section, for adults looking to enter a career in IT, the most important skills to have (that will provide access to a job and begin on career path advancement) are *CompTIA A+, CompTIA Network+, and CompTIA Security+.* One needs these foundational skills before entering a career or training in cybersecurity, systems administration, or other IT fields.

Some employers support additional learning. One notable example is Dahlgren's academic support program. The company highly encourages and promotes the acquisition of degrees and certificates and pays for employees' education (allocating about $2 million per year to academic tuition). The company does not typically hire those who have not already started a degree program but does bring in about 350 students per year who have not graduated and provides a tuition assistance benefit.

Internships are invaluable to students as they provide real-world experience, allowing them to apply theoretical knowledge in a practical setting, develop crucial workplace skills, and make informed career decisions. The Virginia Commonwealth STEM Industry Partnership (CSIIP) links companies and students in STEM, including, but not limited to, high-need areas such as Computer Science, Cybersecurity, Data Science, Information Technology, Engineering, Physical Science and Finance.

Middle school is a critical time for career exploration and the introduction of IT career pathways. Hands-on projects, in which students can build and be creative with technology, are extremely effective in capturing middle school students' interest. This is valuable as:

❶ It gets kids excited about STEM (Science, Technology, Engineering, and Mathematics).

❷ Digital literacy has become a fundamental skill. Understanding the basics of computer systems, coding, and data management is valuable in all industries today.

❸ It develops students' problem-solving and creativity skills, which are also valuable in all industries.

The CyberBytes Foundation and SteamBridge are two providers in Region 6 that are focusing on middle school program delivery. Workforce NOW, run through the Fredericksburg Chamber of Commerce, is creating and implementing 100 work-based learning opportunities within businesses. They are currently working on ensuring businesses know how to host work-based learning opportunities and are hosting an Internship EXPO.

A full list of educational programs in information technology is listed in the table below.

IT Programming, with In-Person Option

Education Provider	Institution Type	Programming	Degree/Credentials
Bridging Communities Regional Career & Technical Center	CTE Programs	Coding and Advanced Programming; Engineering Technology	HS diploma + IRC
Career and Technical Academy in Arlington	Governor's STEM Academies	Computer Program; Computer Science; CIS	HS diploma + IRC
Chesterfield Governor's Career & Technical Academy for Engineering	Governor's STEM Academies	Engineering & Technology	HS diploma + IRC
Cyber Bytes Foundation	Training Providers	Cybersecurity	Academy; Coursework; Upskilling
Eastern Shore Community College	College/University	Business Management w/ IT; Electronics Technology; Computer Technician Specialization; Technical Studies; IT Support; Webpage Development; CompTIA A+; CompTIA IT Fundamentals+; CompTIA Network+; CompTIA Security+	AAS; Certificate; IRC

Education Provider	Institution Type	Programming	Degree/Credentials
Fostering Innovations & Relevance through STEM & Trades	Governor's STEM Academies	Information Technology	HS diploma + IRC
Germanna Community College	College/University	Applied Mathematics; Cloud Computing; Information Systems Technology; Electrical Engineering; Information Management; Networking; Advanced Networking; Cisco; CISSP; CADD	AAS; Certificate
Governor's Career & Technical Education Academy for STEM in Richmond	Governor's STEM Academies	Engineering & Technology	HS diploma + IRC
Governor's STEM Academy at Chantilly High School	Governor's STEM Academies	Computer Systems	HS diploma + IRC
Governor's STEM Academy at Christiansburg High School	Governor's STEM Academies	Engineering & Technology	HS diploma + IRC
Governor's STEM Academy at George C. Marshall High School	Governor's STEM Academies	Computer Systems; Network Administration; Cisco; Cybersecurity	HS diploma + IRC
Governor's STEM Academy at Harrisonburg High School	Governor's STEM Academies	Computer Science	HS diploma + IRC
Governor's STEM Academy for Engineering, Marketing, & IT Studies	Governor's STEM Academies	Engineering & Technology	HS diploma + IRC
Heritage High School Governor's STEM Academy	Governor's STEM Academies	Computer Science; Game Design; Computer Networking; Cybersecurity	HS diploma + IRC
Holt Computer Training	Training Providers	Computer Training	Certification
Jackson River Technical Center	CTE Programs	Computer Systems Technology	HS diploma + IRC; Apprenticeship
New Horizons Computer Learning Center of Richmond	Training Providers	Information Technology	IRC
New Horizons of Washington D.C. & Richmond VA	Training Providers	Information Technology	IRC
New Horizons Regional Education Centers	CTE Programs	Information Technology; Cisco Networking; Computer Programming; Cybersecurity	HS diploma + IRC
New Horizons Regional Education Centers – Woodside Lane Campus	CTE Programs	Information Technology; Cisco Networking; Computer Programming; Cybersecurity	HS diploma + IRC
Northern Neck Technical Center	CTE Programs	Computer Systems Technology; Engineering/STEM	HS diploma + IRC
Northern Neck Technical Center Governor's STEM Academy for Agriculture & Maritime Studies	Governor's STEM Academies	Computer Systems	HS diploma + IRC
ProTrain	Training Providers	Information Technology	Certificates; IRCs; WBL
Pulaski County Public Schools Governor's STEM Academy	Governor's STEM Academies	Information Technology	HS diploma + IRC
Rappahannock Community College	College/University	Asphalt Quality Control Technician; Advanced Networking and Cybersecurity; Basic Electronics; Basic Networking and Cybersecurity; CAD; Computer Applications Specialist; Electrical & Instrumentation Technician; Game Design and Development; Practical Electrical; Web Design; STEM at Work	Certificate; AAS
RioT Accelerator Program - Go Stafford Virginia	Training Providers	Information Technology	OJT

Education Provider	Institution Type	Programming	Degree/Credentials
Stafford Academy for Technology	Governor's STEM Academies	Cybersecurity	HS diploma + IRC
STEAMBridge	Training Providers	Information Technology	Project-Based Learning
STEM Academy at Osbourn High School	Governor's STEM Academies	Information Technology; STEM Engineering	HS diploma + IRC
The Blue Ridge Crossroads Governor's Academy for Technical Education	Governor's STEM Academies	Engineering & Technology	HS diploma + IRC
The Bridging Communities Governor's STEM Academy	Governor's STEM Academies	Coding & Advanced Programming	HS diploma + IRC
The Grassfield High School Governor's STEM Academy	Governor's STEM Academies	Cybersecurity	HS diploma + IRC
University of Mary Washington	College/University	Computer Science; Cybersecurity; Mathematics; Digital Studies	BS; BA
Valley Career and Technical Center	CTE Programs	Computer Technology	HS diploma + IRC
Virginia Job Corps	Community Based Programs	Information Technology	OJT

Virginia's Community Colleges Online IT Programming

Education Provider	Programming
AAS	Business Administration AAS – Information Technology Specialization; Information Systems Technology AAS; Information Systems Technology AAS – Cloud Computing Specialization; Computer & Electronics Technology AAS; Computer Science AAS; Information Technology AAS – Cybersecurity Specialization; Technical Supervision AAS; Secure Computer Networking AAS; Engineering AAS; Engineering Technology AAS
Certificate	Cloud Computing Certificate; Computer & Electronics I Certificate; Computer & Electronics II Certificate; Computer Help Desk Certificate; CISCO Network Administration Certificate; Computer Application Design Certificate; Computer Applications Certificate; Computer Programming Certificate; Cybersecurity Certificate; Cybersecurity & Networking Foundations Certificate; Cybersecurity for Enterprise Certificate; Cybersecurity for Local Area Network; Cybersecurity Intermediate Certificate; Information Systems Technology Certificate; Information Systems Technology Certificate - Digital Design & Graphics Specialization; Foundations of Digital Design & Graphics Certificate; Information Systems Management Certificate; Information Systems Technology for Business Certificate; Network Security & Support Certificate; Web Design Specialist Certificate
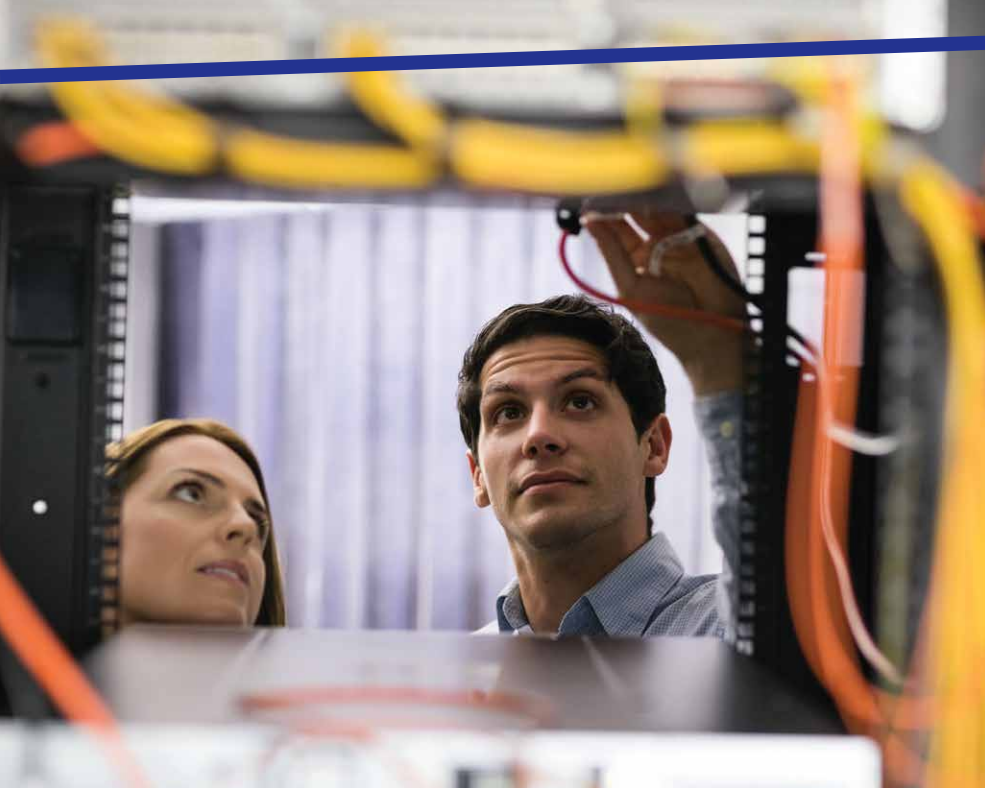
Talent Pathway Summary

Employers value certifications!

IT jobs are embedded throughout many industries.

New entrants to the IT labor market need foundational skills in Computer Support.

Talent development begins in Middle School!

IT jobs pay well and offer job security as workers gain more skills.
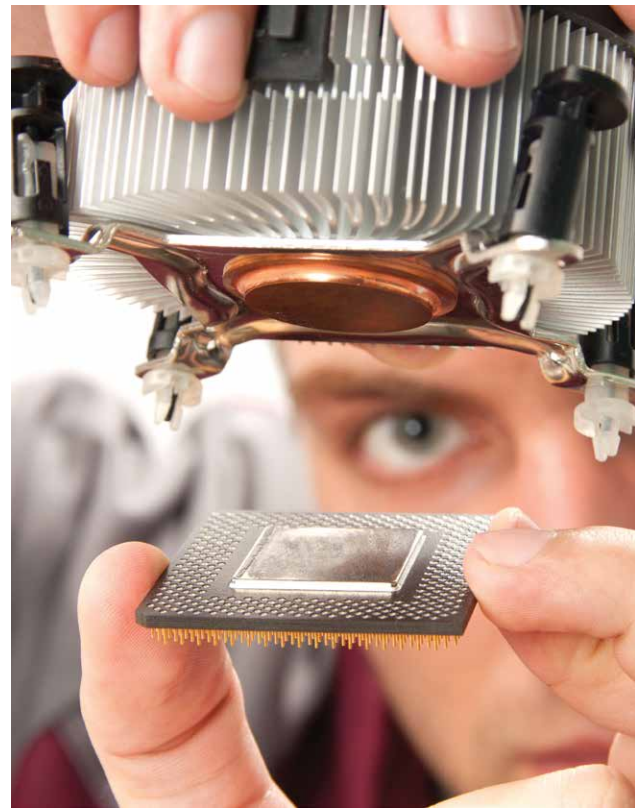
Go Virginia Region 6 Situational Analysis – Manufacturing

2022 Jobs:
1,096

2032 Jobs:
1,120

2022 - 2032 % Change:
2%

Avg. Earnings Per Job:
$95,076

2022 Hires:
398

2022 Separations:
487

The Bureau of Labor Statistics defines the manufacturing sector as that which "comprises establishments engaged in the mechanical, physical, or chemical transformation of materials, substances, or components into new products."[34] In this industry, raw materials, components, or parts are transformed into finished products that can be sold to consumers or used in other industries.

Manufacturing involves a wide range of production processes, such as machining, assembly, molding, welding, and more, depending on the products being made. Additionally, manufacturing encompasses various sectors and industries, including automotive, electronics, aerospace, food and beverage, textiles, chemicals, and many others. The industry is closely linked to other sectors, such as logistics, transportation, and supply chain management. It is also often at the forefront of technological innovation, with advancements in automation, robotics, 3D printing, and other technologies driving improvements in efficiency and productivity.

Manufacturing in Virginia

Virginia's manufacturing sector employs 1,096 individuals in 2022. With a 2% growth projection, the sector is expected to reach 1,120 jobs by 2032. The average earnings per job stand at $95,076, reflecting the sector's contribution to the state's prosperity. In 2022, the industry witnessed 398 hires and 487 separations, highlighting the importance of workforce management strategies. Virginia manufacturers tend to be small firms of around 20 to 40 employees.

The Nestle/Purina location in King William County is one of the larger employers in the region and houses around 200 workers. Nestle/Purina recently built a large, multi-million-dollar plant to produce and package cat litter with the unique soil in the area. The plant is automated so different types of workers are employed with technicians being in need.

WestRock operates a paper mill in West Point, which is also in King William County and employs roughly 250 workers. Dahlgren, though primarily IT-focused, employs skilled machinists.

Interviews revealed that Caroline County has been recruiting numerous manufacturing and distribution centers to relocate into the region. In 2019, McKesson Corp announced a $50-milllion-plus distribution facility in Caroline County to be built out in a roughly five-year time span.[35] In October 2023, World Class Distribution completed its 1.2 million-square-foot distribution center, with plans to hire 1,000 new employees, making it the largest employer in Caroline County.[36] M.C. Dean, with a regional workforce of nearly 400 employees, completed a three-phase expansion[37] in the summer of 2023. In May of 2023, it was announced that a 325,500-square-foot was to begin construction in the summer of 2023.

In proximity to Region 6, Newport News houses many manufacturing operations, especially related to U.S. Department of Defense contracting. These well-paying jobs exacerbate labor and skills shortages for Region 6 manufacturing employers as residents of the Middle Peninsula and Northern Neck commute to jobs in the Newport News-Virginia Beach area.

There are 152 employers within Region 6, employing 3,718 people. Employer locations are mapped in the graphic below.
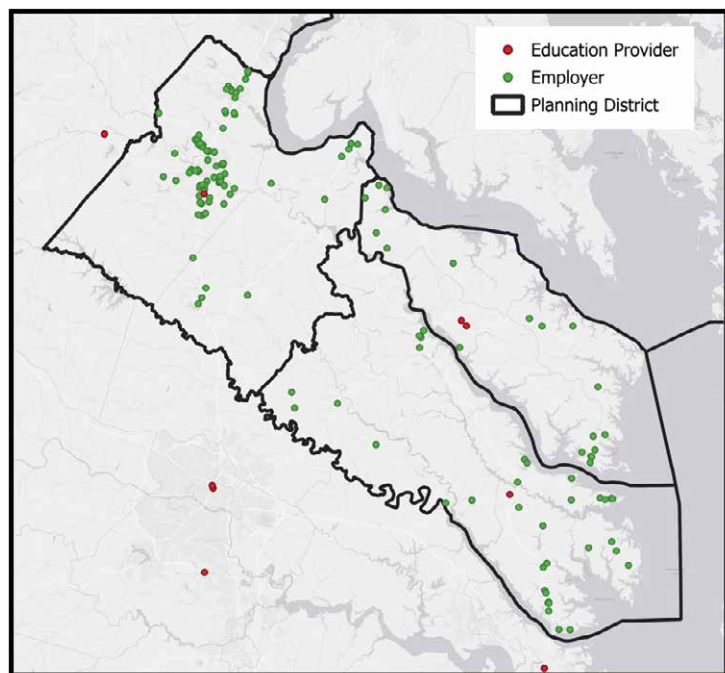
Strategic Manufacturing Expansion: Opportunities for Future Research

When considering Region 6 strategic growth in manufacturing, and attracting manufacturers to the area, opportunities for further research present themselves. What is discussed below is supplementary material for consideration when looking at growing the manufacturing sector in Region 6.

An examination of the region's pertinent resources highlights the presence of sand and gravel in the Middle Peninsula, valuable for manufacturing concrete and asphalt. By 2027, Ready-Mix Concrete manufacturing is expected to have a location quotient of 2.29 across the region, signifying that the region's specialization in concrete manufacturing will significantly exceed the national norm. This may position it as having the most favorable export orientation for the sector, representing an estimated 226 jobs according to Lightcast.

Aggregate from quarries is extremely valuable due to the reluctance of cities and neighborhoods to allow quarries nearby, and the limited ability to ship aggregate over long distances. Data centers, a significant presence in Virginia, require a substantial amount of concrete, which may represent a growth opportunity for this industry as the IT industry in Region 6 is strong and expected to grow. On the other hand, cement is a commodity that can be shipped far and faces more volatile pricing. Cement production is also highly energy-intensive. The emergence of rival technologies and methods, such as On-Site 3D Printing, could limit the growth in use of cement.

Water resources, advantageous for manufacturing processes requiring water, are abundant throughout the region. Noteworthy manufacturing categories using water resources include Gasket, Packing, and Sealing Device Manufacturing (LQ: 1.95), Rope, Cordage, Twine, Tire Cord, and Tire Fabric Mills Manufacturing (LQ: 1.70), Motor Vehicle Transmission and Power Train Parts Manufacturing (LQ: 1.29), and Motor Vehicle Brake Systems Manufacturing (LQ: 1.28). However, local employers interviewed for this report, operating in rural regions, communicated they encountered significant challenges in accessing water for industrial purposes.

Both the Middle Peninsula and Northern Neck regions have several other similar resources:

- Timber (a raw material for construction, furniture, paper, and other wood-based products),
- Clay (used for ceramics, bricks, and other clay-based products), and
- Agricultural products (useful for food processing and agro-industries).

All these factors have potential implications for the training and employment landscape of manufacturing in the region and warrant further exploration.

Additionally, the region's proximity and connection to Fredericksburg serve as resources for manufacturing expansion. While access to innovation and technology is crucial for the success of manufacturing industries, the specific implications of prioritizing one focus area over another warrants further investigation due to the industries' needs and challenges to thrive.

Factors Influencing Employment

Many of the factors influencing employment in aquaculture and information technology spill over into manufacturing. Many manufacturing positions do not require a college

degree, yet they pay well and are an attractive option for younger workers looking to enter a field with stable employment. However, many interviews with manufacturing employers indicate that younger workers are challenging to recruit because exposure and views about modern manufacturing are limited and misplaced. Manufacturers in the region also state that younger workers do not want to be working in "structured" environments. Nationwide, the manufacturing workforce shortage and skills gap are well-documented (e.g. NAM/Deloitte Report[38]). Virginia's Region 6 is also experiencing this shortage.

With the automation of manufacturing, many of the skills needed in information technology crossover into manufacturing. So, in addition to traditional engineering-related career pathways and commensurate knowledge and skills, information technology knowledge and skills in computer networking and software, troubleshooting, robotics, and cybersecurity are critical for many jobs. LinkedIn identifies the skillsets as important for industrial automation and notes that machine and process automation require mechanical and chemical knowledge.[39]

- Knowledge of electrical and electronics circuits, computer, programming, communication systems, network technologies, control panels, electrical power distribution drawings, PLC programming, and related functions.

- Knowledge of electrical and industrial devices, e.g., isolators, boilers, pumps, Variable Frequency and Adjustable Speed Drives, transmitters, and valves.

- Knowledge of analog and digital signals, system dynamics, sensors, measurement and instrumentation engineering, and control systems.

- Knowledge of logical thinking, mathematics, imagination, troubleshooting, decision-making, and good communication skills to deal with customers.

- Knowledge of data analysis, report writing, and presentation.

Interviewees expressed the need for customized training options for small manufacturing companies, meaning that each employer has processes unique to that company and IT workplaces. Due to the majority of Region 6 manufacturing businesses being small, customizing training for each one is not feasible for institutions such as Rappahannock Community College (RCC). However, this is an opportunity for convening as part of a Manufacturing Sector Partnership where RCC and other partners can scale solutions that benefit the entire regional industry.

Through roundtables and interviews, several challenges exist for the manufacturing industry in Virginia's Region 6:

Automation: With the increased automation of manufacturing, workers are increasingly required to possess high-tech skills to function within manufacturing roles. These higher technology skills require additional time and intensity for underskilled and undereducated workers needing opportunities.

Infrastructure: Adequate infrastructure, including transportation and logistics networks, is crucial for the efficient movement of goods. Many areas in the Northern Neck have limited highway access. In many of the rural parts of the region, water and public utilities are difficult to provide to manufacturers in the quantities needed.

Natural Resources: While the region has some natural resources, availability may not be at the scale needed by large manufacturers. For instance, there are not steel resources that would lend the area to car manufacturing or hydrogen resources for chemical reduction processes.

Worker Awareness: Addressing the perception of manufacturing as a career option is important. Younger workers often do not think of manufacturing as a career and do not realize the job stability and competitive wages that manufacturing offers. Additionally, women enroll in manufacturing training programs in far lower numbers than their male counterparts. The living wage offered by many manufacturing jobs may be particularly good for women raising families. Ongoing efforts to change perceptions and promote the value of manufacturing careers to target populations is important.

Opportunities in the Innovation Ecosystem: The region's connection to Fredericksburg is a resource with respect to manufacturing expansion. Access to innovation and technology is crucial for the success and competitiveness of manufacturing industries for increased efficiency and productivity, quality improvement, innovation in product development, customization and flexibility, etc.

Employment Opportunities in Manufacturing

Manufacturing employment in Region 6 is varied and led by the need for Assemblers and Fabricators, Truck Drivers, and Electrical Assemblers. One interviewee noted that workers are needed with knowledge, skills, and experience in Electrical Maintenance to service manufacturing operations. Often different manufacturing jobs can utilize transferable skills from other skilled trades or related technician occupations.

While each job title is limited in the number of workers engaged in the occupation, taken together, the industry has varied skills and employment needs across a spectrum of jobs. The table below displays the occupational information for Region 6 manufacturing.

Employment Data for Manufacturing NAICS Codes

Occupation	Employed in Industry Group (2022)	Employed in Industry Group (2032)	Change (2022 – 2032)	% of Total Jobs in Industry Group (2022)	Median Hourly Earnings	Typical Entry Level Education	Work Experience Required	Typical On-The-Job Training
Assemblers and Fabricators	73	83	11	6.6%	$15.04	High school diploma or equivalent	None	Moderate-term OJT
Heavy and Tractor-Trailer Truck Drivers	52	64	12	4.8%	$21.80	Postsecondary nondegree award	None	Short-term OJT
Electrical, Electronic, & Electromechanical Assemblers, Exc. Coil Winders, Tapers, & Finishers	44	25	(19)	4.0%	$15.53	High school diploma or equivalent	None	Moderate-term OJT
Computer Numerically Controlled Tool Operators	43	33	(10)	4.0%	$19.49	High school diploma or equivalent	None	Moderate-term OJT
First-Line Supervisors of Production and Operating Workers	39	43	4	3.6%	$28.65	High school diploma or equivalent	Less than 5 years	None
Molders, Shapers, and Casters, Except Metal and Plastic	39	52	13	3.5%	$18.50	High school diploma or equivalent	None	Long-term OJT
General and Operations Managers	27	30	3	2.5%	$54.24	Bachelor's degree	5 years or more	None
Welders, Cutters, Solderers, and Brazers	26	34	7	2.4%	$22.06	High school diploma or equivalent	None	Moderate-term OJT
Cabinetmakers and Bench Carpenters	24	28	4	2.2%	$18.66	High school diploma or equivalent	None	Moderate-term OJT
Shipping, Receiving, and Inventory Clerks	23	21	(2)	2.1%	$15.63	High school diploma or equivalent	None	Short-term OJT

Sources: Lightcast; U.S. Bureau of Labor Statistics

Career Pathways

Advance CTE identifies six primary career pathways[40] in the manufacturing industry. They are:

- Production
- Manufacturing Production Process Development
- Maintenance, Installation & Repair
- Quality Assurance
- Logistics & Inventory Control
- Health, Safety & Environmental Assurance

Manufacturing USA has an infographic on manufacturing career pathways[41] that illustrate jobs with adjacent skills and their relationship to high-tech manufacturing careers. Additive Technicians, Automation Technicians, General Composite Technicians, Lean Manufacturing Technicians, and Robotics Technicians are key manufacturing roles that integrate technology; thus, a need for education and training in manufacturing targeting advanced manufacturing processes. Workers need foundational skills in both technology and manufacturing processes to continue progressing in career pathways.

Pathways to Manufacturing Careers

BROUGHT TO YOU BY
ManufacturingUSA

Today's manufacturing jobs offer high-paying opportunities to work with cutting-edge technologies in a wide range of fast-growing fields. Driven by a renewed investment in U.S. manufacturing innovation, the growth potential for these jobs is high—more than 1.3 million manufacturing jobs have been added to the U.S. economy over the past decade. These jobs require skills that many Americans already have and don't necessarily need a college or advanced degree to do, making it easier to upgrade to a manufacturing career than you might think. Below are a just a few example pathways to better-paying, high-tech manufacturing jobs.

MANUFACTURING TO MANUFACTURING

ASSEMBLY MACHINE OPERATOR

+ $19,208 SALARY INCREASE

CURRENT SKILLS: REPAIR, MACHINERY, HAND TOOLS, WELDING, MACHINE OPERATION, FORKLIFT OPERATION, POWER TOOLS, CLEANING

TOP 3 SKILLS NEEDED: PREDICTIVE / PREVENTATIVE MAINTENANCE, SCHEMATIC DIAGRAMS, HVAC

AUTOMATION TECHNICIAN — 201,475 JOB POSTINGS

+ $11,502 SALARY INCREASE

CURRENT SKILLS: REPAIR, MACHINERY, HAND TOOLS, SOLDERING, WELDING, FORKLIFT OPERATION

TOP 3 SKILLS NEEDED: LEAN MANUFACTURING MANUFACTURING PROCESSES, PREDICTIVE / PREVENTATIVE MAINTENANCE

LEAN MANUFACTURING TECHNICIAN — 8,614 JOB POSTINGS

+ $18,521 SALARY INCREASE

CURRENT SKILLS: REPAIR, MACHINERY, HAND TOOLS, WELDING, POWER TOOLS, FORKLIFT OPERATION

TOP 3 SKILLS NEEDED: ROBOTICS, PREDICTIVE / PREVENTATIVE MAINTENANCE, SCHEMATIC DIAGRAMS

ROBOTICS TECHNICIAN — 150,482 JOB POSTINGS

+ $11,339 SALARY INCREASE

CURRENT SKILLS: REPAIR, MACHINERY, HAND TOOLS, WELDING, SCHEMATIC DIAGRAMS, FORKLIFT OPERATION, POWER TOOLS

TOP 3 SKILLS NEEDED: ROBOTICS, PREDICTIVE / PREVENTATIVE MAINTENANCE, SERVO DRIVES / MOTORS

WELDER / SOLDERER

+ $6,475 SALARY INCREASE

CURRENT SKILLS: REPAIR, MACHINERY, HAND TOOLS, WELDING, SCHEMATIC DIAGRAMS, FORKLIFT OPERATION, POWER TOOLS, GRINDERS

TOP 3 SKILLS NEEDED: ENGINEERING DRAWINGS, CALIPERS, SAP SOFTWARE

GENERAL COMPOSITE TECHNICIAN — 20,921 JOB POSTINGS

COMPUTER NUMERICAL CONTROL (CNC) OPERATOR

+ $16,951 SALARY INCREASE

CURRENT SKILLS: REPAIR, CLEANING, CNC, MACHINING, HAND TOOLS

TOP 3 SKILLS NEEDED: 3D PRINTING / ADDITIVE MANUFACTURING, ROBOTICS, PROTOTYPING

ADDITIVE TECHNICIAN — 20,717 JOB POSTINGS

Manufacturing USA (n.d.). Pathways to Manufacturing Careers.

Education and Training Landscape

The Virginia Manufacturing Association (VMA) provides foundational education and training related to manufacturing through two primary avenues:

❶ Manufacturing Skills Institute (VMSI)

❷ Registered Apprenticeship Program

The Virginia Manufacturing Skills Institute:

- Offers training and education programs to enhance the skills of the manufacturing workforce.

- Collaborates closely with local manufacturers to ensure that the training programs are aligned with the specific needs and demands of the manufacturing sector.

- Works with local manufacturers to facilitate job placement for program graduates.

- Offers upskilling programs for individuals already in the manufacturing workforce.

- Helps local companies understand and keep pace with innovation and advanced manufacturing techniques.

VMA has a registered apprenticeship program and helps employers find candidates. However, interviewees revealed that apprenticeship opportunities are severely underutilized and there are opportunities to better utilize this strategy to help employers build a skilled workforce.

At community colleges, much of the training emphasizes instrumentation and welding. Rappahannock Community College has a particularly strong reputation concerning manufacturing-related training.

Germanna Community College utilizes the New Economy Workforce Credential Grant Program (WCG) to offer training for trades with a median annual salary and a high number of projected job openings. The programs currently available include HVAC Technician, Heavy Equipment Operator, Electrician, Plumber, and Welder. The General Assembly authorized WCG in 2016, providing a pay-for-performance model for funding noncredit workforce training leading to a credential in high-demand fields.

Upon enrollment, students are required to pay one-third of the total program cost, which can be covered by third-party funds like noncredit financial aid, training vouchers, or employer payment. Upon successful training completion, the state contributes one-third of the program cost, up to $1,500, to the institution. If a student does not complete the program, they are responsible for this portion of the total cost.

The combined maximum award to an institution for training completion and credential attainment is $3,000. The State Council of Higher Education for Virginia (SCHEV) administers this program.

The table on the following pages highlight the education and training programs available for manufacturing workers in the region.

Manufacturing Programming

Education Provider	Institution Type	Programming	Degree/Credentials
Career and Technical Academy in Arlington	Governor's STEM Academies	CAD	HS diploma + IRC
Chesterfield Governor's Career & Technical Academy for Engineering Studies	Governor's STEM Academies	Engineering	HS diploma + IRC
Eastern Shore Community College	College/University	Industrial Technology; Welding	Certificate
Germanna Community College	College/University	Technical Studies; Asphalt Quality Control Technician; CNC Milling; CADD; Electrical Engineering; Electrician; Industrial Maintenance Technician; Mechanical Engineering; Technology in Mechatronics; Welding	AAS; Certificate
Governor's Career & Technical Education Academy for STEM in Richmond	Governor's STEM Academies	Engineering	HS diploma + IRC
Governor's STEM Academy at Chantilly High School	Governor's STEM Academies	Engineering Systems	HS diploma + IRC
Governor's STEM Academy at Christiansburg High School	Governor's STEM Academies	Engineering; Manufacturing Production; Process Development	HS diploma + IRC
Governor's STEM Academy at George C. Marshall High School	Governor's STEM Academies	Robotic Systems; Engineering Systems	HS diploma + IRC
Governor's STEM Academy at Harrisonburg High School	Governor's STEM Academies	Robotics; Engineering/STEM	HS diploma + IRC
Governor's STEM Academy for Engineering, Marketing, & IT Studies	Governor's STEM Academies	Engineering & Technology	HS diploma + IRC
Governor's STEM Academy of Architecture, Environment, & Engineering at Kecoughtan High School	Governor's STEM Academies	Construction Design	HS diploma + IRC
Heritage High School Governor's STEM Academy	Governor's STEM Academies	Engineering & Robotics	HS diploma + IRC
Jackson River Technical Center	CTE Programs	Welding	HS diploma + IRC; Apprenticeship
Lynchburg Regional Governor's STEM Academy	Governor's STEM Academies	Mechatronics	HS diploma + IRC
Manufacturing Apprenticeships	Training Providers	Manufacturing	OJT
Massanutten Technical Center	CTE Programs	Welding	HS diploma + IRC; Apprenticeship
New Horizons Regional Education Centers	CTE Programs	Mechatronics; Precision Machining; Welding	HS diploma + IRC
New Horizons Regional Education Centers – Woodside Lane Campus	CTE Programs	Mechatronics; Precision Machining; Welding	HS diploma + IRC
Northern Neck Technical Center Governor's STEM Academy for Agriculture & Maritime Studies	Governor's STEM Academies	Engineering/STEM	HS diploma + IRC
ProTrain	Training Providers	Manufacturing	Certificates; IRCs; WBL
Rappahannock Community College	College/University	General Engineering Technology; Welding	Certificate; AAS
Rowanty Technical Center	CTE Programs	Welding	HS diploma + IRC
The Grassfield High School Governor's STEM Academy	Governor's STEM Academies	Welding; Mechatronics	HS diploma + IRC

Education Provider	Institution Type	Programming	Degree/Credentials
VA Manufacturing Skills Institute	Training Providers	Manufacturing	Upskilling
Valley Career and Technical Center	CTE Programs	Industrial Maintenance; Precision Machining; Welding	HS diploma + IRC
Virginia Job Corps	Community Based Programs	Manufacturing	OJT
Virginia's Community Colleges Online	Community College Online	Industrial Technology AAS – Industrial Maintenance Technology Specialization; Industrial Technology AAS - Quality Assurance Specialization; Industrial Maintenance Certificate; Quality Assurance Certificate; Industrial Supervision Certificate	AAS; Certificate

Talent Pathway Summary

Lack of Awareness of Opportunities Inhibits Talent Availability

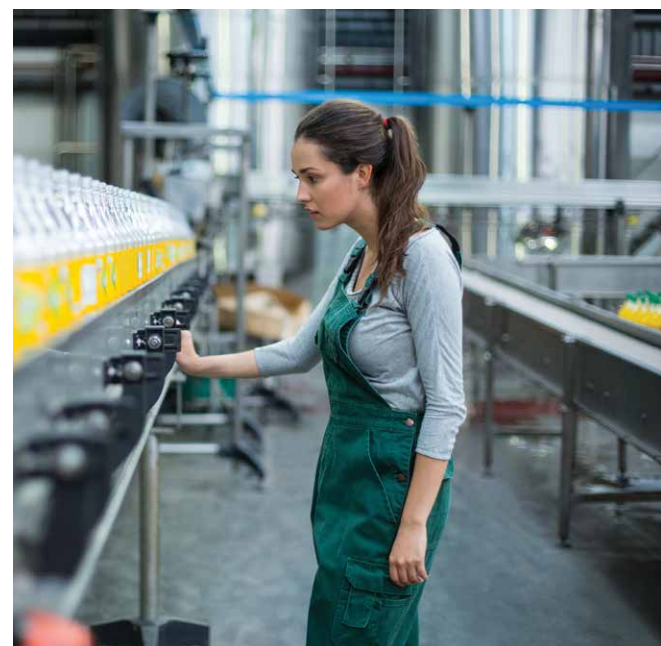Workers Needed in Varied Occupations

Work-based Learning Provides Good Options for Skills-Building

Manufacturing is About Technology!

Workers Need Foundational Math and Technology Skills

Appendix A: Occupational Profiles

Industry	Occupation Title	SOC
Aquaculture	Fishing and Hunting Workers	45-3031.00
IT	Software Developers	15-1252.00
IT	Computer and Information Research Scientists	15-1221.00
IT	Computer Systems Analysts	15-1211.00
IT	Computer User Support Specialists	15-1232.00
IT	Information Security Analysts	15-1212.00
Manufacturing	Miscellaneous Assemblers and Fabricators	51-2099.00
Manufacturing	Heavy and Tractor-Trailer Truck Drivers	53-3032.00
Manufacturing	Molders, Shapers, and Casters, Except Metal and Plastic	51-9195.00
Manufacturing	Welders, Cutters, Solderers, and Brazers	51-4121.00

Occupation Title: Fishing and Hunting Workers

SOC Code:

45-3031.00

At-a-Glance Statistics:

Bright Outlook

Sample Job Titles:

Commercial Fisherman, Commercial Fishing Vessel Operator, Deckhand, Fisherman, Fur Trapper, Hunter, Nuisance Wildlife Trapper, Trapper, Urban Wildlife Damage Control Specialist, Wildlife Control Operator

Key Tasks:

Patrol trap lines or nets to inspect settings, remove catch, and reset or relocate traps.

Obtain permission from landowners to hunt or trap on their land.

Travel on foot, by vehicle, or by equipment such as boats, snowmobiles, helicopters, snowshoes, or skis to reach hunting areas.

Steer vessels and operate navigational instruments.

Skin quarry, using knives, and stretch pelts on frames to be cured.

Maintain and repair trapping equipment.

Scrape fat, blubber, or flesh from skin sides of pelts with knives or hand scrapers.

Put fishing equipment into the water and anchor or tow equipment, according to the fishing method used.

Maintain engines, fishing gear, and other on-board equipment and perform minor repairs.

Sort, pack, and store catch in holds with salt and ice.

Education and Training (level of education & training required for the occupation):

Some of these occupations may require a high school diploma or GED certificate.

Median Wages (USA)

Hourly: $16.33
Annually: $33,970

Top Industries

Agriculture, Forestry, Fishing, and Hunting

Employment Projection (Virginia; 2022-2032)

142,000

Occupation Title: Software Developers

SOC Code:

15-1252.00

At-a-Glance Statistics:

Bright Outlook

Sample Job Titles:

Application Developer, Application Integration Engineer, Developer, Infrastructure Engineer, Network Engineer, Software Architect, Software Developer, Software Development Engineer, Software Engineer, Systems Engineer

Key Tasks:

Analyze information to determine, recommend, and plan installation of a new system or modification of an existing system.

Analyze user needs and software requirements to determine feasibility of design within time and cost constraints.

Confer with data processing or project managers to obtain information on limitations or capabilities for data processing projects.

Confer with systems analysts, engineers, programmers and others to design systems and to obtain information on project limitations and capabilities, performance requirements and interfaces.

Consult with customers or other departments on project status, proposals, or technical issues, such as software system design or maintenance.

Coordinate installation of software system.

Design, develop and modify software systems, using scientific analysis and mathematical models to predict and measure outcomes and consequences of design.

Determine system performance standards.

Develop or direct software system testing or validation procedures, programming, or documentation.

Modify existing software to correct errors, adapt it to new hardware, or upgrade interfaces and improve performance.

Education and Training (level of education & training required for the occupation):

Most of these occupations require a four-year bachelor's degree, but some do not.

Median Wages (Virginia)

Hourly: $62.97
Annually: $130,980

Top Industries

Professional, Scientific, and Technical Services (42% employed in this sector)
Information (20%)
Finance and Insurance (10%)

Employment Projection (Virginia; 2022-2032)

136,300

Occupation Title: Computer and Information Research Scientists

SOC Code:

15-1221.00

At-a-Glance Statistics:

Bright Outlook

Sample Job Titles:

Computer Scientist, Computer Specialist, Control System Computer Scientist, Research Scientist, Scientific Programmer Analyst

Key Tasks:

Analyze problems to develop solutions involving computer hardware and software.

Apply theoretical expertise and innovation to create or apply new technology, such as adapting principles for applying computers to new uses.

Assign or schedule tasks to meet work priorities and goals.

Meet with managers, vendors, and others to solicit cooperation and resolve problems.

Design computers and the software that runs them.

Conduct logical analyses of business, scientific, engineering, and other technical problems, formulating mathematical models of problems for solution by computers.

Evaluate project plans and proposals to assess feasibility issues.

Participate in multidisciplinary projects in areas such as virtual reality, human-computer interaction, or robotics.

Consult with users, management, vendors, and technicians to determine computing needs and system requirements.

Develop and interpret organizational goals, policies, and procedures.

Education and Training (level of education & training required for the occupation):

Bachelor's degree required for some jobs
Doctoral degree required for some jobs
Master's degree required for some jobs

Median Wages (Virginia)

Hourly: $65.98
Annually: $137,240

Top Industries

Professional, Scientific, and Technical Services
Government

Employment Projection (Virginia; 2022-2032)

3,400

Occupation Title: Computer Systems Analysts

SOC Code:

15-1211.00

At-a-Glance Statistics:

Bright Outlook

Sample Job Titles:

Applications Analyst, Business Systems Analyst, Computer Analyst, Computer Systems Analyst, Computer Systems Consultant, Information Systems Analyst (ISA), IT Analyst (Information Technology Analyst), IT Systems Analyst (Information Technology Systems Analyst), Programmer Analyst, Systems Analyst

Key Tasks:

Troubleshoot program and system malfunctions to restore normal functioning.

Provide staff and users with assistance solving computer-related problems, such as malfunctions and program problems.

Test, maintain, and monitor computer programs and systems, including coordinating the installation of computer programs and systems.

Use the computer in the analysis and solution of business problems, such as development of integrated production and inventory control and cost analysis systems.

Coordinate and link the computer systems within an organization to increase compatibility so that information can be shared.

Use object-oriented programming languages, as well as client and server applications development processes and multimedia and Internet technology.

Analyze information processing or computation needs and plan and design computer systems, using techniques such as structured analysis, data modeling, and information engineering.

Consult with management to ensure agreement on system principles.

Specify inputs accessed by the system and plan the distribution and use of the results.

Expand or modify system to serve new purposes or improve work flow.

Education and Training (level of education & training required for the occupation):

Associate's degree required for some jobs
Bachelor's degree required for some jobs
Some college, no degree required for some jobs

Median Wages (Virginia)

Hourly: $50.90
Annually: $105,870

Top Industries

Professional, Scientific, and Technical Services
Finance and Insurance

Employment Projection (Virginia; 2022-2032)

37,600

Occupation Title: Computer User Support Specialists

SOC Code:

15-1232.00

At-a-Glance Statistics:

Bright Outlook

Sample Job Titles:

Computer Support Specialist, Computer Tech (Computer Technician), Desktop Support Technician (Desktop Support Tech), Help Desk Analyst, Help Desk Tech (Help Desk Technician), IS Tech (Information Systems Technician), IT Specialist (Information Technology Specialist), IT Support Specialist (Information Technology Support Specialist), IT Tech (Information Technology Technician), Technical Support Specialist

Key Tasks:

Oversee the daily performance of computer systems.

Set up equipment for employee use, performing or ensuring proper installation of cables, operating systems, or appropriate software.

Read technical manuals, confer with users, or conduct computer diagnostics to investigate and resolve problems or to provide technical assistance and support.

Answer user inquiries regarding computer software or hardware operation to resolve problems.

Install and perform minor repairs to hardware, software, or peripheral equipment, following design or installation specifications.

Confer with staff, users, and management to establish requirements for new systems or modifications.

Enter commands and observe system functioning to verify correct operations and detect errors.

Maintain records of daily data communication transactions, problems and remedial actions taken, or installation activities.

Refer major hardware or software problems or defective products to vendors or technicians for service.

Prepare evaluations of software or hardware, and recommend improvements or upgrades.

Education and Training (level of education & training required for the occupation):

Bachelor's degree required for some jobs
Post-secondary certificate required for some jobs
Associate's degree required for some jobs

Median Wages (Virginia)

Hourly: $29.02
Annually: $60,360

Top Industries

Professional, Scientific, and Technical Services
Educational Services

Employment Projection (Virginia; 2022-2032)

53,200

Occupation Title: Information Security Analysts

SOC Code:

15-1212.00

At-a-Glance Statistics:

Bright Outlook

Sample Job Titles:

Information Security Officer, Information Security Specialist, Information Systems Security Analyst, Information Systems Security Officer (ISSO), Information Technology Security Analyst (IT Security Analyst), Network Security Analyst, Security Analyst, Systems Analyst

Key Tasks:

Develop plans to safeguard computer files against accidental or unauthorized modification, destruction, or disclosure and to meet emergency data processing needs.

Monitor current reports of computer viruses to determine when to update virus protection systems.

Encrypt data transmissions and erect firewalls to conceal confidential information as it is being transmitted and to keep out tainted digital transfers.

Perform risk assessments and execute tests of data processing system to ensure functioning of data processing activities and security measures.

Modify computer security files to incorporate new software, correct errors, or change individual access status.

Review violations of computer security procedures and discuss procedures with violators to ensure violations are not repeated.

Document computer security and emergency measures policies, procedures, and tests.

Confer with users to discuss issues such as computer data access needs, security violations, and programming changes.

Monitor use of data files and regulate access to safeguard information in computer files.

Coordinate implementation of computer system plan with establishment personnel and outside vendors.

Education and Training (level of education & training required for the occupation):

53% Bachelor's degree required
23% Post-baccalaureate certificate required
13% Associate's degree required

Median Wages (Virginia)

Hourly: $62.56
Annually: $130,130

Top Industries

Professional, Scientific, and Technical Services
Finance and Insurance

Employment Projection (Virginia; 2022-2032)

16,800

Occupation Title: Miscellaneous Assemblers and Fabricators

SOC Code:

51-2099.00

At-a-Glance Statistics:

None

Sample Job Titles:

None

Key Tasks:

None

Education and Training (level of education & training required for the occupation):

None

Median Wages (Virginia)

Hourly: $17.51
Annually: $36,420

Top Industries

Manufacturing

Administrative and Support Services

Employment Projection (Virginia; 2022-2032)

141,400

Occupation Title: Heavy and Tractor-Trailer Truck Drivers

SOC Code:

53-3032.00

At-a-Glance Statistics:

Bright Outlook

Sample Job Titles:

CDL Driver (Commercial Driver's License Driver), Driver, Line Haul Driver, Log Truck Driver, Over the Road Driver (OTR Driver), Production Truck Driver, Road Driver, Semi Truck Driver, Tractor Trailer Driver, Truck Driver

Key Tasks:

Check all load-related documentation for completeness and accuracy.

Inspect loads to ensure that cargo is secure.

Check vehicles to ensure that mechanical, safety, and emergency equipment is in good working order.

Crank trailer landing gear up or down to safely secure vehicles.

Obtain receipts or signatures for delivered goods and collect payment for services when required.

Maintain logs of working hours or of vehicle service or repair status, following applicable state and federal regulations.

Read bills of lading to determine assignment details.

Report vehicle defects, accidents, traffic violations, or damage to the vehicles.

Perform basic vehicle maintenance tasks, such as adding oil, fuel, or radiator fluid, performing minor repairs, or washing trucks.

Couple or uncouple trailers by changing trailer jack positions, connecting or disconnecting air or electrical lines, or manipulating fifth-wheel locks.

Education and Training (level of education & training required for the occupation):

54% High school diploma or equivalent required
26% Less than high school diploma required.
19% Post-secondary certificate required

Median Wages (Virginia)

Hourly: $23.31
Annually: $48,490

Top Industries

Transportation and Warehousing
Wholesale Trade

Employment Projection (Virginia; 2022-2032)

241,200

Occupation Title: Molders, Shapers, and Casters, Except Metal and Plastic

SOC Code:

51-9195.00

At-a-Glance Statistics:

None

Sample Job Titles:

Bed Laborer, Caster, Fabricator, Injection Molding Machine Operator, Machine Operator, Mold Mechanic, Molder, Molding Line Operator, Press Operator

Key Tasks:

Read work orders or examine parts to determine parts or sections of products to be produced.

Trim or remove excess material, using scrapers, knives, or band saws.

Brush or spray mold surfaces with parting agents or insert paper into molds to ensure smoothness and prevent sticking or seepage.

Engrave or stamp identifying symbols, letters, or numbers on products.

Assemble, insert, and adjust wires, tubes, cores, fittings, rods, or patterns into molds, using hand tools and depth gauges.

Clean, finish, and lubricate molds and mold parts.

Separate models or patterns from molds and examine products for accuracy.

Set the proper operating temperature for each casting.

Load or stack filled molds in ovens, dryers, or curing boxes, or on storage racks or carts.

Align and assemble parts to produce completed products, using gauges and hand tools.

Education and Training (level of education & training required for the occupation):

Most require a high school diploma.

Median Wages (Virginia)

Hourly: $18.31
Annually: $38,080

Top Industries

Manufacturing

Employment Projection (Virginia; 2022-2032)

5,800

Occupation Title: Welders, Cutters, Solderers, and Brazers

SOC Code:

51-4121.00

At-a-Glance Statistics:

None

Sample Job Titles:

Assembly Line Brazer, Brazer, Fabrication Welder, Maintenance Welder, MIG Welder (Metal Inert Gas Welder), Solderer, TIG Welder (Tungsten Inert Gas Welder), Welder, Welder Fitter, Wirer

Key Tasks:

Operate safety equipment and use safe work habits.

Examine workpieces for defects and measure workpieces with straightedges or templates to ensure conformance with specifications.

Weld components in flat, vertical, or overhead positions.

Detect faulty operation of equipment or defective materials and notify supervisors.

Recognize, set up, and operate hand and power tools common to the welding trade, such as shielded metal arc and gas metal arc welding equipment.

Select and install torches, torch tips, filler rods, and flux, according to welding chart specifications or types and thicknesses of metals.

Mark or tag material with proper job number, piece marks, and other identifying marks as required.

Determine required equipment and welding methods, applying knowledge of metallurgy, geometry, and welding techniques.

Prepare all material surfaces to be welded, ensuring that there is no loose or thick scale, slag, rust, moisture, grease, or other foreign matter.

Align and clamp workpieces together, using rules, squares, or hand tools, or position items in fixtures, jigs, or vises.

Education and Training (level of education & training required for the occupation):

54% High School diploma or equivalent required
21% Less than high school diploma required
12% Post-secondary certificate required

Median Wages (Virginia)

Hourly: $24.54
Annually: $51,030

Top Industries

Manufacturing
Construction

Employment Projections (Virginia; 2022-2032):

42,600

Appendix B: NAICS Codes Used in Industry Analysis

Aquaculture Cluster NAICS

114111	Finfish Fishing
114112	Shellfish Fishing
114119	Other Marine Fishing
311710	Seafood Product Preparation and Packaging

IT Cluster NAICS

511110	Newspaper Publishers
511120	Periodical Publishers
511130	Book Publishers
511140	Directory and Mailing List Publishers
517410	Satellite Telecommunications
518210	Data Processing, Hosting, and Related Services
519110	News Syndicates
519120	Libraries and Archives
519130	Internet Publishing and Broadcasting and Web Search Portals
519190	All Other Information Services

Manufacturing Cluster NAICS

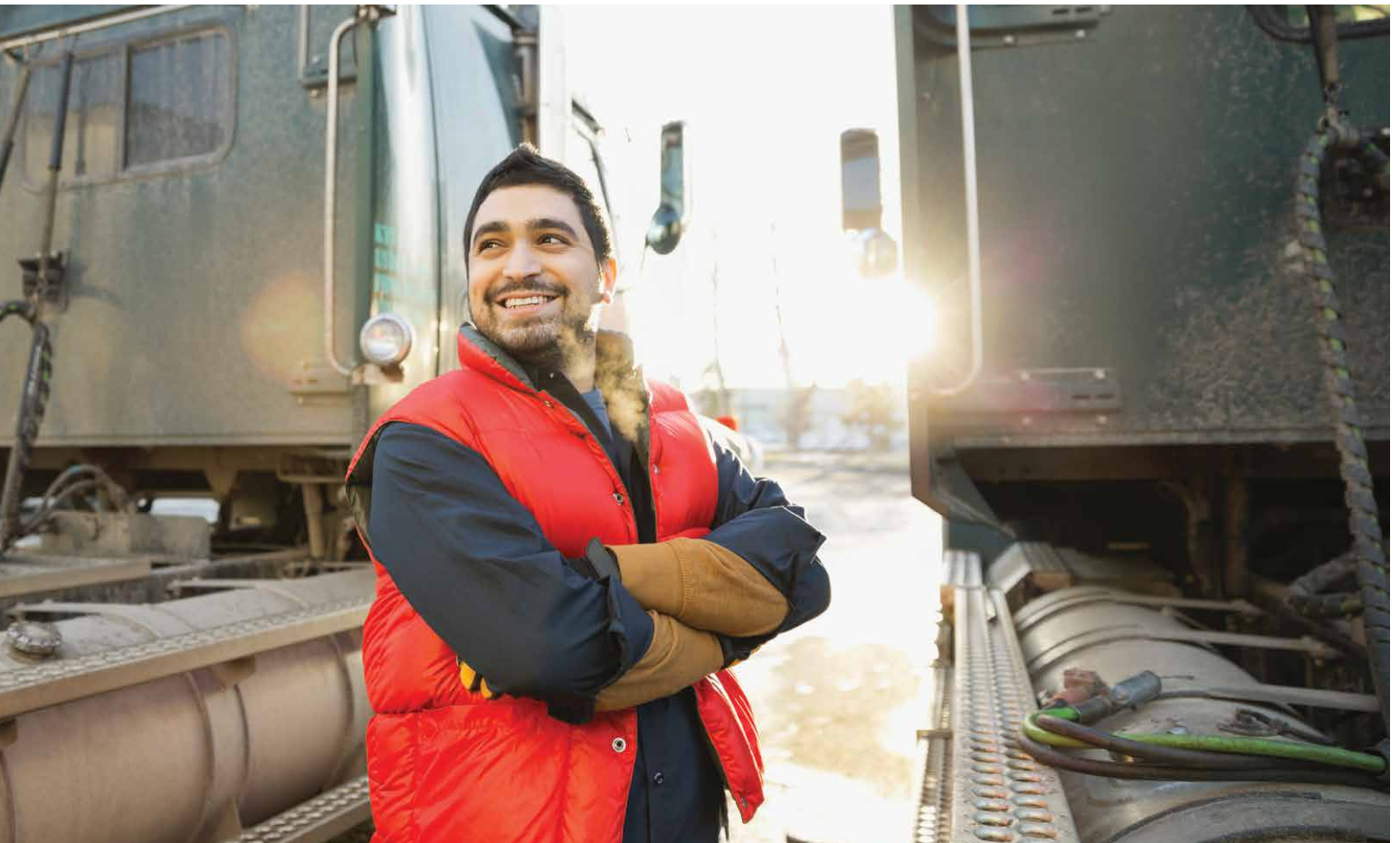|	
314910	Textile Bag and Canvas Mills
314994	Rope, Cordage, Twine, Tire Cord, and Tire Fabric Mills
314999	All Other Miscellaneous Textile Product Mills
326140	Polystyrene Foam Product Manufacturing
326199	All Other Plastics Product Manufacturing
327320	Ready-Mix Concrete Manufacturing
327390	Other Concrete Product Manufacturing
332312	Fabricated Structural Metal Manufacturing
332322	Sheet Metal Work Manufacturing
332323	Ornamental and Architectural Metal Work Manufacturing
332994	Small Arms, Ordnance, and Ordnance Accessories Manufacturing

332999	All Other Miscellaneous Fabricated Metal Product Manufacturing
333914	Measuring, Dispensing, and Other Pumping Equipment Manufacturing
333922	Conveyor and Conveying Equipment Manufacturing
333923	Overhead Traveling Crane, Hoist, and Monorail System Manufacturing
333991	Power-Driven Handtool Manufacturing
333993	Packaging Machinery Manufacturing
334220	Radio and Television Broadcasting and Wireless Communications Equipment Manufacturing
334290	Other Communications Equipment Manufacturing
334413	Semiconductor and Related Device Manufacturing
334418	Printed Circuit Assembly (Electronic Assembly) Manufacturing
336310	Motor Vehicle Gasoline Engine and Engine Parts Manufacturing
336340	Motor Vehicle Brake System Manufacturing
336350	Motor Vehicle Transmission and Power Train Parts Manufacturing
336390	Other Motor Vehicle Parts Manufacturing
337110	Wood Kitchen Cabinet and Countertop Manufacturing
337121	Upholstered Household Furniture Manufacturing
339112	Surgical and Medical Instrument Manufacturing
339114	Dental Equipment and Supplies Manufacturing
339115	Ophthalmic Goods Manufacturing
339910	Jewelry and Silverware Manufacturing
339950	Sign Manufacturing
339991	Gasket, Packing, and Sealing Device Manufacturing
339992	Musical Instrument Manufacturing
339999	All Other Miscellaneous Manufacturing

Endnotes

1   Iacurci, G. (2023, February 1). *2022 was the 'real year of the Great Resignation,' says economist.* Personal Finance. https://www.cnbc.com/2023/02/01/why-2022-was-the-real-year-of-the-great-resignation.html.

2   The Manufacturing Institute (2021). *Creating Pathways for Tomorrow's Workforce Today: Beyond Reskilling in Manufacturing.* https://themanufacturinginstitute.org/research/creating-pathways-for-tomorrows-workforce-today-beyond-reskilling-in-manufacturing/.

3   Stephanie, F., & Lucy, I. (2023, November 14). *A National Crisis by the Numbers.* https://www.uschamber.com/workforce/america-works-data-center.

4   Zickuhr, K. (2021, May 31). *Is there a skilled labor shortage? The economic evidence on skills gap and labor shortage concerns.* https://equitablegrowth.org/is-there-a-skilled-labor-shortage-the-economic-evidence-on-skills-gap-and-labor-shortage-concerns/.

5   Hudson, K. (2019). *Virginia Shellfish Aquaculture Situation and Outlook Report.* Virginia Institute of Marine Science. https://www.vims.edu/research/units/centerspartners/map/_docs/docs_aqua/mrr-2019-8.pdf.

6   Meyer, K., Bird, K., & Castleman, B. (2022). *Stacking the Deck for Employment Success: Labor Market Returns to Stackable Credentials.* (EdWorkingPaper: 20-317). Retrieved from Annenberg Institute at Brown University: https://doi.org/10.26300/jzq6-2y24.

7   Measures should incorporate ideas such as those provided here: https://bipartisanpolicy.org/blog/workforce-pell-grants-moving-forward-with-accountability/.

8   Lightcast, 2022 data.

9   Lightcast, 2022 data.

10 Lightcast, 2022 data.

11 Virginia Department of Education (2022-23). *Annual Reports of Graduates and Completers.* https://www.doe.virginia.gov/data-policy-funding/data-reports/statistics-reports/graduation-completion-dropout-postsecondary-data/high-school-graduates-completers/high-school-graduates-completers-archive-data.

12 United States Census Bureau (2023, December 7). *American Community Survey.* United States Census Bureau 5-Year Data (2009-2022). https://www.census.gov/data/developers/data-sets/acs-5year.html.

13 Casselman, B., & Smialek, J. (2023, November 12). *Vermont May Be the Face of a Long-Term U.S. Labor Shortage.* https://www.nytimes.com/2023/11/12/business/economy/vermont-labor-shortage.html?smid=url-share.

14 Virginia Initiative for Growth and Opportunity (n.d.). *Region 6 Information.* Retrieved November 28, 2023, from https://govirginia.org/regions/six/.

15 https://www.dhcd.virginia.gov/pdcs.

16 Goncalves, F. (2022, November 7). *Economic contributions of the Virginia seafood industry - Fact Sheet.* https://www.pubs.ext.vt.edu/AAEC/aaec-303/aaec-303.html.

17 Virginia Marine Resources Commission (2023, August 22). *Shellfish Aquaculture, Farming and Gardening.* https://www.mrc.virginia.gov/Shellfish_Aquaculture.shtm.

18 Chesapeake Bay Foundation (n.d.). *Sea-Level Rise.* Retrieved September 5, 2023, from https://www.cbf.org/issues/climate-change/sea-level-rise.html#:~:text=In%20fact%2C%20coastal%20Virginia%20has,the%20land%20is%20also%20sinking.

19 Middle Peninsula Planning District Commission (2023, September 15). *Public Access Authority.* https://www.mppdc.com/index.php/service-centers/coastal/paa.

20 Maine Aquaculture Association (2021, October 19). *Occupational Standards for Maine Aquaculture Training Providers.* https://maineaqua.org/education/.

21 Maine Aquaculture Association (2021, October 1). *Shellfish Aquaculture Career Pathway.* https://maineaqua.org/wp-content/uploads/2021/10/ME-Shellfish-Career-Map.pdf.

22 Fredericksburg Regional Chamber of Commerce (2023, January 31). *RCC and Virginia Tech Open their Aquaculture Career Training Program for High School Students.* https://www.fredericksburgchamber.org/rcc-and-virginia-tech-open-their-aquaculture-career-training-program-for-high-school-students/.

23 Fredericksburg Regional Alliance (n.d.). *Information Technology.* Retrieved August 30, 2023, from https://fredregion.com/information-technology/.

24 NOTE: This data spans beyond firms categorized as Information and Data Centers using GO Virginia NAICS to define the priority cluster.

25 Fredericksburg Regional Alliance at the University of Mary Washington (2020, January 13). *Industry Cluster Study - Fredericksburg Region.* https://fredregion.com/wp-content/uploads/2021/03/FRA-Industry-Cluster-Analysis-2021.pdf.

26 Rule, Z. (2023, January 5). *Job Skills of 2023 Report.* https://www.coursera.org/campus/resources/job-skills-2023.

27 Coursera (n.d.). *IT Certification Roadmap: A Guide.* Retrieved October 1, 2023, from https://www.coursera.org/articles/it-certification-roadmap-a-guide.

28 Coursera (n.d.). *10 Essential IT Certifications for 2023.* Retrieved October 1, 2023, from https://www.coursera.org/articles/essential-it-certifications-entry-level-and-beginner.

29 US Bureau of Labor Statistics (n.d.). C*omputer and Information Technology Occupations.* Occupational Outlook Handbook. Retrieved September 23, 2023, from https://www.bls.gov/ooh/computer-and-information-technology/.

30 U.S. Department of Labor (n.d.). *Information Technology.* O*Net Online. Retrieved September 27, 2023, from https://www.onetonline.org/find/career?c=11.

31 Coursera (n.d.). *7 IT Career Paths and How to Get Started in 2023.* Retrieved October 1, 2023, from https://www.coursera.org/articles/it-career-paths-how-to-get-started.

32 U.S. Bureau of Labor Statistics (n.d.). Information Security Analysts. *Occupational Outlook Handbook.* Retrieved September 23, 2023, from https://www.bls.gov/ooh/computer-and-information-technology/information-security-analysts.htm.

33 Data Center Dynamics (2023, June 1). *10m sq ft: Amazon files for four data center campuses in Virginia's Spotsylvania and Caroline Counties.* Data Center Dynamics. https://www.datacenterdynamics.com/en/news/10m-sq-ft-amazon-files-for-four-data-center-campuses-in-virginias-spotsylvania-and-caroline-counties/.

34 U.S. Bureau of Labor Statistics (n.d.). *Manufacturing: NAICS 31-33.* Industries at a Glance. Retrieved October 1, 2023, from https://www.bls.gov/iag/tgs/iag31-33.htm.

35 The Free Lance-Star (2019, April 19). *McKesson is coming to town.* Fredericksburg.com. https://fredericksburg.com/news/local/mckesson-is-coming-to-town/article_0290f3e2-0822-59b4-80b1-add2bafc90a3.html.

36 Virginia Business (2023, October 31). *Food/bev distributor opens $275M Caroline County center.* https://www.virginiabusiness.com/article/food-bev-distributor-opens-275m-caroline-county-center/.

37 MC Dean (2022, December 8). *M.C. Dean Announces Third Phase Expansion in Caroline County, Virginia.* Caroline County. https://co.caroline.va.us/DocumentCenter/View/6832/M-C-Dean-12-6-22-Third-Building-Announcement-Approved.

38 Wellener, P. (2021, May 4). *Creating pathways for tomorrow's workforce today: Beyond reskilling in manufacturing.* Deloitte Insights. https://www2.deloitte.com/us/en/insights/industry/manufacturing/manufacturing-industry-diversity.html.

39 Kumar, P. (2019, February 28). *Knowledge and Skill-set for Industrial Automation.* LinkedIn Pulse. https://www.linkedin.com/pulse/knowledge-skill-set-industrial-automation-dr-parmod-kumar.

40 Advance CTE (n.d.). M*anufacturing Career Clusters.* Retrieved October 1, 2023, from https://careertech.org/what-we-do/career-clusters/manufacturing/.

41 Manufacturing USA (n.d.). *Pathways to Manufacturing Careers.* Retrieved October 5, 2023, from https://www.manufacturingusa.com/sites/manufacturingusa.com/files/05_Pathways%20to%20Manufacturing%20Careers_WEB_withBkgd_4000px.png.

Notes