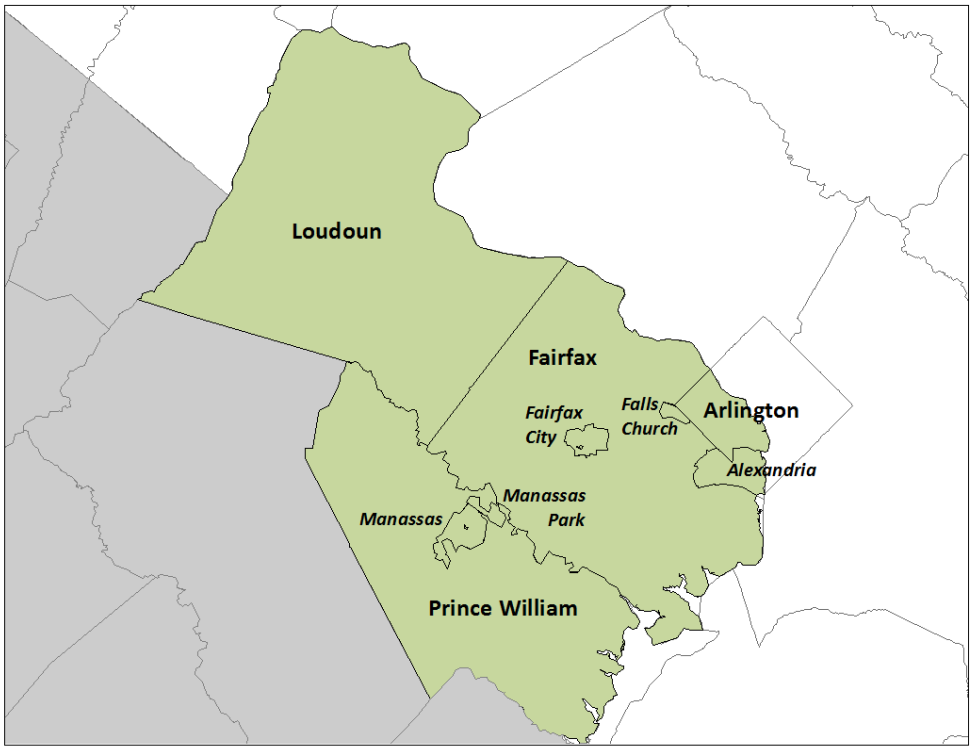

Economic Growth and Diversification Plan

September 6, 2017

Prepared for:

GO Northern Virginia Regional Council (Region 7)

GO VIRGINIA | VIRGINIA INITIATIVE FOR GROWTH & OPPORTUNITY IN EACH REGION

Prepared by:

The George Mason University Center for Regional Analysis

GEORGE MASON UNIVERSITY | CENTER FOR REGIONAL ANALYSIS

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Plan-In-Brief

The Virginia Initiative for Growth and Opportunity in Each Region (GO Virginia) is a public-private approach to boosting economically-sustainable growth in the Commonwealth. This initiative will promote collaborative, regional initiatives to expand economic opportunity; grow and diversify the economy; and increase career readiness in high-wage industries. The Initiative is specifically geared to incentivize inter-jurisdiction cooperation. Guided by a regional council made up of business and community leaders, education institutions, economic and workforce development professionals, and elected officials, the following represents the Economic Growth and Diversification Plan for the Northern Virginia (Region 7) area that includes Arlington County, Fairfax County, Loudoun County, Prince William County, and the independent cities of Alexandria, Fairfax City, Falls Church, Manassas, and Manassas Park.

This plan—developed by the Center for Regional Analysis (CRA) at George Mason University on behalf of the GO Northern Virginia Regional Council (Region 7)—describes the key economic challenges facing the region and articulates the priority goals established by the Council that will guide efforts to alter the region's economic trajectory. This report is the culmination of a highly intense, but collaborative effort between the Council, CRA, and a wide range of community stakeholders to draft Northern Virginia's Economic Growth and Diversification Plan for review and approval by the GO Virginia board.

Key Characteristics of the Northern Virginia Economy

- The Northern Virginia regional economy drives much of the state's economy representing about one-third of all Commonwealth economic output in 2015.
- The region is home to more than 2.46 million residents, 30 percent of the state's population.
- The region includes Loudoun, the fastest growing county in the state at 31 new residents per day, though overall the region's population growth rates have slowed in recent years.
- Northern Virginia is the wealthiest region in the state with per capita annual income at $70,571—a figure 36 percent higher than the state and 47 percent higher than the nation.
- The region's key economic development assets include:
    - Highly educated workforce with 57 percent of the working age population possessing at least a bachelor's degree.
    - Major federal government agencies that provide almost 80,000 direct jobs.
    - $37.8 billion in federal procurement spending in Region 7 for FY2016.
    - Key federal research centers such as Defense Advanced Research Projects Agency, Office of Naval Research, Air Force Office of Scientific Research, and the National Science Foundation, plus nine Federally Funded Research and Development Centers.
    - Campuses of three Research 1 Universities (GMU, VT, UVA)
    - Emerging bio-medical research centers such as Inova Center for Personalized Medicine and Janelia Research Campus.
    - Largest number of computer security analysts in the nation.

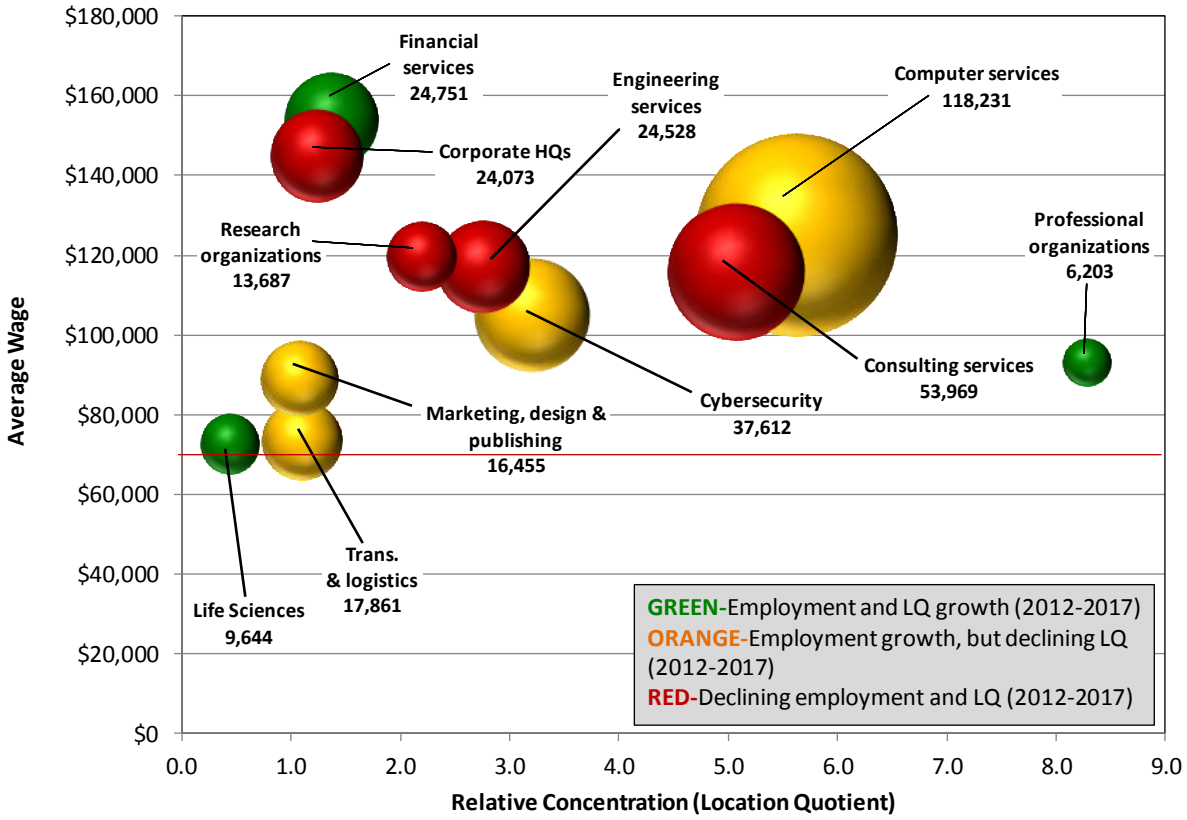
- Region 7 has significant economic challenges:
    - An over-reliance on federal spending has caused the region to be particularly susceptible to sequestration resulting in slower economic growth over the past several years, especially in comparison with other major metropolitan areas in the nation. Annual federal spending in Region 7 remains about $7 billion lower than the 2010 peak.
    - Too much of the region's recent job growth has been concentrated in non-traded sectors of the economy, which has caused wage growth to be much lower than either the state or the nation.
    - Even with relatively high per capita income, Region 7 has a very high cost of living with housing costs being 70 percent higher than the national average. This has contributed to domestic net out-migration of the Northern Virginia population in each of the three most recent annual reporting periods.
    - The Department of Defense is expanding their procurement of technology services to firms more likely located on the west coast.
    - The region does well in creating innovative and entrepreneurial firms, but the large majority of the most successful of those firms are eventually sold to out-of-area companies.

Economic and Workforce Analysis

The economic and workforce analysis component of the planning process developed data focused on three dimensions: industrial clusters that represent qualified industries (high wage, traded sectors, growth opportunities); occupations critical to the growth of targeted clusters; and the skills sets required for these occupations. Based on data analysis and consultation with the Region 7 Council, the research team examined several industry clusters regarding wages, number of jobs, job growth trends, and competitive position based on national location quotients. The figure below summarizes these data and shows that several of the most valuable and important industry clusters in Northern Virginia are not growing at a competitive rate.

- The region's three largest clusters—computer services, consulting services, and cybersecurity—are all heavily influenced by government contracting and have not fully recovered from the consequences of sequestration.
- Only three clusters—financial services, professional organizations, and life sciences—experienced growth in both employment and competitive positioning.
  A key commonality among targeted clusters is the need for significant numbers of capable technology workers. Computer-related occupations represent a substantial share of total jobs in several of the Region's top clusters:
    - 58.1 percent of all jobs in the computer services cluster,
    - 13.0 percent of research organization jobs,
    - 13.0 percent of jobs at corporate headquarters,
    - 10.0 percent of engineering services employment, and
    - 9.6 percent of all consulting jobs.

Northern Virginia's Industry Clusters



Source: Chmura Economics JobsEQ, 2017 Q1; Clusters defined by US Cluster Mapping Project

- Information security analysts are more than six times more concentrated in Region 7 than nationally.
- Research performed by Northern Virginia Community College shows that during the second

Computer occupations in Northern Virginia

SOC	Title	Employment	Location Quotient	Average Annual Wages	Annual emp. change (12-17)*	Projected annual emp. change (17-22)	Current Job Postings#
15-1132	Software Developers, Applications	19,875	2.76	$114,100	0.1%	2.3%	5,188
15-1133	Software Developers, Systems Software	14,937	3.95	$121,100	-0.3%	2.1%	95
15-1121	Computer Systems Analysts	14,932	2.92	$102,300	0.2%	2.5%	523
15-1151	Computer User Support Specialists	11,004	2.10	$61,000	0.2%	2.0%	4,086
15-1199	Computer Occupations, All Other	9,859	4.26	$109,500	-0.6%	0.6%	6,981
15-1142	Network & Computer Systems Admins.	9,591	2.89	$102,900	0.1%	1.6%	4,307
15-1131	Computer Programmers	6,721	2.67	$98,400	0.2%	-1.8%	94
15-1122	Information Security Analysts	5,310	6.08	$108,400	0.0%	2.4%	7,022
15-1143	Computer Network Architects	5,181	3.63	$118,000	-0.2%	1.4%	194
15-1152	Computer Network Support Specialists	4,193	2.55	$79,500	-0.2%	1.1%	2

Source: Chmura Economics, JobsEQ Q1 2017

**Average of the 4 quarters ending in Q1 2012, and the 4 quarters ending in Q1 2017*

Data represent found online ads active between 5/13/17 and 6/13/17

quarter of 2017, there were almost 9,500 total cyber positions being advertised in Northern Virginia. The table below offers data on key technology jobs in Northern Virginia.

- The Northern Virginia Technology Council has identified five hard-to-fill competency areas: Big data and analytics, cyber security and privacy, data center and cloud infrastructure, network systems, and programming and software development.
    - The NVTA study also noted that soft skills (e.g., written and verbal communication, problem solving and critical thinking, and relationship management) are vital considerations.
    - Many Northern Virginia technology jobs require U.S. citizenship, security clearances, and 4-year degrees to meet federal specifications.
- Increasing the number of degree completers is a necessary step in addressing the region's shortage of technology workers, but this will not sufficiently address the immediate challenge facing the region. Industry-recognized credentials are one way in which workers can demonstrate to employers that they possess these skills, and they do not need to spend 2 or 4 years at colleges or universities to obtain these skills.
- While the region will continue to attract talent, the growing importance of industry-recognized skills presents opportunities for ***native Northern Virginia workers*** through short courses, boot camps, and similar existing programs. These also include programs targeted to exiting military personnel.

Priority Goals

Based on the information briefly described above, input from regional stakeholders, and a highly collaborative and deliberative process, the Region 7 Council identified seven strategic priority industry clusters for the Economic Growth and Diversification Plan.

The Key Industry Clusters that will serve as a focus of the Region 7 Economic Growth and Diversification Plan implementation include:

- **Computer Services**
- **Cybersecurity**
- **Consulting Services**
- **Financial Services**
- **Engineering Services**
- **Research Organizations**
- **Life Sciences**

Scaling up and enhancing the competitive position of these industry clusters will require collaborative action that benefits jurisdictions throughout Northern Virginia, and the Commonwealth more generally. Given its regional challenges, the scope of the GO Virginia mission, and the scale of the available resources, the GO Northern Virginia Regional Council will consider funding projects that achieve the region's priority goals:

1. **Strengthening Northern Virginia's technology workforce,**
2. **Accelerating the development of 'growth' companies, and**

3. **Enhancing technology transfer and the commercialization of intellectual property from the region's research centers and institutions.**

These consensus goals will inform the regional council's decision making process, but the council will also consider any high impact project that contributes to the overarching GO Virginia goal of achieving private-sector driven job growth in high-wage sectors through interjurisdictional cooperation.

The descriptions below identify the types of strategies the regional council will consider, prospective performance measures, and potential partners and sources of match funding. The Region 7 Council identified a strong preference for high-impact projects, meaning that there will likely be few total projects, but that each successful applicant will receive substantial support. However, the plan does allow for meaningful smaller projects that may represent pilot efforts for innovative programs that can be tested with fewer initial funds and supported more fully after proof-of-concept. Therefore, we have provided a scale to indicate the expected budget required to complete each strategy.

- **$**=Projects requiring less than $100,000 of GO Virginia funding
- **$$**=Projects requiring between $100,000 and $500,000 of GO Virginia funding
- **$$$**=Projects requiring more than $500,000 of GO Virginia funding

It will be the responsibility of the proposers to describe the specific project elements and how their proposed initiatives will benefit multiple jurisdictions in Northern Virginia, or multiple jurisdictions throughout the Commonwealth. They will also be required to identify and describe how they will track outcome and output measures, and gain commitments from key partners. In some instances, the proposed projects will involve scaling up current, ongoing initiatives so that they can serve more participants or more jurisdictions. In these instances, proposals will benefit by being able to demonstrate and quantify the impacts of their existing efforts.

The projects that are ultimately funded will be determined by the quality of the proposals and the extent to which they align with the regional priorities. The next section lays out the Council's goals and will guide project funding decisions.

Goal #1: Strengthen Northern Virginia's Technology Workforce

The region will produce technology workers, both in terms of quality and quantity, needed to grow and enhance the competitiveness of regional technology firms.

Challenge: The number of workers entering technology-related occupations is insufficient to meet regional demand

- Efforts should include preparing workers who are just entering the labor force and those switching careers—to choose technology-related careers.
- Look to leverage existing non-degree training and certification programs, expanding apprenticeship and internship opportunities, and programs supporting exiting military, where possible.
- Include incumbent worker training opportunities that are relevant, accessible, and affordable.

Strategies and Expected Outcomes

- **Strategy 1.1:** Strengthen and expand non-degree programs (e.g., certifications and credentials) that allow workers to enter and advance in technology careers.
    - *Performance measures:* Certifications and credentials granted
    - *Funding required:* $-$$$

- **Strategy 1.2:** Establish and expand internships, apprenticeships and other work-based learning opportunities that prepare workers and provide them with experience in technology careers.
    - *Performance measures:* Program placements, completions, placements in permanent full-time positions
    - *Funding required:* $-$$$

- **Strategy 1.3:** Strengthen and expand programs that prepare veterans and exiting military personnel with the skills and certifications necessary to enter technology careers.
    - *Performance measures:* Program placements, completions, placements in permanent full-time positions
    - *Funding required:* $-$$

- **Strategy 1.4:** Identify and develop programs recognizing career pathways that can guide current and future technology workers through an articulated series of educational programs (including credit and non-credit programs from both public and private training providers) that will allow them to advance their careers from entry-level to middle-skill positions and on through to more leadership positions.
    - *Performance measures:* Program participants, cluster employment, cluster average wages.
    - *Funding required:* $-$$

- **Strategy 1.5:** Strengthen and expand technology-oriented incumbent worker training programs that keep the workforce of small- and medium-sized firms (SMEs) current and competitive.
    - *Performance measures:* Number of SMEs participating in incumbent worker training programs, jobs created/retained due to training
    - *Funding required:* $$

- **Strategy 1.6:** Organize regional cluster networks to promote collaborative workforce development and training solutions.
    - *Performance measures:* Participating companies, cluster employment
    - *Funding required: $*

- **Strategy 1.7:** Develop a regional data system to continuously track and monitor the availability of technology workers with the region's education and training pipeline.
    - *Performance measures:* Students and workers in education and training pipeline, number of technology workers.
    - *Funding required: $*

Potential partners:

- Public school systems, particularly Career and Technical Education Programs
- Regional Workforce Boards
- Colleges and universities (e.g., George Mason University, Northern Virginia Community College, etc.)
- Industry groups (e.g., Northern Virginia Technology Council)
- Private and non-profit training providers
- Potential partners will be both regional and cross-regional entities, especially where project can leverage existing regional and state-level collaborations

Potential sources of matching funds:

- Workforce Innovation and Opportunity Act funding
- Local jurisdictions
- Regional foundations
- Private sector companies
- Industry groups and associations

Goal #2: Accelerate the development of 'growth companies'

Regional firms poised for growth will have ready access to the resources, facilities, and expertise necessary to grow their business and expand their markets.

Challenge: Many companies lack awareness of, and access to, the resources, facilities and expertise that would allow them to grow and expand in Northern Virginia.

- Growth companies are established small- and medium-sized firms with a proven track record of growth. By definition, these do not include individual entrepreneurs or firms that are still in their initial product development stage.
- Programs could focus on funding for expansion, research and development, and commercialization; non-financial support programs related to business planning, regulatory requirements, modern business processes or exporting; or initiatives that provide business owners easy and affordable access to experts providing customized competitive market and business intelligence, business processes, and innovation training and information.
- The region possesses many programs, resources and facilities that can help growth companies enhance their existing success that can be leveraged with GO Virginia grants.

Strategies and Expected Outcomes

- **Strategy 2.1:** Build greater awareness and usage of existing business support programs and resources; expand these programs to include more companies from multiple Northern Virginia jurisdictions.
    - *Performance measures:* Increased participation in existing or new programs targeted to Growth Companies in priority clusters
    - *Funding required:* $-$$

- **Strategy 2.2:** Support the expansion of programs designed to assist small- and medium-sized businesses (SMEs) enter new markets, both domestically and internationally.
    - *Performance measures:* Companies served, new sales by small- and medium-sized establishments (SMEs) in target clusters
    - *Funding required:* $-$$

- **Strategy 2.3:** Develop economic gardening programs that provide established small businesses (in the priority clusters) with customized competitive market and business intelligence on markets, customers, competitors, business processes, and innovation.
    - *Performance measures:* Change in number of jobs and sales in participating firms
    - *Funding required:* $$

- **Strategy 2.4:** Conduct regional survey/census of growth firms and business support programs.
    - *Performance measures:* Number of firms participating in survey, Number of new technology companies in the region
    - *Funding required:* $

Potential partners:

- Business support providers (e.g., Mason Enterprise Center, Genedge Alliance)
- Industry groups (e.g., Northern Virginia Technology Council)
- Economic Development Organizations
- Chambers of Commerce
- Area incubators and accelerators (e.g., Capital Post, 1776)
- Universities (e.g., George Mason University, Marymount University)
- Relevant state organizations (e.g., Virginia Economic Development Partnership, Center for Innovative Technology)

Potential sources of matching funds:

- Local jurisdictions
- Industry groups and associations
- Private sector companies

Goal #3: Enhance technology transfer and commercialization from research centers and institutions

The region will have effective processes and sufficient resources to commercialize the innovative technologies developed in its public and private research centers and institutions.

Challenge: The region's innovation ecosystem remains highly dependent on the federal government and is not fully maximizing its innovative assets.

- Northern Virginia's innovation ecosystem is quite different from other technology intensive economic regions in that Region 7 businesses often grow without venture capital and are highly involved in government contracting and services.
- The region has a wealth of research assets ranging from post-secondary research institutions, bio-medical research campuses, and vital federal research agencies. The region is also unique in that it is home to nine of the nation's 43 Federally Funded Research and Development Centers.
- Leveraging funding that provide more early-stage capital for small businesses looking to develop and commercialize new, innovative technologies will enhance opportunities for business growth and industrial diversification. This could include federal programs (Small Business Innovation Research, Small Business Technology Transfer Research) and Innovation Voucher-type programs.
- Sustainable success will also require connecting innovators and inventors to entrepreneurs and experienced business people.

Strategies and Expected Outcomes

Strategy 3.1: Provide counseling, mentoring and other instructional programs for technology and venture-backed startups, to facilitate innovators bringing new technologies to the marketplace.

- *Performance measures:* Participating companies, sales from commercialized technologies, jobs created/retained
- *Funding required:* $$-$$$

Strategy 3.2: Create an innovation voucher program that would provide small, established technology companies with discreet amounts of funding ($5,000 to $15,000) to access not-for-profit expertise from universities, national laboratories, and/or nonprofit research centers. These grants would enable companies to prepare assessments of research needs, analyze technology transfer options or identify technology solutions.

- *Performance measures:* Vouchers granted, sales resulting from new technologies, jobs created/retained
- *Funding required:* $$-$$$

Strategy 3.3: Provide grants to encourage companies to prepare and submit Small Business Innovation Research (SBIR) and Small Business Technology Transfer Research (STTR) grant applications.

- *Performance measures:* Companies assisted, successful grant applications
- *Funding required:* $-$$

Strategy 3.4: Support executive-in-residence programs to connect emerging technology companies with experienced technology industry executives. These executives will embed with emerging firms to lead them through the commercialization and capital fundraising process.

- *Performance measures:* Companies assisted, jobs created in assisted firms
- *Funding required:* $$-$$$

Potential partners:

- Business support providers (e.g., Mason Enterprise Center, Genedge Alliance)
- Industry groups (e.g., Northern Virginia Technology Council)
- Private sector companies
- Area incubators and accelerators (e.g., Capital Post, 1776, Inova Personalized Health Accelerator)
- Locally-based Federally Funded Research and Development Centers (e.g., Rand Corporation, MITRE)
- Research universities (e.g., George Mason University, Virginia Tech, George Washington University, University of Virginia)
- Bio-medical research campuses (e.g., Inova Center for Personalized Health, Janelia Research Campus)
- Federal research agencies (e.g., DARPA, NSF, USPTO)

Potential sources of matching funds:

- Local jurisdictions
- Industry groups and associations

Implementing the Plan

As the Northern Virginia's GO Virginia efforts move from the planning phase to implementation, the regional council will undertake several activities to advance it efforts and achieve its goals. These activities will include:

- Ongoing outreach,
- Encouraging partnerships,
- Increasing administrative efficiencies,
- Laying the groundwork for financial sustainability,
- Setting procedures for effective evaluation,
- Promoting successful investments, and
- Routinely revisiting and adapting the plan.

The early stages of GO Virginia implementation will be critical for the effort's long-term success. Initial success will largely be defined by the projects in which the Council invests. However, in order to be a sustainable entity and perceived as something more than just a source of state funding, these initial projects must effectively and demonstrably address the region's priority goals, and the regional council itself must demonstrate that it has been an effective steward of the public's dollars. Early tangible results will go a long way to determining future sustainability.

Introduction

The Virginia Initiative for Growth and Opportunity in Each Region (GO Virginia) is a public-private approach to boosting economically-sustainable growth in the Commonwealth.[1] This initiative will promote collaborative, regional initiatives to expand economic opportunity, grow and diversify the economy, and increase career readiness in high-wage industries. The unique, and exciting feature of GO Virginia is the state providing direct funding to leverage cross-jurisdictional and interregional cooperation on locally and regionally developed programs, while simultaneously recognizing the unique economic characteristics of Virginia regions.

Lead by some of the Commonwealth's premier business leaders, the GO Virginia Board, with the support of the Virginia Department of Housing and Community Development (DCHD), developed the framework for regional councils to guide the planning and manage the recruitment and vetting of programs to be supported by GO Virginia funds. Each regional council is made up of business and community leaders, education institutions, economic and workforce development professionals, and elected officials who are guiding the development of Economic Growth and Diversification Plans that lay out how regional and interregional GO Virginia initiatives and projects will be implemented.

The GO Virginia board, in consultation with state and local leaders, identified the geographic boundaries for each GO Virginia region. The Northern Virginia (Region 7) GO Virginia region includes Arlington County, Fairfax County, Loudoun County, Prince William County, and the independent cities of Alexandria, Fairfax City, Falls Church, Manassas, and Manassas Park (Figure 1). Northern Virginia is unique within the Commonwealth because it is part of a much larger, multistate region. The region accounts for about 40 percent of the Washington–Arlington–Alexandria, DC–VA–MD–WV Metropolitan Statistical Area population. As a result interstate collaboration, often facilitated through organizations like the Metropolitan Washington Council of Governments (MWCOG), is required to address many of the region's pressing challenges in areas such as transportation, but also in areas such as workforce, housing, and land use.

The region possesses two workforce boards—The Alexandria/Arlington Regional Workforce Council and the Northern Virginia Workforce Development Board that serves the region's 7 other jurisdictions. It also served by one community college—Northern Virginia Community College (NVCC)—the largest public educational institution in the Commonwealth of Virginia and the nation's second largest community college. NVCC has over 75,000 students and six campuses[2] throughout Northern Virginia. The region is also served by one planning and development commission—The Northern Virginia Regional Commission. Each of the jurisdictions has an economic development organization or office, there are numerous chambers of commerce and organizations like the Northern Virginia Technology Council represent the region's extensive technology community.

[1] More information on the GO Virginia initiative can be found at www.govirginia.org

[2] Alexandria, Annandale, Loudoun, Manassas, Woodbridge, and the Medical Education Center in Springfield.

The Northern Virginia region plays an important role in supporting the work of the US federal government, and this shared dependence on the federal government leads to many shared economic challenges and opportunities. The federal government's role has been a source of opportunity and growth, but an over-dependence on federal spending has limited the region's ability to grow and expand industries that serve private sector markets. This dependence on the federal government runs through many of the region's economic challenges, including an ability to attract and retain technology workers, the ability to grow and retain innovative small- and medium-sized enterprises (SMEs), and an innovation ecosystem shaped by federal spending and institutions.

The GO Virginia program provides an opportunity for the region to begin addressing these challenges. The region's nine jurisdictions all share many common concerns about training the workers to support the region's critical technology industry. They also are all looking for ways to create a more dynamic regional economy that not only maintains its existing strengths, but also develops new strengths that are less reliant on federal contracting. The concerns are not entirely unique to Northern Virginia. For instance, regions such as the Hampton Roads and Fredericksburg area are also heavily influenced by federal and defense spending. The GO Virginia program provides an opportunity to work with those regions on efforts to train exiting military for in-demand cybersecurity jobs or help small and medium-sized enterprises grow and diversify their markets.

The GO Northern Virginia Regional Council (Region 7)—comprised of action-oriented individuals representing a wide range of organizations, local governments and institutions in the private, non-profit, and public sectors[3]—has been allotted over $3 million dollars[4] to fund projects designed to ultimately create jobs in industries that pay above average annual wages ($70,000), benefit multiple jurisdictions by encouraging cooperation on economic development initiatives, and attract new dollars and jobs to the region. The region will also have the opportunity to compete for a statewide pool of funding, primarily for projects that involve inter-regional collaboration.

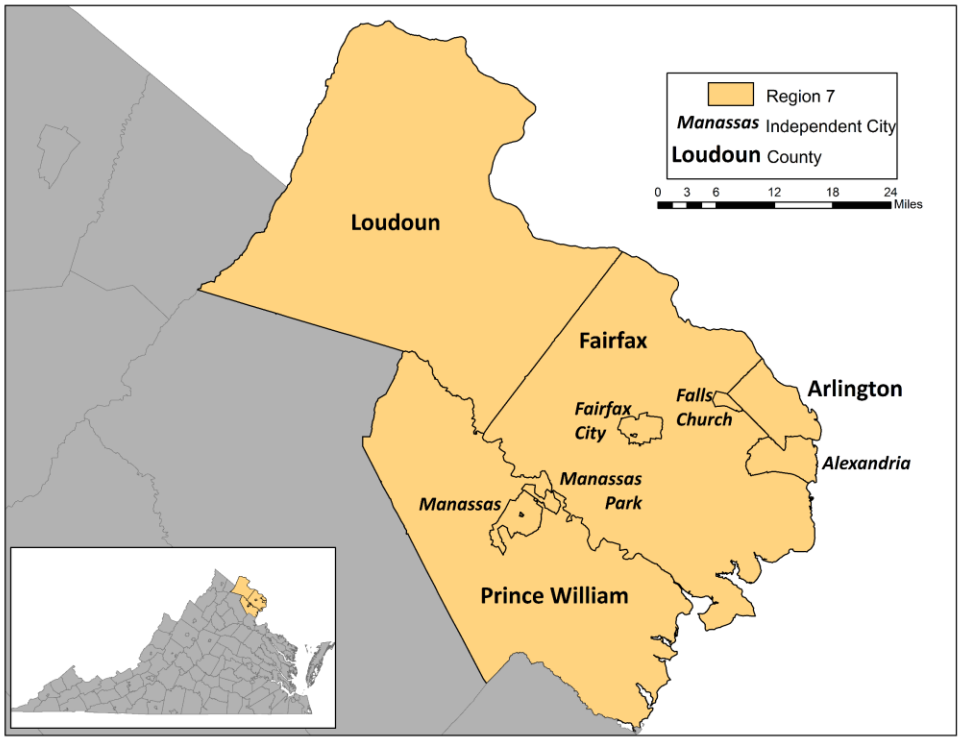
Given the scale of GO Virginia funding, the GO Northern Virginia Regional Council will focus its funding on projects that will help the region address three goals. First and foremost, the region will seek to strengthen the region's technology workforce. Second, it will look for opportunities to accelerate the development of 'growth' companies. Finally, it will enhance technology transfer and the commercialization of intellectual property from the region's research centers and institutions. The Council will also consider any high impact projects that contribute to the overarching GO Virginia goal of achieving private-sector driven job growth in high-wage sectors through interjurisdictional cooperation.

This plan—developed by the Center for Regional Analysis (CRA) at George Mason University on behalf of the GO Northern Virginia Regional Council—describes the key economic challenges facing the region and articulates the region's priority goals that will guide efforts to alter the region's economic trajectory. This report is the culmination of a highly intense, but collaborative effort between the Council, CRA, and

[3] A complete list of Region 7 Council members can be found in Appendix A.

[4] These funds must be matched dollar for dollar with non-state funding.

Figure 1: Map of GO Northern Virginia region (Region 7)



wide range of community stakeholders to draft Northern Virginia's Economic Growth and Diversification Plan for review and approval by the GO Virginia board.

The report begins by reviewing the broad economic and demographic trends shaping the Northern Virginia economy. It then provides a detailed analysis of the industry clusters that drive the region's economy and explores those clusters' key workforce needs—particularly as they relate to computer and technology workers. It then articulates the region's priority goals, and identifies potential strategies for achieving these goals and the performance measures for determining their success. It concludes by describing some steps that the region will take to implement the plan. Two appendices identify the composition of the GO Northern Virginia Regional Council and provide a detailed description of the process used to develop the Northern Virginia's Economic Growth and Diversification Plan.

About the region

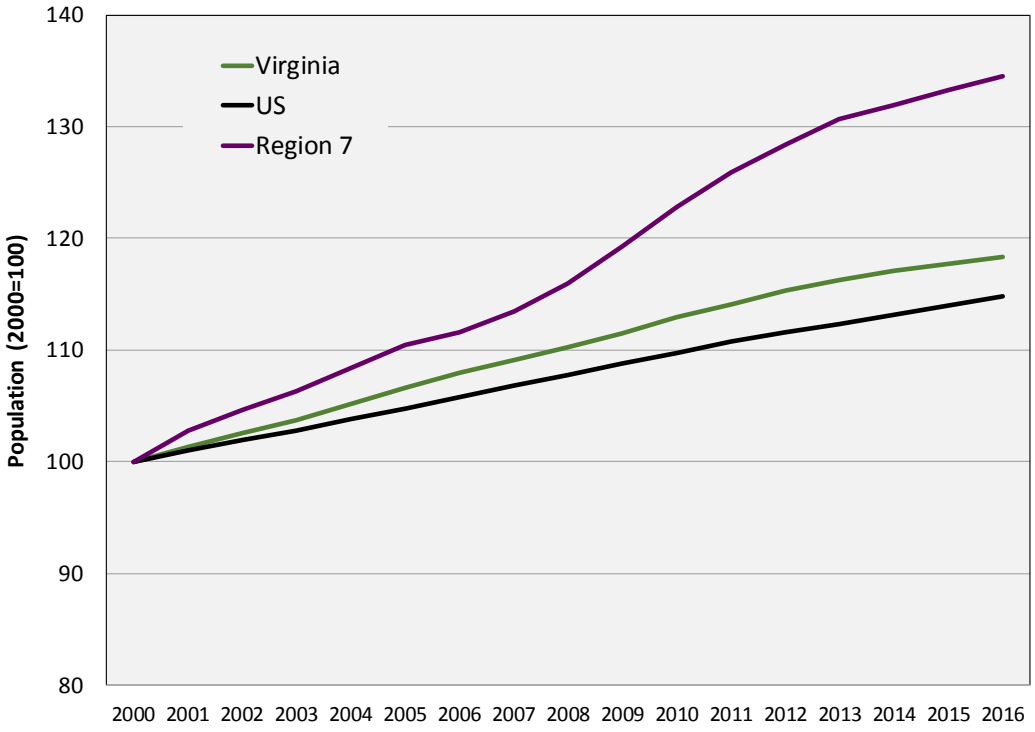
Northern Virginia is one of the Commonwealth's economic engines

The Northern Virginia regional economy drives much of the state's economy. In 2015, Northern Virginia's GDP ($153 billion) accounted for roughly a third of Virginia's overall economic output.[5] This is more than 70 percent greater than Virginia's next largest region (Hampton Roads). The region is also home to 2.46 million residents, or 29 percent of the Commonwealth's total population. Figure 2 shows that Northern Virginia's population growth has far exceeded that of either the Commonwealth or the nation over the past two decades, and its population is now almost 35 percent larger than it was in 2000. Between 2000 and 2010 the region's population grew 2.1 percent annually, but since 2010 the region's growth has slowed to 1.5 percent annually.

In spite of this slowing population growth, Northern Virginia is the state's fastest growing region and continues to grow faster than either the state (1.2 percent annually) or nation (0.9 percent annually). Within the region, Fairfax County is the region's largest jurisdiction, its 1.14 million residents account for approximately 46 percent of the region's total population. Loudoun County is Virginia's fastest growing jurisdiction. Even though it is only 16 percent of the region's total population, Loudoun County was the source of almost one-third of the region's net new residents between 2010 and 2016.

In addition to being the Commonwealth's largest region, it is also its wealthiest. In 2015, the region's per

Figure 2: Index of Population Growth (2000 Population=100)



Source: US Census Bureau, Population Estimates Programs

[5] Bureau of Economic Analysis and Moody's Analytics (Prepared by McKinsey for GO Virginia)

capita annual income was $70,571—a figure 36 percent higher than the state and 47 percent higher than the nation. As further evidence of the region's importance to Virginia, consider that without Northern Virginia, the state's per capita income drops nearly $10,000 from $52,052 to $42,641. Not surprisingly, multiple regional jurisdictions were among the nation's wealthiest. For instance, the per capita incomes in Arlington ($86,161) and Alexandria ($82,683) ranked 26th and 30th, respectively, out of more than 3,000 jurisdictions. Similarly, Fairfax County/Fairfax City/Falls Church ($74,923) ranked 48th and Loudoun County ($69,895) ranked 67th. Please note that even though there are well-recognized economic differences among the jurisdictions in Region 7, such as headquarters and offices of professional service providers being concentrated in Arlington, Alexandria, and Fairfax, versus data centers in Loudoun, or manufacturing in Prince William County, our descriptions of economic, demographic, and workforce trends and the related goals for the Economic Growth and Diversification Plan are offered at the regional level.

Several other measures reflect the region's economic strength. For instance, in 2015 Region 7 had a poverty rate (6.2 percent) that was almost half of the state rate (11.2 percent). Employment opportunities are available within the region, as Northern Virginia's unemployment rate was only 3.2 percent in May 2017—a figure lower than any other Go Virginia region. By comparison, Virginia has a state unemployment rate of 3.8 percent and the US stands at 4.3 percent unemployed. Within the region, Arlington stands out with a May 2017 unemployment rate of 2.8 percent.

The majority of individuals who live in Northern Virginia both live and work within its boundaries. Approximately seven in ten[6] Northern Virginia residents live and work in the region. Those that live in the region and are employed outside are mostly working in Washington DC (15.1 percent). About 7 percent of residents commute elsewhere in Virginia for work, while just over 6 percent of Northern Virginia residents work in Maryland (largely in Montgomery and Prince George's counties).

Commuting patterns tend to move from west to east across the region. In Arlington and Alexandria, 32.6 percent of the residents work in the District of Columbia, compared to 15.3 percent in Fairfax County, Fairfax City, and Falls Church, and 6.9 percent in Loudoun and Prince William Counties. Approximately 22 percent of Fairfax County workers are drawn from Loudoun and Prince William counties. Just over half (55 percent) of those employed in Loudoun and Prince William Counties commute from outside those counties – primarily from Stafford County in Region 6 and Fauquier County in Region 9.

The region's commute times are among the nation's longest. Average travel time from place of residence to employment is about 35.4 minutes,[7] ranging from 28.1 minutes in Arlington to 39.6 minutes in Prince William County. By comparison, the Virginia State average commute time is about six minutes less at 28.2 and nationally commute times are about ten minutes less at 25.4 minutes.

[6] Commuting patterns based on 2014 US Census Bureau, On The Map data

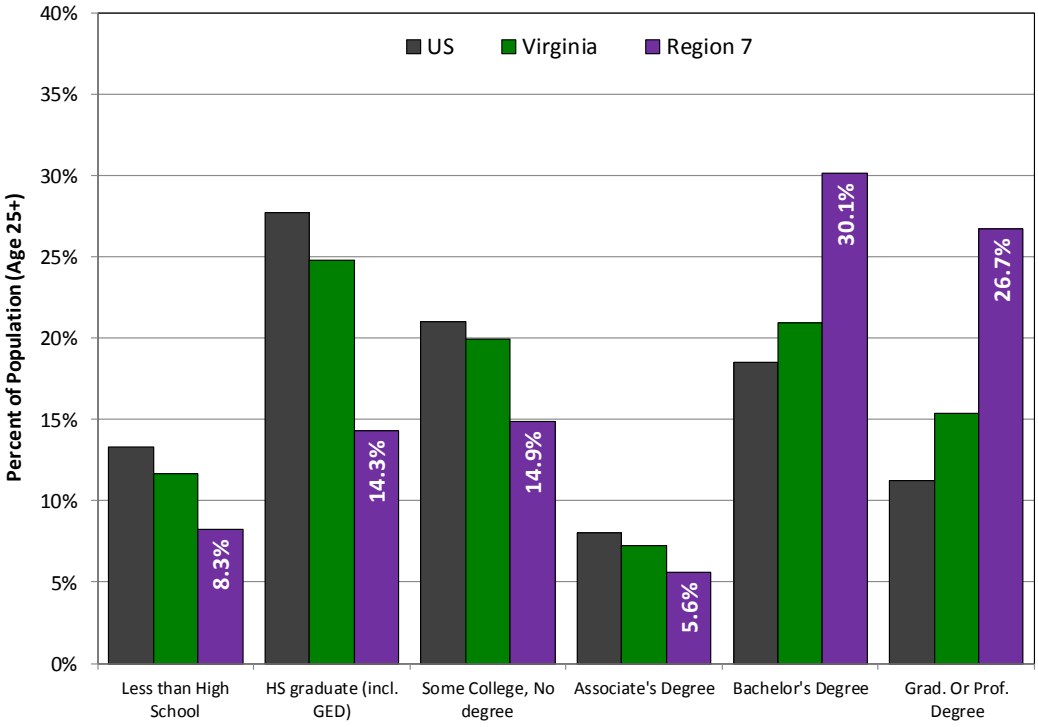
[7] US Census Bureau 2011-2015 ACS.

The region's high median income level and low poverty rate is enviable, yet also reflects the high cost of living in Northern Virginia. The high cost of living, and particularly high cost of housing, and longer commutes are especially challenging for the region's lower wage workers. These factors are also a challenge in attracting and retaining workers, who might find greater opportunities elsewhere.

The region has assets to leverage in support of the region's economic development

The region's highly educated workforce contributes to its economic strength. Figure 3 shows that 57 percent of the region's working age population have a bachelor's degree or higher. This is more than 20 percent points higher than the state (36.4 percent) and almost twice as great as the nation (30 percent).

Figure 3: Educational Attainment of Population Aged 25+



Source: US Census Bureau, 2011-2015 American Community Survey

The educational attainment levels of residents by individual jurisdictions highlight the region's workforce advantage, as five of the region's jurisdictions are among the 10 most educated counties in the nation. Falls Church has more people (aged 25+) with at least a Bachelor's Degree (78.8 percent) than any other jurisdiction in the country; Arlington is 2nd (72.9 percent), Alexandria is 4th (61.4 percent), Fairfax is 6th (59.9 percent), and Loudoun is 10th (58.2 percent). Moreover, Arlington, Alexandria, and Falls Church all have more people with graduate degrees than 4-year degrees.

Many of these workers support the federal government either directly or with federal contracting firms. As part of the broader National Capital Region, Northern Virginia is home to large federal government facilities including the Pentagon, US Patent and Trade Office (USPTO), National Science Foundation (NSF), Defense Advanced Research Projects Agency (DARPA), Central Intelligence Agency (CIA), Quantico Marine Corps Base, and Fort Belvoir among others. Nearly 80,000 individuals work directly for the

federal government within the region, but the impact of the federal government goes far beyond direct employment. In 2016, the federal government supplied $37.8 billion of procurement spending in the region.[8] This procurement spending supports the region's professional and business services sector, which makes up almost a quarter of the Northern Virginia job base.

The federal government also contributes greatly to the region's innovative capacity. The region is home to government agencies such as the Defense Advanced Research Projects Agency (DARPA), the Office of Naval Research (ONR), the Air Force Office of Scientific Research (AFOSR), and the National Science Foundation (NSF), which sponsor much of the nation's basic research. The region is also home to nine of the nation's 43 Federally Funded Research and Development Centers (FFRDCs) that undertake research and development on behalf of the federal government.[9] These federal agencies and institutions are important regional assets, but the region also has campuses of three R1 institutions in Virginia Tech, University of Virginia and George Mason University. Over the past decade, the region has also benefitted from emerging bio-medical research centers such as Inova Center for Personalized Health in Fairfax (and its associated incubator—Inova Personalized Health Incubator) and the Janelia Research Campus in Loudoun County.

The region faces a number of growth challenges

The region's heavy dependence on the federal government cuts two ways. During the last recession, the region's economy did not experience the shock that many other regions experienced. As the rest of the country recovered, however, Northern Virginia's growth stalled due to the impact of the federal budget cuts associated with Budget Control Act of 2011, which led to budget sequestration. Consequently, the region continues to grow jobs, but after nearly two decades of growth higher than the nation, employment growth is now lagging the US. Between 2000 and 2010, regional employment grew 1.7 percent annually (compared to 0.2 and 0.9 percent in the US and VA, respectively), but between 2010 and 2016 the region grew 1.2 percent annually (compared to 1.4 for the US and 0.9 percent in VA).

[8] *Waters, K. (2017) "Federal Procurement Spending in the Washington Region: 2008-2016," The Stephen F. Fuller Institute, George Mason University.* In this instance, Northern Virginia refers to the Virginia cities and counties of the Washington-Arlington-Alexandria MSA. Almost the entirety of federal procurement spending occurs within the counties and independent cities of Region 7.

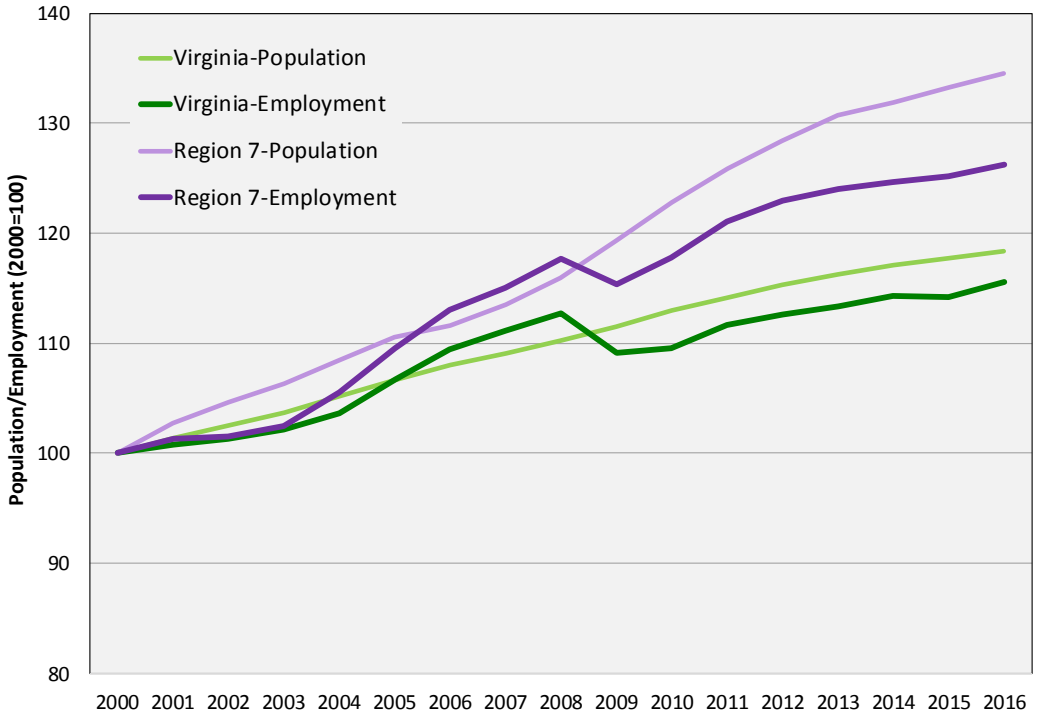
[9] https://www.nsf.gov/statistics/ffrdclist/

Figure 4 shows that since the recession, Northern Virginia's population growth has outpaced job growth. This indicates that a disproportionate share of the region's job growth is the result of increasing demand for personal services that simply recycle money in the community, rather than more 'export'-oriented jobs that bring new money into the region. For example, the "economic value," as measured by contributions to gross regional product, for an export-oriented job in professional business services is three- to five-times that of jobs in the retail or hospitality sector. Thus, if more of the relative job growth is in locally-serving industries, overall growth in income will likely slow. According to data from Chmura Economics, between the end of 2010 and end of 2016, average wages in Region 7 grew 1.3 percent annually, compared to 1.7 percent in Virginia and 2.4 percent nationally.

Even though wage growth has slowed, the region's per capita income remains much higher than the nation ($48,112) or the Commonwealth ($52,052). However, these relatively high incomes are somewhat offset by the region's high cost of living. According to the US Bureau of Economic Analysis' 2015 regional price parity index, the cost of all goods and services within the Washington-Arlington-Alexandria MSA was nearly 20 percent more expensive than the national average, making it the nation's 7th most expensive metro. Much of this is driven by the relatively high cost of housing, which is almost 70 percent more expensive than the national average.

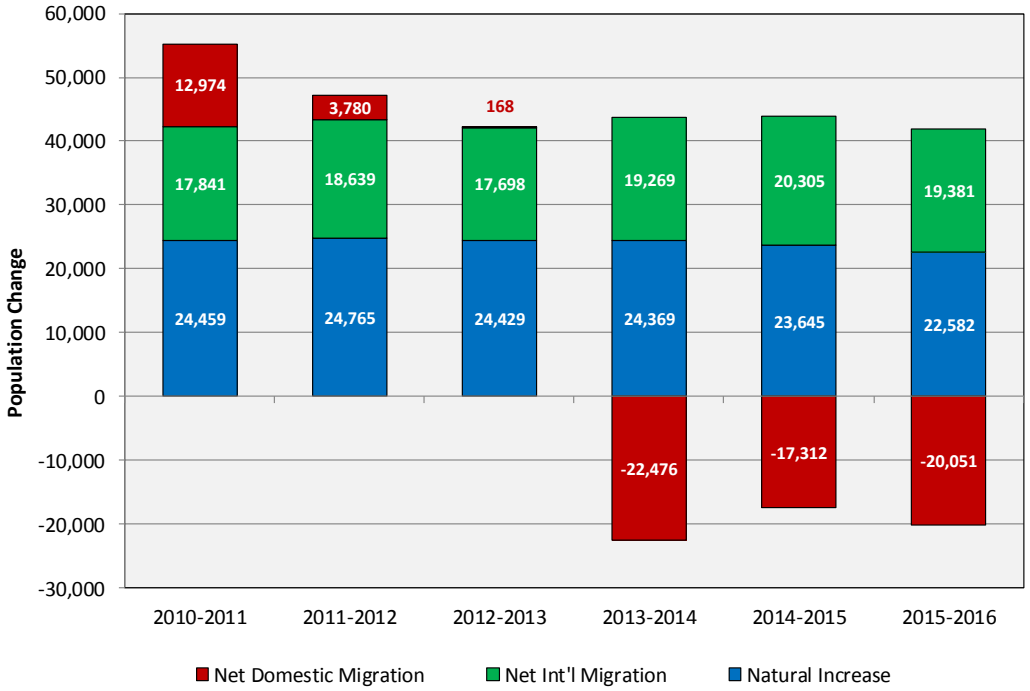
The slower wage growth and high cost of living contributes to the region's relatively high labor force participation rate—which currently stands at 74.6 percent; compared to 63.7 percent nationwide and 66.3 percent in Virginia. Part of this is attributable to both demographic and economic reasons. Demographically, the high proportion of prime working age residents and the high level of educational

Figure 4: Index of Employment and Population Growth (2000=100)



Source: US Census Bureau Population Estimates, US Bureau of Labor Statistics Local Area Unemployment Statistics (2016 preliminary)

Figure 5: Components of Population Change



Source: US Census Bureau, Population Estimates Program, V2016

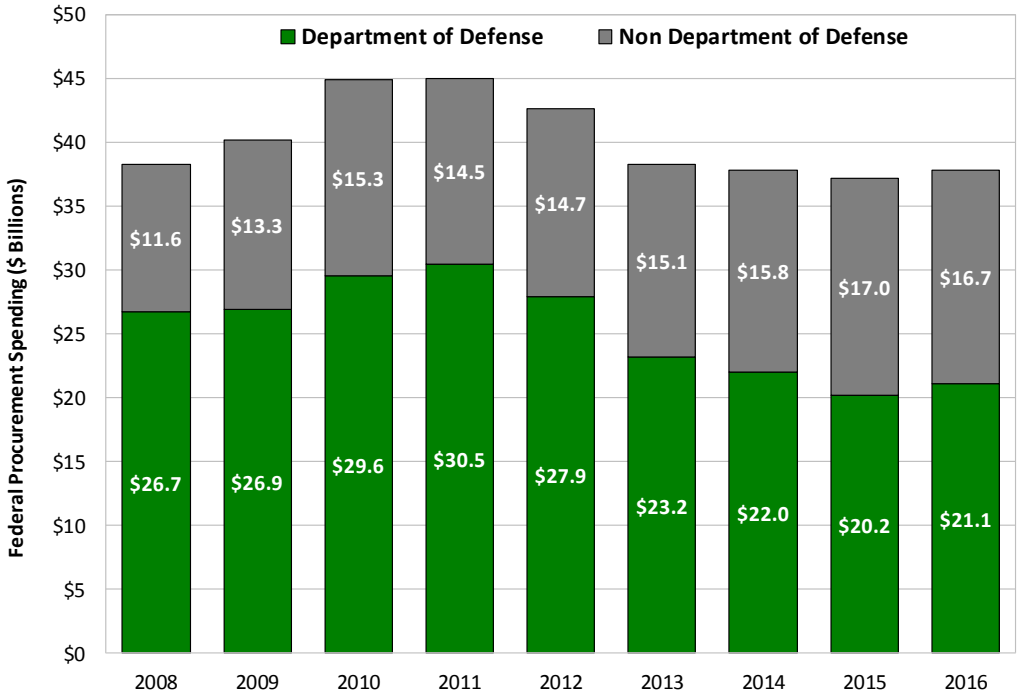
attainment (reflected in its earning capacity) both contribute to higher labor force participation. Economically, the region has relatively more economic opportunity and this too draws people into the workforce. However, many workers are drawn into the workforce out of necessity rather than opportunity. For many households, it is difficult to afford to live in Northern Virginia without multiple incomes.

Relatively slower job and wage growth and the high cost of living also likely contribute to the region's continued net domestic out-migration. Figure 5 shows that since 2013, more domestic residents have left Northern Virginia than moved to the region. This indicates that Northern Virginia is becoming a less attractive place for people to live, relative to other US locations. Domestic in-migrants are important to the region's talent base because they tend to be younger and more educated. A third of out-of-state in-migrants are aged 25-34 and almost 70 percent of out-of-state in-migrants had at least a 4-year degree. These in-migrants are often attracted by relatively high paying jobs and amenities that are attractive to young professionals. However, the growing costs associated with having a family or purchasing a home (the average housing price in the northern Virginia region was $529,427 in May 2017) may lead mobile workers to look elsewhere. In spite of these trends, the region continues to attract international in-migrants and that remains a positive indicator for the region. International in-migrants are generally higher educated, as almost 60 percent of the region's international immigrants in 2015 had least a 4-year degree, compared to 44 percent for those migrating to the US as a whole.

Federal spending is foundational to the region's economy

As noted above, the federal government drives much of the Northern Virginia economy. In fact, the federal government and the many contractors that support it represent the region's primary 'export'

Figure 6: Federal Procurement Spending in Northern Virginia



Source: usaspending.gov; The Stephen S. Fuller Institute at the Schar School, GMU;
**Northern Virginia portion of Washington, DC MSA*

industries. Even though the work is performed locally for local customers, federally-driven activities bring 'new' money from outside the region. Within Northern Virginia there are over 78,000 direct federal government jobs. This accounts for 44 percent of total Federal Government employment within the Commonwealth of Virginia. However, the region's largest employing sector—Professional and Business Services – employs approximately 350,000 workers throughout the region and federal contracting supports many of those jobs.

The reliance on federal spending poses a unique regional challenge because federal spending decisions are largely outside of local control. Figure 6 shows that in FY 2016 federal procurement spending in the region was $37.8 billion; more than 55 percent of this spending was defense-related. To place this in context, Northern Virginia[10] receives about 9 percent of total Federal procurement, and roughly 8 percent of total Department of Defense procurement spending. [11] Within the broader Washington, DC metro area, Northern Virginia receives over half of the metro area's total federal contracting dollars; and three quarters of its Department of Defense procurement spending.

The out-sized role that the federal government plays in the region has important economic consequences. As noted above, the professional and business services sector is foundational to the region's economic base, and Figure 7 shows that the spending cuts associated with sequestration resulted in substantial year over year declines in professional and business services employment. Even

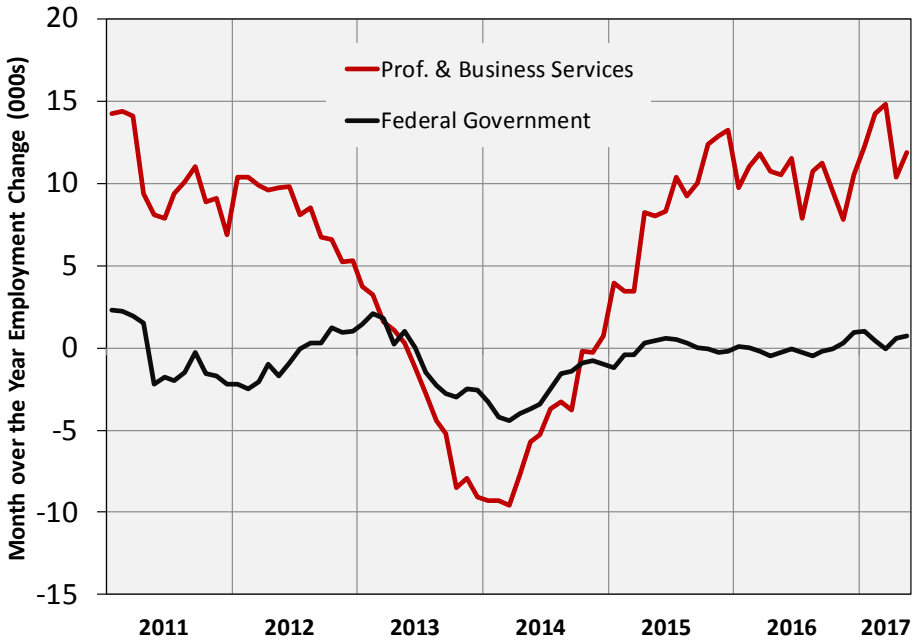
[10] In this instance, Northern Virginia refers to the Virginia cities and counties of the Washington-Arlington-Alexandria MSA. Almost the entirety of federal procurement spending occurs within the counties and independent cities of Region 7.

[11] *Waters, K. (2017) "Federal Procurement Spending in the Washington Region: 2008-2016," The Stephen F. Fuller Institute, George Mason University*

though federal procurement and federal employment has remained flat, employment has started to rebound.

The professional and business services sector contains many of the region's technology workers, and these activities are also highly influenced by federal spending. One-third (32 percent) of 2016 federal procurement spending ($23.5 billion) in the DC metro area goes to computer-related industries. In fact, the Washington metro area receives 60 percent of all the federal contracting in computer systems design services, custom computer programming services, and other computer-related services. As a result, it is an important driver of the region's technology industries and supports many of its computer-related occupations.

Figure 7: Month over the Year Federal and Prof & Business Services Employment in Northern Virginia



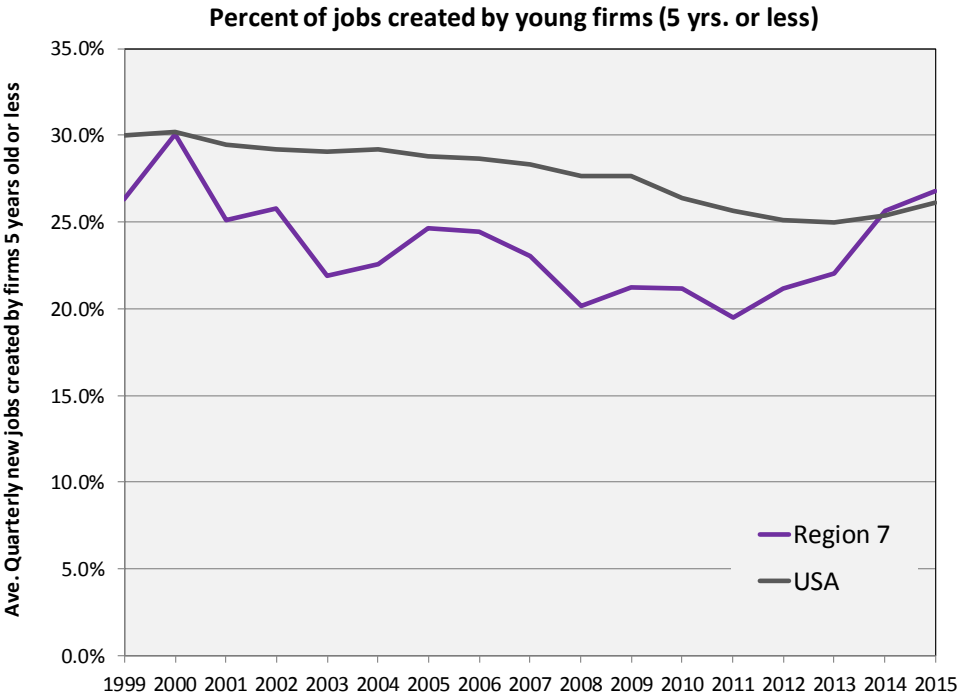
Source: Bureau of Labor Statistics, Current Employment Statistics

Another challenge for the region is that while it has innovative assets to leverage, the Federal government drives the innovation economy more than venture capital. The Department of Defense is a large purchaser of technology in the region, but it is starting to look to regions such as Silicon Valley or Boston for their technology needs. There are several distinct innovation challenges facing the region. First, given that government services drive the region's technology firms, there is a lower tolerance for risk here than in other places. As a result, start-ups are less likely to contribute jobs than in other locations. Figure 8 shows that even though the percent of jobs created by young firms (5 years old or less) has increased over the past few years, the region only recently reached the national average. This is due in large part younger firms contributing a growing share of new jobs, rather than an increase in the number of jobs created by younger firms.

Second, a recent study of entrepreneurial innovation in the Greater Washington Region[12] showed that the region produces many innovative and entrepreneurial companies, but they do not stay here. Over the past two decades, 105 businesses were sold for over $1 billion; only 16 were sold to buyers in the region. Moreover, of the 6,000 business sales in last 20 years, three-quarters were sold to out-of-region purchasers. New firms help to diversify the region's economy and reduce its federal dependence, but for this to occur the region will need to increase its capacity to create *and* retain new firms.

[12] *Aberman, J. (2016) "Building Entrepreneurial Innovation in the Greater Washington Region," Report to the 2030 Group*

Figure 8: Percent of Jobs Created by Young Firms (5 years old or less) in Northern Virginia



Source: US Census Bureau, Longitudinal Employer-Household Dynamics, Quarterly Workforce Indicators

Economic and workforce analysis

Driven to a great degree by federal government contracting, Northern Virginia's professional and business services sector employs over 350,000 workers, and accounts for roughly 30 percent of the region's total employment. Figure 9 shows the largest industries within the professional and technical business services sector, and provides greater detail about the types of activities included in this sector. Two of these industries—computer systems design and related services; and management, technical and scientific consulting services—are greatly affected by federal spending. Combined, these two industries represent about 170,000 jobs in the region, with *average* salaries exceeding $100,000. Moreover, these industries are highly concentrated in the region; computer systems design and related services is six times more concentrated in the region than it is nationally, and management, technical and scientific consulting services is more than four times more concentrated based on location quotients.

While this would appear to give the region a distinct competitive advantage in these industries, recent growth trends show that over the past five years these industries experienced very little growth. For instance, computer systems design and related services; and management, technology and scientific consulting services both grew more than 4 percent annually in the United States over the past five years, but within Region 7 these industries' employment remained flat. This is due to many of the factors discussed above including a strong dependence on federal procurement spending and an inability of regional firms in these sectors to sufficiently diversify into more commercial market opportunities.

Figure 9: Largest industries in Northern Virginia's Professional and Business Services Sector

NAICS	Industry	Employment	Avg. Annual Wages	Location Quotient	Annual % Emp Change (2012-2017)	
					Region 7	USA
5415	Computer Systems Design & Related Services	109,961	$124,710	6.22	0.2%	4.7%
5416	Mgmt, Sci., & Tech. Consulting Services	59,801	$114,551	4.41	-0.1%	4.0%
5617	Services to Buildings & Dwellings	33,215	$29,446	1.50	2.8%	2.3%
5413	Architectural, Engineering, & Related Services	28,304	$112,978	2.17	-2.7%	1.5%
5511	Management of Companies & Enterprises	24,073	$145,014	1.27	-1.6%	3.0%
5412	Accounting, Tax Prep., Bookkeeping, & Payroll Services	21,452	$101,185	2.25	4.3%	1.9%
5616	Investigation & Security Services	16,430	$59,936	2.03	3.0%	2.5%
5419	Other Prof., Sci., & Tech. Services	14,943	$75,732	1.71	3.1%	2.3%
5613	Employment Services	13,934	$53,820	0.47	4.4%	3.4%
5417	Scientific Research & Development Services	13,687	$120,561	2.25	-4.2%	1.7%

Source: Chmura Economics JobsEQ, 2017 Q1

In spite of regional challenges, these activities remain critical components of the region's economic base and their importance is widely recognized. Northern Virginia has a robust, relatively well funded, and highly professional network of jurisdiction-based economic development agencies. These agencies represent their respective service areas in a very effective manner. However, unlike some Virginia regions, Northern Virginia does not have a single regional development organization to do regional marketing. Even so, a review of local economic development strategies reveals (Figure 10) that these industries—particularly those related to IT services—are a common thread across the region and remain an important area of economic strength and opportunity. Other targeted industries, such as light manufacturing in Prince William County and Manassas, have a strong technology emphasis. Similarly, many of the life sciences opportunities—such as the translational medicine activities in Fairfax County—are as much 'Big Data' activities as they are lab work. These technology-oriented activities, both in service of government and the private sector, will continue to play an important role in the regional economy.

Figure 10: Industry targets identified by economic development organizations

	Arlington	Alexandria	Fairfax Co.	Prince William Co.	Loudoun Co.	Manassas City
ICT & IT Services	X	X	X	X	X	
Cyber Security	X		X			
Med-Tech	X				X	
Ed-Tech	X					
Fin-Tech		X				
Data Analytics	X		X			
Data Centers					X	
Federal Agencies & Contracting (incl. Aerospace)			X	X	X	X
Entrepreneurship	X	X			X	X
Transportation & logistics				X	X	X
Life Sciences (incl. Trans. Medicine)			X	X		
Food & Agriculture					X	X
Light Manufacturing				X		X
Commercial Creatives		X				
Prof. & Trade Associations		X				
Research & Development			X			
Clean & Green	X					
Hospitality						X

Many of the region's key industry clusters serve the federal government

About the cluster analysis

To gain a better understanding of Northern Virginia's economic base, we have examined the region's key industry clusters. Industry clusters are groups of industries connected by some form of interdependence (often through their supply chain or labor requirements). The cluster analysis

presented below is based on the US Cluster Mapping Project's [13] cluster definitions. The US Cluster Mapping Project research team developed cluster categories based on the interdependence of US industries.[14] As a result, this standardized set of cluster categories were developed to enable comparative analysis among US regions.[15]

The clusters analyzed here reflect many of the industries targeted by the region's economic developers and represent the most relevant 'traded' clusters in the Northern Virginia economy. These activities all bring new money into the regional economy and therefore drive economic growth. The cluster analysis here will help to answer several key questions, including: 1) is the cluster large and growing? 2) does the cluster provide good jobs? and 3) does the cluster provide the region with some kind of unique competitive advantage? Figure 11 shows the region's primary economic clusters. Each bubble reflects several factors:

- ***Average wages:*** Average wages (on the Y-axis) provide an indication of the quality of opportunities available in the industries that make up that cluster.
- ***Relative concentration:*** We measure relative concentration (on the X-axis) using location quotients (LQ). LQs measure the relative percentage of the region's cluster employment, as compared with the cluster's national employment share. An LQ greater than 1.0 means that one might assume the region has more workers than are required to make the product or service to supply in-region demand. The excess employment would presumably be used to produce extra products or services for export from the region, thus indicating a potential regional advantage.
- ***Employment:*** The size of the bubble shows the number of jobs in those regional clusters. The employment numbers displayed here represent total employment, and as a result include both wage and salary jobs and self-employed individuals.
- ***Recent trends:*** The color of the bubbles reflects cluster trends over the past five years.[16] Green clusters experienced growth in both employment and relative concentration, thereby indicating that these clusters became more regionally competitive. The yellow-orange clusters experienced employment growth and declining relative concentration and thus are failing to keep pace with national trends. Red clusters lost both employment and relative concentration over the past five years.

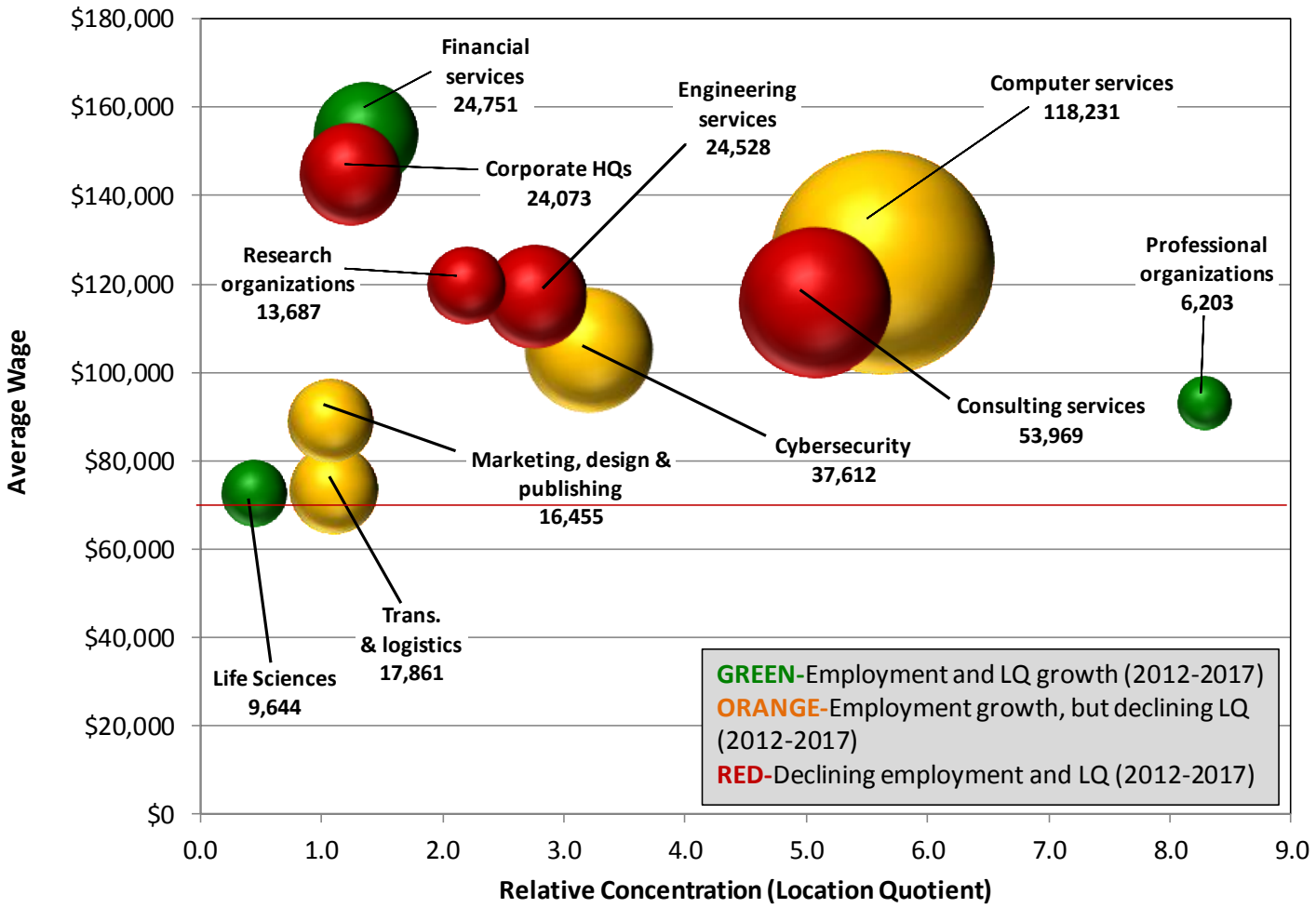
[13] The US Clusters Mapping Project is an initiative undertaken by Harvard Business School, MIT Sloan, and Temple Fox School of Business and funded by the US Economic Development Administration. http://www.clustermapping.us/about

[14] Specifically, the US Cluster Mapping Project considered co-location of industry employment and establishments, input-output linkages, and industries with similar occupational staffing patterns (http://www.clustermapping.us/content/cluster-mapping-methodology).

[15] In two instances—Cybersecurity and Life Sciences—the GMU Center for Regional Analysis developed unique cluster definitions, where the US Cluster Mapping's cluster classifications did not provide definitions representative of their activities in Northern Virginia.

[16] These data are provided by Chmura Economics and represent the average of the four quarters ending in Q1 2012, and the average of the four quarters ending in Q1 2017.

Figure 11: Northern Virginia's Industry Clusters



Source: Chmura Economics JobsEQ, 2017 Q1; Clusters defined by US Cluster Mapping Project

Key industry cluster trends

The region's three largest clusters—computer services, consulting services, and cybersecurity—are all heavily influenced by government contracting. Although highly concentrated in the region and responsible for many high paying jobs, these clusters have not fully recovered from the consequences of sequestration. These trends are also apparent in some smaller regional clusters (e.g., engineering services, research organizations) that similarly rely heavily on federal spending and activity.

The computer services cluster is the region's largest traded cluster with over 118,000 jobs. Over the past half-decade, Northern Virginia's computer services cluster grew modestly—0.5 percent annually between 2012 and 2017—but nationally this cluster grew 4.6 percent annually during the same period. This highlights the region's weak competitive position relative to other IT centers around the country. The computer systems design services industry is the largest industry within the clusters, and with 76,000 jobs accounts for 64 percent of total cluster employment and its growth trends have mirrored the computer services cluster broadly. Data processing, hosting and related services—which includes the region's data centers—is the only industry in the computer services cluster that has grown faster locally (4.6 percent annually) than it has nationally (3.8 percent annually). That said, it makes up only 7 percent of total cluster employment (8,270 jobs).

The consulting services cluster is another high paying cluster ($116,000 annual average wage) that is highly dependent on federal spending. The cluster now employs about 54,000 workers, which is down over 1,700 jobs from where it stood five years ago. As a result, the cluster lost employment at a rate of 0.3 percent annually during a period where the cluster grew 3.8 percent nationally. Much like the computer services cluster, this cluster remains highly concentrated in the region, but it is experiencing an erosion of its competitive advantage.

The region's cybersecurity cluster was defined differently than the other clusters because there is no defined cybersecurity industry in the Harvard project. As a result, we looked at this cluster through the lens of occupational data, and considered employment trends in the five occupations most relevant to cybersecurity.[17] In most instances, growing cyber-related activities do not revolve around entirely new jobs being created, but rather workers in jobs related to, for instance, network administration to take on additional tasks and responsibilities. However, this is not always the case within Northern Virginia where the presence of the federal government and the national security complex means the region has cyber jobs dedicated specifically to cybersecurity. In fact, according the US Bureau of Labor Statistics, the Washington, DC metro area has nearly twice as many information security analysts as the next largest metro area, the New York City MSA. Even with the importance of cybersecurity to the region, trends in this cluster resemble those of the other federally-dependent clusters above as employment growth over the past five years has been minimal (0.1 percent annually) and lagging far behind national growth trends (2.4 percent annual growth).

[17] These occupations (and their Standard Occupational Classification (SOC) Codes) include: Computer Systems Analysts (15-1121), Information Security Analysts (15-1122), Database Administrators (15-1141), Network and Computer Systems Administrators (15-1142), and Computer Network Architects (15-1143).

Only three clusters—financial services, professional organizations and life sciences—experienced growth in both employment and relative concentration. Among the key traded clusters identified in Figure 11, the professional organizations cluster was the smallest, but most highly concentrated. This reflects the locational advantages for advocacy organizations to be in the National Capital Region. Among the region's key clusters, the financial services cluster was the highest paying cluster ($154,000 annual average wage). This cluster added over 4,000 net new jobs between 2012 and 2017, and unlike many of the region's more prominent clusters, it actually grew at a faster pace regionally (4.1 percent annually) than the cluster did nationally (1.1 percent). The region's life sciences cluster (which does not include healthcare services-related industries like hospitals) was the region's smallest and least concentrated cluster. That said, it has experienced some modest growth over the past five years due in part to growth in industries like medical laboratories.

Computer-related occupations are crucial across the region's key clusters

In addition to a heavy dependence on the federal government, one of the other commonalities among the clusters described above is the need for significant numbers of capable technology workers. As noted above, business leaders and workforce leaders all note that there are many more IT and technology-related jobs available in the region than qualified candidates, and this lack of technology workers significantly impedes the ability for technology firms to grow and expand. The region's pressing need for additional IT talent is highlighted in the workforce analyses commissioned by NVCC and both of the region's workforce boards.[18]

An analysis of each cluster's staffing patterns shows that computer-related occupations[19] account for significant shares of the industry clusters identified above. Naturally, computer-related occupations are most prominent within the computer services clusters, where they account for 58.1 percent of all jobs. However, they also represent critical components of other key regional clusters such as research organizations (13.0 percent), corporate headquarters (13.0 percent), engineering services (10.0 percent), and consulting services (9.6 percent).

While not a traditional IT center like Silicon Valley or Research Triangle, Northern Virginia remains a significant IT center. This is perhaps best illustrated by the high relative concentration of the region's largest computer-related occupations. Figure 12 shows that each of the region's largest computer-related occupations are more than twice as concentrated in the region's workforce as they are in the national workforce. Most notably, information security analysts are more than six times more concentrated in the region than nationally. This reflects the importance, and relative competitiveness, of the region's cybersecurity industry, which offers services to government and commercial sectors.

[18] E.g. White, M. "Assessing Alexandria/Arlington's Regional Labor Market", George Mason University Center for Regional Analysis, prepared for the Alexandria/Arlington Regional Workforce Council.; Northern Virginia Workforce Development Board (Area #11) Local Plan, and NVTC Greater Washington *Technology Workforce Needs Assessment*.

[19] Specifically, all occupations that fall within SOC 15-1000.

Figure 12: Computer occupations in Northern Virginia

SOC	Title	Employment	Location Quotient	Average Annual Wages	Annual emp. change (12-17)*	Projected annual emp. change (17-22)	Current Job Postings#
15-1132	Software Developers, Applications	19,875	2.76	$114,100	0.1%	2.3%	5,188
15-1133	Software Developers, Systems Software	14,937	3.95	$121,100	-0.3%	2.1%	95
15-1121	Computer Systems Analysts	14,932	2.92	$102,300	0.2%	2.5%	523
15-1151	Computer User Support Specialists	11,004	2.10	$61,000	0.2%	2.0%	4,086
15-1199	Computer Occupations, All Other	9,859	4.26	$109,500	-0.6%	0.6%	6,981
15-1142	Network & Computer Systems Admins.	9,591	2.89	$102,900	0.1%	1.6%	4,307
15-1131	Computer Programmers	6,721	2.67	$98,400	0.2%	-1.8%	94
15-1122	Information Security Analysts	5,310	6.08	$108,400	0.0%	2.4%	7,022
15-1143	Computer Network Architects	5,181	3.63	$118,000	-0.2%	1.4%	194
15-1152	Computer Network Support Specialists	4,193	2.55	$79,500	-0.2%	1.1%	2

Source: Chmura Economics, JobsEQ Q1 2017

**Average of the 4 quarters ending in Q1 2012, and the 4 quarters ending in Q1 2017*

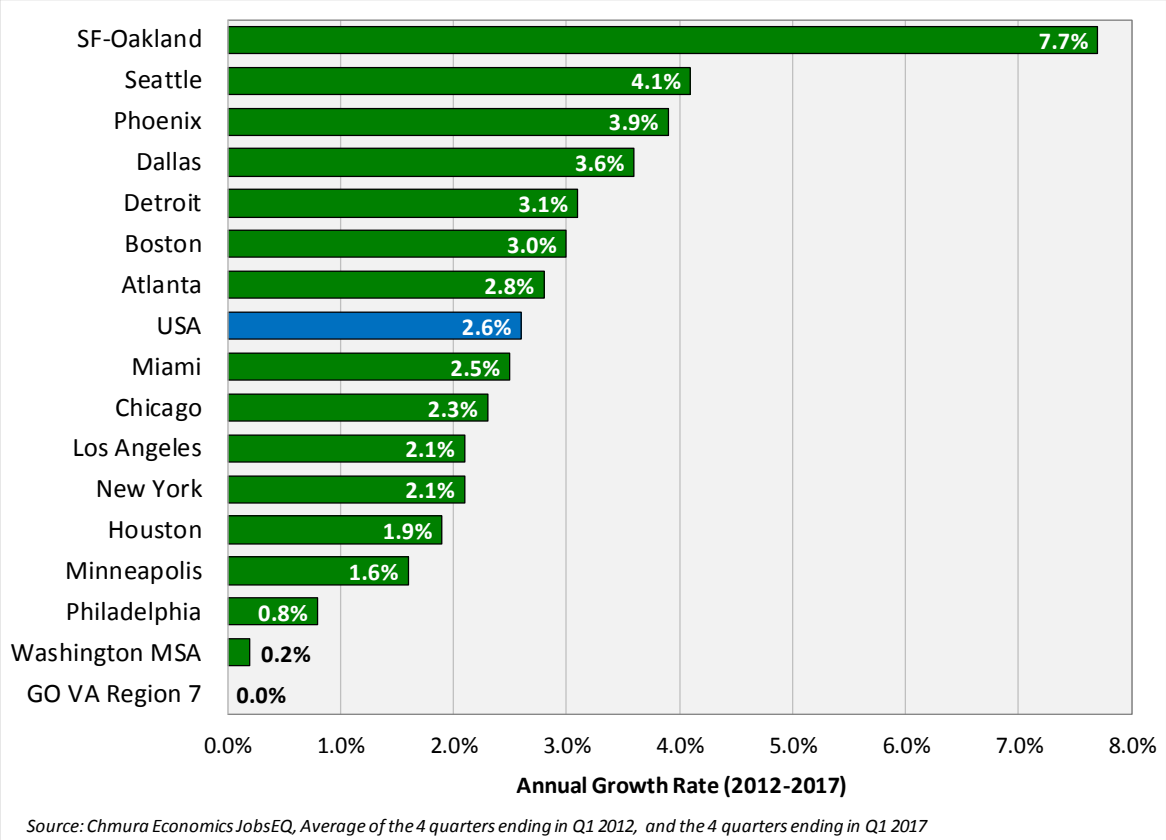
Data represent found online ads active between 5/13/17 and 6/13/17

Federal budget sequestration has also slowed growth in these occupations. Figure 13 shows how these economic headwinds have impacted the region's demand for workers in computer occupations (SOC 15-1000). Nationally, the number of workers in computer-related occupations grew 2.6 percent between 2012 and 2017.[20] Growth in these occupations has been strong in several large metro areas, particularly in large technology centers like the San Francisco Bay Area and Seattle. In contrast, the Washington, DC metro area grew only 0.2 percent during this period and Northern Virginia's employment remained flat.

[20] *Average of the 4 quarters ending in Q1 2012, and the 4 quarters ending in Q1 2017.*

Still, with few exceptions many of these occupations—such as computer systems analysts, information security analysts, applications software developers and systems software developers—are projected to

Figure 13: Growth in computer-related occupations (SOC 15-1000), 2012-2017



Source: Chmura Economics JobsEQ, Average of the 4 quarters ending in Q1 2012, and the 4 quarters ending in Q1 2017

grow in excess of two percent annually over the next five years. These projections often provide a longer-term gauge of demand, whereas job posting data shows that there is a more immediate and significant demand for jobs like information security analysts, applications software developers, and computer user support specialists.[21] Similarly, analysts at Northern Virginia Community College used Burning Glass job data to further show the region's pressing need for IT talent. During the second quarter of 2017, there were almost 9,500 total cyber positions being advertised in Northern Virginia; 4 of the 5 most commonly advertised job titles in the region were for IT-related jobs.[22]

[21] The job posting data presented here were accessed through Chmura Economics JobsEQ online data tool. Where these real-time LMI systems like Help Wanted Online or Burning Glass are powerful tools for analyzing current labor demand, they come with several important caveats. For instance, not all online job advertisements lead to actual jobs or hiring, as in some case employers may just be looking to build a pool of potential applicants. Additionally, not all jobs openings are posted online. Larger employers and positions that require greater levels of education tend to advertise job openings online than small employers seeking lower-skilled workers. As a result, a large IT contractor is more likely to advertise its jobs online than a small lawn care company, or for that matter a small IT company. For more information about the strengths and weaknesses of Real-Time LMI and several of the main vendors, please see: http://www.jff.org/publications/real-time-labor-market-information-environmental-scan-vendors-and-workforce-development

[22] https://www.nvcc.edu/workforce/docs/Q22017Dashboard.pdf , The Trends in Workforce Demand reports compiled by the Metropolitan Washington Council of Governments also shows similarly high need for IT-related workers.

Not only are these jobs critical to many of the region's priority clusters, but they also make important contributions to the region's overall well-being because most of these occupations tend to pay wages well above the regional average. Nine of the region's ten largest computer-related occupations pay average wages that exceed the regional average wage and many pay over six figures. The one occupation that pays below average wages—computer user support specialists—should not be dismissed. It is an important 'middle skill' job that often provides an entry point for workers without a 4-year college degree to launch careers in information technology.[23]

The region is facing a shortage of technology workers

As the region and its technology clusters rebound from the consequences of sequestration, some challenges have emerged. The consensus among both businesses and stakeholders is that the region has an insufficient number of technology workers. As noted above, the IT industries in other metro areas grew as Northern Virginia's stalled. In the competition for IT talent, Northern Virginia has been at a competitive disadvantage to those regions. There are many other metro areas that can provide a greater diversity of opportunities, but they can also offer a lower cost of living, more affordable housing, or easier commutes. The region is in a national, and even international, competition for talent.

In 2016, the Northern Virginia Technology Council commissioned a *Technology Workforce Needs Assessment* for the Greater Washington area.[24] This study found that employers faced five specific hard-to-fill competency areas:

- Big data and analytics,
- Cyber security and privacy,
- Data center and cloud infrastructure,
- Network systems, and
- Programming and software development.

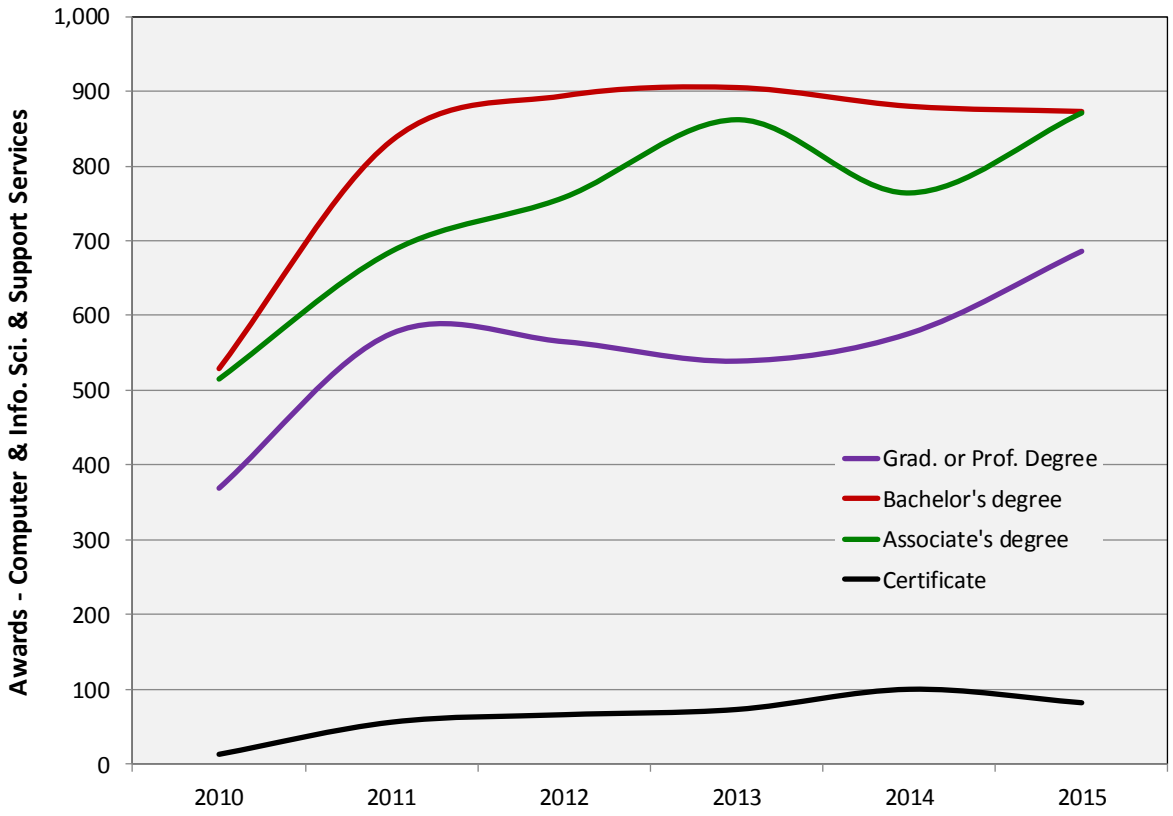
As part of this study, employers also noted that soft skills (e.g., written and verbal communication, problem solving and critical thinking, and relationship management) are also vital considerations. Employers also noted, depending on the nature of the work, the need for U.S. citizenship, security clearances, and 4-year degrees to meet the requirements of federal agencies. Security clearances were particularly important for network systems work.

Figure 14 shows that the region's post-secondary institutions have increased the number of students completing degrees in computer and information sciences to respond to growing demand. In 2015, there were 42 percent more computer and information sciences graduates (5,904 completers) than there had been in 2010 (3,947 completers). Figure 15 shows that many of these completers received degree in broad computer science, information technology, or information sciences. However, there

[23] Harpel, E. and White, M. (2017) "Career pathways for middle-skill jobs in the Greater Washington region's leading industry clusters" prepared for The 2030 Group. Available at: http://cra.gmu.edu/regional-workforce-research/

[24] http://www.nvtc.org/documents/NeedsAssessment.pdf

Figure 14: Completions from Computer and Information Science and Support Services programs



Source: US Dept. of Education, Integrated Postsecondary Education Data System (IPEDS) , Chmura Economics Jobs EQ

were also significant numbers of completers from programs related to computer systems networking and network administration, and computer and information systems security.

Institutions such as George Mason University and Northern Virginia Community College were responsible for many of these graduates, as Bachelors and Associates degrees each accounted for about 35 percent of the total number of degrees. These graduates are important for Northern Virginia, but also for the Commonwealth more broadly. Over 60 percent of Virginia's graduate or professional degrees in computer and information sciences were completed in Northern Virginia, as were 49 percent and 33 percent of its computer and information sciences associate's degrees and bachelor's degrees, respectively.

Increasing the number of degree completers is a necessary step in addressing the region's shortage of technology workers, but this will not sufficiently address the immediate challenge facing the region. Many employers and key stakeholders acknowledge that workers do not necessarily need degrees to do their jobs, but they do need specific skills (e.g., competency in specific programming languages or applications). Industry recognized credentials are one way in which workers can demonstrate to employers that they possess these skills, and they do not need to spend 2 or 4 years to obtain these skills.

While the region will continue to attract talent, the growing importance of industry-recognized skills presents opportunities for native Northern Virginia workers—workers who already accept high housing costs and transportation challenges in exchange for superior cultural amenities and being a part of the national capital region. Short or boot-camp style courses can provide opportunities for new workers—or workers looking to shift careers—to relatively quickly obtain the skills they need to work in the region's technology clusters. There are numerous programs already underway in the region to do just that. For instance, the region's workforce investment boards can help to subsidize the cost of training for dislocated workers. Workforce funding can also be used to subsidize the initial salary of retrained workers, thereby reducing some of the risk perceived by companies who hire workers from these less than traditional labor pools.

There are also a number of new, innovative programs underway. For instance, the Capital One Foundation provided a $100,000 grant to Northern Virginia Community College to work with students from two Prince William County schools to get their CompTIA[25] A+ certification. This program will not only provide them with the basic skills they need to get jobs, but also to introduce them to broader

Figure 15: Completions from Computer and Information Science and Support Services programs (2014-2015)

CIP Code	Program Title	Certificate	Associate's Degree	Bachelor's Degree	Grad. Or Prof. Degree	Total Awards
11.0103	Information Technology	2	393	393	132	920
11.0401	Information Science/Studies	0	0	166	292	458
11.0101	Computer and Information Sciences, General	57	69	86	70	282
11.1002	System, Networking, and LAN/WAN Management/Manager	0	188	0	0	188
11.0701	Computer Science	0	141	39	1	181
11.1003	Computer and Information Systems Security/Information Assurance	0	13	103	55	171
11.0901	Computer Systems Networking and Telecommunications	0	11	24	134	169
11.0801	Web Page, Digital/Multimedia and Information Resources Design	23	18	43	0	84
11.1006	Computer Support Specialist	0	27	0	0	27
11.0501	Computer Systems Analysis/Analyst	0	0	16	0	16
11.0201	Computer Programming/Programmer, General	0	11	0	0	11
11.0802	Data Modeling/Warehousing and Database Administration	0	0	0	2	2
11.0803	Computer Graphics	0	0	2	0	2
11.9999	Computer and Information Sciences and Support Services, Other	0	0	1	0	1

Source: Chmura Economics JobsEQ

[25] Computer Technology Industry Association (CompTIA)

career opportunities available in the region's cybersecurity industry. Northern Virginia Community College's 'Uncommon Coders' program is another program of note. It is a 12-week program designed to prepare exiting military service members for private sector IT jobs. Veterans are seen as an important source of IT talent because they are likely to have an easier time obtaining required security clearance. This program is a collaborative effort supported by companies, workforce boards, and the Northern Virginia Technology Council.[26]

[26] http://www.nvcc.edu/workforce/uncommon-coders/index.html

Priority Goals

The challenges described above—slow growth overall and within key industry clusters, a shortage of technology workers, and the need to grow and keep more innovative, private sector companies—are all the result of a region that remains too highly dependent on the US federal government. In order for the region to change its economic trajectory, it must generate more private sector opportunities in the industry clusters that drive the regional economy.

The Priority Goals described below are the result of a well-informed, data-driven, collaborative process involving the Region 7 Council, the GMU research team, and a group of key stakeholders who provided insights and information relevant to the creation of the Economic Growth and Diversification Plan. The process, which is described in more detail in Appendix B, resulted in the development of key strategic goals that will guide and inform the selection of collaborative projects to receive GO Virginia funding (regional allocation) and for submittal to the competitive grant program. For each strategic goal, the report offers a description of the challenges to be addressed, specific strategic actions to address these challenges, likely partners, funding guidelines (grant and matching), and identifies the performance metrics that will be used as feedback for continuing program improvement.

GO Virginia funding can be used to address these issues, provided those efforts support export-oriented[27] industry clusters that pay above average wages. In Northern Virginia, above average wages exceed $70,000 annually. Given these parameters, the GO Northern Virginia Regional Council elected to focus its funding activities on several technology-oriented industry clusters. These clusters include:

- **Computer Services**
- **Cybersecurity**
- **Consulting Services**
- **Financial Services**
- **Engineering Services**
- **Research Organizations**
- **Life Sciences**

Scaling up and enhancing the competitive position of these industry clusters will require collaborative action that benefits jurisdictions throughout Northern Virginia and the Commonwealth more generally. Given its regional challenges, the scope of the GO Virginia mission, and the scale of the available resources, the GO Northern Virginia Regional Council intends to focus on projects that will help the region achieve three priority goals. These goals are:

1. **Strengthening Northern Virginia's technology workforce,**
2. **Accelerating the development of 'growth' companies, and**
3. **Enhance technology transfer and the commercialization of intellectual property from the region's research centers and institutions.**

[27] Those clusters that bring 'new' money into the region, as opposed to locally-serving industries (e.g., retail) that recycle money in the region.

These consensus goals will inform the regional council's decision making process, but the council will also consider any high impact project that contributes to the overarching GO Virginia goal of achieving private-sector driven job growth in high-wage sectors through interjurisdictional cooperation.

The following articulates the Region 7 goals, explains the challenges they address, and lays out a direction for addressing these challenges and achieving outcomes that will push the region toward a stronger economic future. It is not only intended to serve as a statement of the region's priorities, but also to serve as a guide for parties interested in utilizing GO Virginia funding to support their efforts to address regional challenges.

The descriptions below identify the types of strategic projects the regional council will consider, sample performance measures, and potential partners and sources of match funding. Examples of relevant ongoing regional initiatives have also been included. These examples are not meant to be an exhaustive list of current ongoing activities, but rather are intended to illustrate the types of efforts that the Council might consider funding. There are also some instances where the strategies described involve the region taking greater advantage of statewide initiatives or programs offered by state agencies and organizations. It is more efficient for the region to utilize these existing programs than fund the creation of similar regional programs. Similar types of initiatives, both in and outside the region, are identified in Appendix C.

The Region 7 Council identified a strong preference for high-impact projects. This means that there will likely be fewer total projects, but they will be larger in scale. However, the plan does allow for meaningful smaller projects that may represent pilot efforts for innovative programs that can be tested with fewer initial funds and supported more fully after proof-of-concept. Therefore, we have provided a scale to indicate the expected budget required to complete each strategy.

- **$**=Projects requiring less than $100,000 of GO Virginia funding
- **$$**=Projects requiring between $100,000 and $500,000 of GO Virginia funding
- **$$$**=Projects requiring more than $500,000 of GO Virginia funding

It will be the responsibility of the proposers to describe specific project elements and how their proposed initiatives will benefit multiple jurisdictions in Northern Virginia, or multiple jurisdictions across the Commonwealth. They will also be required to identify and describe how they will track outcome and output measures, and gain commitments from key partners. In some instances, the proposed projects will involve scaling up current, ongoing initiatives so that they can serve more participants or more jurisdictions. In these instances, proposals will benefit by being able to demonstrate and quantify the impacts of their existing efforts.

The projects that are ultimately funded will be determined by the quality of the proposals and the extent to which they align with the regional priorities described below. The next section lays out the Council's goals and will guide project funding decisions.

Goal #1: Strengthen Northern Virginia's Technology Workforce

The region will produce technology workers, both in terms of quality and quantity, needed to grow and enhance the competitiveness of regional technology firms.

Challenge: The number of workers entering technology-related occupations is insufficient to meet regional demand

Explanation and justification

There is a broad regional consensus around the need for more technology workers, both for specific activities related to cybersecurity or to fill information technology or information sciences positions more broadly. Many regional employers and workforce stakeholders note that the region has good paying jobs that need filling, but insufficient numbers of qualified candidates limit their ability to expand and take advantage of new business opportunities. This issue is seen as one of the region's true cross-cutting issues. It is a vital consideration for the industry clusters that form the region's economic base, and it is an issue for which every jurisdiction grapples. While attracting new workers will remain important, the region can make investments in initiatives that will create jobs and opportunities for Northern Virginia workers.

The region will benefit by investing in efforts that prepare more workers—including both workers just entering the labor force and those switching careers—to choose technology-related careers. These initiatives could leverage existing non-degree training and certification programs, apprenticeship and internship opportunities, and programs supporting exiting military. For the region's technology-related clusters to remain competitive, the skills of the technology workforce must also remain current. Not only will workers need access to the training they need to invest in their own careers, but employers must also have access to incumbent worker training opportunities. To be truly useful to employers and workers, incumbent worker training programs must be relevant, accessible, and affordable.

Many regional stakeholders are already participating and investing in these kinds of initiatives. For example, the regional workforce boards provide training dollars to support workers pursuing IT careers and organize and support incumbent worker training for regional technology companies. Northern Virginia Community College has increased its capacity to deliver both credit and non-credit courses related to IT and cybersecurity more specifically. These are just a few of the public and private education and training providers engaged in preparing workers to support the region's technology clusters. Expanding these programs will create a greater density of good jobs for area workers and thereby allow the region to retain existing technology workers, which will also make the region more attractive for new workers. Moreover, it will enable Northern Virginia firms to remain competitive within their given industries and maintain and grow their Northern Virginia operations.

Strategies and Expected Outcomes

- **Strategy 1.1:** Strengthen and expand non-degree programs (e.g., certifications and credentials) that allow workers to enter and advance in technology careers.

  Not all technology jobs require degrees. Industry recognized certifications allow workers to obtain the skills needed to perform many of the required tasks. Often more so than degrees, certifications provide better signals to employers about the actual skills possessed by job seekers. Moreover, stackable credentials built up over time enable workers to document their ability to build their skillsets in order to advance their careers.

  - *Performance measures:* Certifications and credentials granted
  - *Funding required:* $-$$$

- **Strategy 1.2:** Establish and expand internships, apprenticeships and other work-based learning opportunities that prepare workers and provide them with experience in technology careers.

  Work-based learning opportunities (e.g., internships, apprenticeships) can effectively expose students and new workers to career opportunities in technology-related careers. Depending on the nature of the programs, workers can receive both broad-based training and training specific to a given company's needs. Internships allow new workers to gain experience in a potential field of interest, while apprenticeship programs involve on-the-job training, classroom instruction, and a commitment of the employer to hire the apprentice full-time after the successful completion of the program. It allows employers to train new workers specifically for the positions that they need filled.

  - *Performance measures:* Program placements, completions, placements in permanent full-time positions
  - *Funding required:* $-$$$

- **Strategy 1.3:** Strengthen and expand programs that prepare veterans and exiting military personnel with the skills and certifications necessary to enter technology careers.

  Northern Virginia has a strong Department of Defense presence and exiting military personnel are viewed as an important source of workforce talent. The unique demands placed on the region's IT workforce from its heavy emphasis on IT services and cybersecurity, make them a particularly important for meeting the region's workforce needs. Veterans are seen as an important source of IT talent because they are likely to have an easier time obtaining required security clearance. Therefore, training additional exiting military personnel for IT careers and placing them in IT jobs will be a key part in strengthening the region's technology workforce.

  - *Performance measures:* Program placements, completions, placements in permanent full-time positions
  - *Funding required:* $-$$

- **Strategy 1.4:** Identify and/or develop programs recognizing career pathways.

  Career pathways can guide current and future technology workers through an articulated series of educational programs (including credit and non-credit programs from both public and private training providers). These articulated pathways provide workers with the information and training necessary to advance their careers from entry-level to middle-skill positions, and on through to leadership positions. These pathways can help new workers, or workers looking to move into higher paying fields, start technology careers rather than just technology jobs.

  - *Performance measures:* Program participants, cluster employment, cluster average wages.
  - *Funding required:* $-$$

- **Strategy 1.5:** Strengthen and expand technology-oriented incumbent worker training programs that keep the workforce of small and medium-sized firms current and competitive.

  To help the current workforce adapt to changing technologies and production processes, technology companies need access to affordable and accessible incumbent worker training. This training must not only be relevant but also delivered in a format and venue that works for businesses. There are already programs underway within the region that helps offset the cost of incumbent worker training. Smaller companies sometimes are unable to participate in these programs because they lack the sufficient scale to make it worthwhile. Efforts to address these challenges might seek to find areas of common need and include developing programs that train workers from multiple small firms simultaneously.

  - *Performance measures:* Number of SMEs participating in incumbent worker training programs, jobs created/retained due to training
  - *Funding required:* $$

- **Strategy 1.6:** Organize regional cluster networks to promote collaborative workforce development and training solutions.

  Industry- or cluster-specific groups can facilitate better communication about workforce needs between employers and key education and training providers. This can help guide the investment of education and training dollars to address real world company needs. They can also help identify issues of shared concern and the development of collaborative regional solutions to address shared challenges facing companies in key regional clusters.

  - *Performance measures:* Participating companies, cluster employment
  - *Funding required: $*

- **Strategy 1.7:** Develop a regional data system to continuously track and monitor the availability of technology workers with the region's education and training pipeline.

  Technology workers are being trained and are working throughout the region. The region's education and training infrastructure includes high schools, community colleges, universities and private training providers. Combined these institutions and organizations are filling the region's talent pipeline. In order to effectively meet the needs of the region's technology companies, it is important for the region to fully track the number of workers moving through this pipeline and how many will be available to meet the needs of industry. Creating a system that tracks the number of available workers being prepared amongst all these disparate organizations and institutions will allow the region to better align its workforce supply and demand. Moreover, the ability to demonstrate the most current availability of workers will provide the region with another tool to effectively market itself to potential employers looking to locate or expand in Northern Virginia. Given all the institutions and training providers involved in pulling together this kind of system, it must be a collaborative and regional initiative.

    - *Performance measures:* Students and workers in education and training pipeline, number of technology workers.
    - *Funding required: $*

Potential partners:

- Public school systems, particularly Career and Technical Education Programs
- Regional Workforce Boards
- Colleges and universities (e.g., George Mason University, Northern Virginia Community College, etc.)
- Industry groups (e.g., Northern Virginia Technology Council)
- Private and non-profit training providers
- Potential partners will be both regional and cross-regional entities, especially where projects can leverage existing regional and state-level collaborations.

Potential sources of matching funds:

- Workforce Innovation and Opportunity Act funding
- Local jurisdictions
- Regional foundations
- Private sector companies
- Industry groups and associations

Ongoing regional initiatives

- A $100,000 Capital One Foundation grant was used by Northern Virginia Community College (NVCC) to work with students from Prince William County to receive CompTIA[28] A+ certification and introduce them to career opportunities within the rapidly growing cybersecurity industry.[29]

- As a part of the Amazon Web Services (AWS) training initiative, the Northern Virginia AWS Solutions Architect Apprenticeship allows service members and veterans to work directly with Amazon to go through a technical training program over 16 weeks. Following the training, members participate in a 12 month paid apprenticeship with Amazon which often leads to full-time roles at Amazon or elsewhere.[30]

- Northern Virginia Community College's 'Uncommon Coders' program is a 12-week program directed in part to support veterans and transitioning military with the purpose of helping them move into private sector IT jobs. The program is supported by local businesses, workforce boards, and the Northern Virginia Technology Council.[31]

- The Northern Virginia Technology Council's (NVTC) Veterans Employment Initiative aims to accelerate veterans' transition to civilian life by providing better employment opportunities within Virginia's technology community. The Initiative matches veterans with jobs, internships, mentorships and certifications, while also providing support to member companies in their efforts to hire, train and retain qualified veteran employees.[32]

- SySTEMic Solutions is Northern Virginia Community College's STEM outreach program to develop a sustainable STEM pipeline in the region with the collaboration among school divisions, university partners, businesses and community organizations.[33]

- The Incumbent Worker Training Initiative of Northern Virginia[34] is a collaborative effort of the Alexandria-Arlington Regional Workforce Council, the Northern Virginia Workforce Development Board, and Northern Virginia Community College. This program—funded in part through a federal grant—helps to offset the cost of incumbent worker training (50-90 percent depending on the size of the firm) for companies with fewer than 250 workers that are involved in IT and cybersecurity.

[28] Computer Technology Industry Association (CompTIA)

[29] http://www.nvcc.edu/news/press-releases/2016/cybersecurity-pathway.html

[30] http://www.myskillsource.org/pdf/AWSApprenticeshipFlyer.pdf

[31] http://www.nvcc.edu/workforce/uncommon-coders/index.html

[32] http://www.nvtc.org/veterans/

[33] http://www.nvcc.edu/systemic/whoweare.html

[34] https://workforcecouncil.arlingtonva.us/2016/09/incumbent-worker-training-initiative-northern-virginia/

- Northern Virginia Technology Council's (NVTC) Tech Talent Initiative (TTI) provides a series of complimentary programs and activities addressing the shared current and future talent needs of the region's technology employers to certification, skill and competency development.[35]

[35] http://www.nvtc.org/resources/tech_talent_initiative.php

Goal #2: Accelerate the development of 'growth companies'

Regional firms poised for growth will have ready access to the resources, facilities, and expertise necessary to grow their business and expand their markets.

Challenge: Many companies lack awareness of, and access to, the resources, facilities and expertise that would allow them to grow and expand in Northern Virginia.

Explanation and justification

Growth companies are established small- and medium-sized firms with a proven track record of growth. By definition, these do not include individual entrepreneurs or firms that are still in their initial product development stage. In addition to providing overall job growth opportunities, supporting growth companies may also contribute to efforts to diversify the regional economy. Most startup companies initially serve private sector markets. A recent survey of Washington Metro Area startup companies, many of which are technology focused, showed that 77 percent of their revenue came from private sector activity (e.g., business-to-business, business-to-consumer).[36]

Within Northern Virginia, startup firms have pursued federal contracting opportunities because they are often multiyear contracts that have historically provided relatively stable revenue streams. However, these opportunities are now less readily available, and the region's startup firms will need to identify other opportunities and markets if they want to grow their businesses. The region has recognized strengths in fields such as cybersecurity and information technology, but a recent Brookings Institution study showed that these regional clusters would benefit from a stronger global orientation.[37]

To maximize their potential, growth companies often require external assistance. In some instances, companies may need introductions to potential investors who can help finance the development of new products or services. In other instances, growth firms need to better leverage the non-financial support programs related to business planning, regulatory requirements, modern business processes, or exporting. Growth firms may also benefit from initiatives that provide easy and affordable access to *'economic gardening'* programs.[38] These programs are targeted to second-stage companies and work to help them address key challenges by providing them with, for example, customized competitive market and business intelligence on markets, customers, competitors, business processes, and innovation.

The region possesses many programs, resources and facilities that can help growth companies enhance their existing success. For instance, the Mason Enterprise Center is part of Virginia's Small Business Development Center Network and serves the whole Northern Virginia region. It has a wide range of business assistance programs focused on business and strategic planning, financing, marketing,

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[36] *2016 Startup Census Report, Greater Washington, DC Region.* www.fosterly.com

[37] *Greater Washington Metro Export Plan: Global Cities Initiative.* This plan was developed by the Metro Washington Council of Governments, Greater Washington Board of Trade, and Consortium of Universities for the Metropolitan Washington Area, as part of the Brookings Institutions and JP Morgan Chase's Global Cities Initiative. The plan was released in January 2017 and is available here: https://www.mwcog.org/documents/2017/01/11/greater-washington-metro-export-plan/

[38] http://www.kauffman.org/what-we-do/resources/policy/economic-gardening

government contracting, and exporting among others. The region is also home to Virginia's Center for Innovation Technology (CIT), which has a series of resources available to help Growth Companies including CIT GAP funds,[39] which make investments in Virginia-based technology, life science and 'clean' technology companies.

There are also programs within Region 7's individual jurisdictions. For example, the Alexandria Economic Development Partnership (AEDP) funds BOOST Alexandria—a business acceleration program that helps startups grow and expand in Alexandria.[40] AEPD has used grant funding from the Department of Defense to support Capitol Post, a non-profit that serves military veterans and spouses looking to grow sustainable and scalable businesses. Capitol Post is also home to Bunker Labs DC, an accelerator for high-growth startups. Arlington Economic Development's BizLaunch program provides small businesses with much of the local information (e.g., taxes, permitting, licensing) that they need to grow and expand. Even if existing programs have been geared towards startup companies, the expertise and resources they offer may help Growth Companies reach their next stage of development.

Many firms are often unaware that these resources exist, do not know how to access them, or they face barriers (e.g., time, money) that prevent them from fully utilizing these programs. To accelerate the development of companies seeking to grow their business in Northern Virginia, the region will need to better connect Growth Companies to these programs and help reduce barriers to their participation. This will require identifying growth companies, understanding their challenges, and then developing programs that allow them to better access the region's many programs and resources. Moreover, creating an ecosystem of services and resources for enhancing firm performance will help attract investment and encourage Growth Companies to remain in Northern Virginia, even as their markets expand nationally and/or globally.

Strategies and Expected Outcomes

- **Strategy 2.1:** Build greater awareness and usage of existing business support programs and resources; expand these programs to include more companies from multiple Northern Virginia jurisdictions.

  There are a wide variety of business support services available through local jurisdictions, state-supported organizations (e.g., Mason Enterprise Center, CIT), and private service providers. These services may include assistance with improving business planning, adopting lean processes, or undertaking market research. More companies will be able to utilize and benefit from these services if they are more aware of what is offered and how those services can help SMEs grow.

  - *Performance measures:* Increased participation in existing or new programs targeted to Growth Companies in priority clusters
  - *Funding required:* $-$$

[39] http://www.cit.org/service-lines/cit-gap-funds/

[40] http://www.alexecon.org/sites/aedp/files/fact_sheet_-_boost_alexandria.pdf

- **Strategy 2.2:** Support the expansion of programs designed to assist small and medium-sized businesses enter new markets, both domestically and internationally.

  Companies can grow by developing new products and/or selling their products into new markets. Entering new markets, particularly international markets, can pose unique challenges particularly for small and medium-sized companies. Smaller firms tend to have little experience with foreign markets and how to mitigate the risks of entering markets with different rules, regulations and cultures. Similarly, SMEs looking to shift their markets from private sector customers to government contracting, or vise-versa may face similar challenges. Support services exist to help companies looking to export for the first time or move into new markets. The most intensive of these programs reach relatively small numbers of companies at a given time. Expanding these programs and enabling more small companies to participate would allow additional companies to take advantage of these services and put them on a path to growth.

    - *Performance measures:* Companies served, new sales by small- and medium-sized establishments (SMEs) in target clusters
    - *Funding required:* $-$$

- **Strategy 2.3:** Develop economic gardening programs that provide established small businesses (in the priority clusters) with customized competitive market and business intelligence on markets, customers, competitors, business processes, and innovation.

  Growth firms may also benefit from initiatives that provide easy and affordable access to 'economic gardening' programs. These programs are targeted to second-stage companies—companies with a track record of success and an intention and desire to grow. They help these companies address key challenges by working with them individually to, for example, develop customized competitive market and business intelligence on markets, customers, competitors, business processes, and innovation. They provide small companies with resources that are typically only available to larger companies.

    - *Performance measures:* Change in number of jobs and sales in participating firms
    - *Funding required:* $$

- **Strategy 2.4:** Conduct regional survey/census of growth firms and business support programs.

  The programs described above are often dependent on identifying growth companies, or companies that are preparing to grow. These companies do not always self-identify, making it challenging to connect them to the services that might support and enable their growth. Conducting a regional survey or census of growth firms, not only will allow the region to better understand the scale and scope of their activities, but would also help the region identify firms that would benefit from support services. The more firms that are identified, the more can be connected to growth services to help them expand their markets and grow their workforce.

  - *Performance measures:* Number of firms participating in survey, Number of new technology companies in the region
  - *Funding required:* $

Potential partners:

- Business support providers (e.g., Mason Enterprise Center, Genedge Alliance)
- Industry groups (e.g., Northern Virginia Technology Council)
- Economic Development Organizations
- Chambers of Commerce
- Area incubators and accelerators (e.g., Capital Post, 1776)
- Universities (e.g., George Mason University, Marymount University)
- Relevant state organizations (e.g., Virginia Economic Development Partnership, CIT)

Potential sources of matching funds:

- Local jurisdictions
- Industry groups and associations
- Private sector companies

Ongoing regional initiatives

- An initiative managed by the Virginia Economic Development Partnership (VEDP), Virginia International Trade Alliance (VITAL) aims to increase international trade in Virginia. VITAL expands international trade programs via formal partnerships with Virginia's public universities, industry associations and the Virginia Chamber of Commerce to serve their member companies as they expand international sales.[41]

- The ExporTech program helps companies enter or expand into global markets. This program leads companies through a facilitated process that will help them address key challenges such as developing an international business growth plan, having experts review their plans, and

[41] http://exportvirginia.org/vital/

connecting these companies with organizations that will help them move quickly from planning to export sales in specific targeted markets. The program is a national program developed by the US Commerce Department's National Institute of Standards and Technology Manufacturing Extension Partnership (NIST MEP). The Genedge Alliance (Virginia's NIST MEP affiliate) delivers the ExporTech Program.[42]

- The Alexandria Economic Development Partnership sponsors the BOOST Alexandria business acceleration program. The BOOST program uses proven accelerator models and curriculum to help Alexandria-based startups form and grow. The program is intended to increase business development activity and greater economic resiliency in Alexandria. The first BOOST cohort included 12 startups ranging from seed stage to series A.

- The Mason Enterprise Center's Defense Export Sales Initiative assists government contractors looking to move into global markets. The initiative was a one-year cooperative undertaking, consisting of seminars, on-going counseling, plus access to industry experts and government specialists with knowledge of specific markets and suitable customers.

[42] https://www.genedge.org/resources/programs/exportech-virginia

Goal #3: Enhance technology transfer and commercialization from research centers and institutions

The region will have effective processes and sufficient resources to commercialize the innovative technologies developed in its public and private research centers and institutions.

Challenge: The region's innovation ecosystem remains highly dependent on the federal government and is not fully maximizing its innovative assets.

Explanation and justification

As noted earlier, the Washington metro area is an important—but not typical—technology center in that it develops and provides technology services primarily in the service of the federal government. As a result, it also has a different type of innovation ecosystem. Venture capital drives much of the formation of innovative new companies and technologies in large technology centers like Boston or Silicon Valley, but the greater Washington region has a different model for innovation. Given the federal government's large regional footprint, there are two types of entrepreneurial communities in the region—businesses involved in biotech and software that attract venture funding from non-local investors, and businesses that often grow without venture capital and are highly involved in government contracting and services.[43] Northern Virginia is more characterized by the latter.

This unique innovative ecosystem does not mean that the region lacks the ability to create an innovation ecosystem capable of supporting new company formation and the commercialization of new technologies. In fact, the region has a wealth of research assets ranging from post-secondary research institutions (e.g., George Mason University, Virginia Tech, George Washington University, University of Virginia), bio-medical research campuses (e.g., Inova Center for Personalized Health, Janelia Research Campus), and vital federal research agencies (e.g., DARPA, NSF, US PTO). The region is also unique in that it is home to nine of the nation's 43 Federally Funded Research and Development Centers (e.g., RAND Corporation, MITRE).

New technology ventures are inherently risky and often costly so many companies underinvest in activities that could result in new products. Utilizing programs that fund new technology ideas is one way to reduce risk and provide more early-stage capital for small businesses looking to develop and commercialize new, innovative technologies. This means positioning Northern Virginia firms to take greater advantage of federal programs such as the Small Business Innovation Research (SBIR) and Small Business Technology Transfer Research (STTR) programs[44], or state programs such as the Virginia Research Investment Fund.[45] Another example are Innovation Voucher programs that provide firms with

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[43] *Aberman, J. (2016) "Building Entrepreneurial Innovation in the Greater Washington Region," Report to the 2030 Group*

[44] Through a competitive process SBIR sets aside 2.5 percent of the federal research budgets for small businesses to propose projects of interest to federal funders and that also have potential commercial appeal. Representing 0.3 percent of those federal research budgets, the STTR program serves collaborations between universities or nonprofits working with small businesses.

[45] http://www.schev.edu/index/institutional/grants/va-research-investment-fund

grants for research and development assistance from a university or research center, typically targeted to small- and medium-sized firms. Minnesota and Rhode Island are examples of state innovation voucher programs that could serve as models for regional efforts.

Fully leveraging the region's many research assets will also require connecting innovators and inventors to entrepreneurs and experienced business people who are willing and able to bring new technologies and intellectual property to market. These experienced counselors and business executives can assist with securing research and development and/or equity financing, intellectual property issues, or identifying additional technical expertise or market research. The region must also do more than just commercialize new technologies. It must also leverage the expertise contained in the region's universities, research centers and industries to help established small businesses solve specific problems that might represent obstacles to firm growth and development. These elements, when combined effectively, create what is often called an Innovation Ecosystem where there is a sustainable pattern of creation, commercialization, and profit realization that supports spending on new creation.

Accomplishing this goal will enable the region to create new engines of innovation and wealth creation. It is an important element for the region to maintain its primacy as a location for government contracting, while at the same time creating unique products and services that can lead to more private sector market opportunities. As a result, this goal is an important step toward achieving greater economic diversification and reducing the region's overall dependence on the federal government.

Strategies and Expected Outcomes

- **Strategy 3.1:** Provide counseling, mentoring and other instructional programs for technology and venture-backed startups, to facilitate innovators bringing new technologies to the marketplace.

  Many inventors may not fully understand the commercial potential of their inventions. These inventors and small firms developing new technologies would benefit from technology commercialization and incubation assistance programs that support academic, government and commercial innovators to develop the right business model necessary to bring their innovations to the marketplace. These programs often provide counseling and access to mentors with domain expertise in order to increase their potential for commercial success. Expanding these programs and the number of innovators and start-ups they serve will increase the region's capacity to create new commercial products and successful technology ventures.

  - *Performance measures:* Participating companies, sales from commercialized technologies, jobs created/retained
  - *Funding required:* $$-$$$

- **Strategy 3.2:** Create an innovation voucher program for small, established technology companies.

  Small and medium-sized companies are often slow to seek outside help, because they either do not fully appreciate the value of outside expertise or they simply cannot afford it. Innovation voucher programs provide eligible small companies with discreet amounts of funding (e.g., $5,000 to $15,000) to access not-for-profit expertise from universities, national laboratories, and/or nonprofit research centers. These grants would enable companies to prepare assessments of research needs, analyze technology transfer options or identify technology solutions. These voucher programs have an added benefit of building the region's network of consultants, coaches, and technical assistance providers.

  - *Performance measures:* Vouchers granted, sales resulting from new technologies, jobs created/retained
  - *Funding required:* $$-$$$

- **Strategy 3.3:** Provide grants to encourage companies to prepare and submit Small Business Innovation Research (SBIR) and Small Business Technology Transfer Research (STTR) grant applications.

  New technology ventures are inherently risky and often costly, and as a result many companies underinvest in activities that could result in new products. One approach to reducing that risk and providing more early-stage capital for small businesses that are developing and commercializing new, innovative technologies might be to support investment in programs that fund new technology ideas. The SBIR/STTR grant programs encourage small businesses to undertake federal research and development that has the potential for broader commercial opportunities. Preparing these grant applications can be elaborate and burdensome for many small businesses. Efforts can be made to reduce the barriers small companies face in preparing these grant applications, such as small grants underwriting the grant application process or providing technical assistance for grant writers. Reducing these barriers will increase the number of regional businesses submitting SBIR/STTR grant applications.

  - *Performance measures:* Companies assisted, successful grant applications
  - *Funding required:* $-$$

- **Strategy 3.4:** Support executive-in-residence programs that connect emerging technology companies with experienced technology industry executives. These executives will embed with emerging firms to lead them through the commercialization and capital fundraising process.

  Many emerging companies are started by inventors and innovators who have deep knowledge of their field, but limited business experience. In order to grow, these companies require more experienced executive talent. Executive-in-residence programs can connect these companies with executives that have experience in helping start-up companies grow. They can help these companies by getting them through the initial growth challenges - providing them with the necessary strategic guidance and networks needed to thrive.

    - *Performance measures:* Companies assisted, jobs created in assisted firms
    - *Funding required:* $$-$$$

Potential partners:

- Business support providers (e.g., Mason Enterprise Center, Genedge Alliance)
- Industry groups (e.g., Northern Virginia Technology Council)
- Private sector companies
- Area incubators and accelerators (e.g., Capital Post, 1776, Inova Personalized Health Accelerator)
- Locally-based Federally Funded Research and Development Centers (e.g., Rand Corporation, MITRE)
- Research universities (e.g., George Mason University, Virginia Tech, George Washington University, University of Virginia)
- Bio-medical research campuses (e.g., Inova Center for Personalized Health, Janelia Research Campus)
- Federal research agencies (e.g., DARPA, NSF, USPTO)

Potential sources of matching funds:

- Local jurisdictions
- Industry groups and associations

Ongoing regional initiatives

- Innovation Commercialization Assistance Program (ICAP) is a Virginia-wide technology commercialization and incubation assistance program that supports academic, government and commercial incubators in their support of innovators bringing new technologies to the marketplace. The program provides counseling, access to mentors with domain expertise and

lean startup-based instructional programs with specific focus on IT, big data, and cybersecurity firms. ICAP is a program of Virginia's Small Business Development Council (SBDC) Network.[46]

- The Center for Innovative Technology's (CIT) Commonwealth Research Commercialization Fund (CRCF) accelerates innovation and economic growth in Virginia by advancing solutions to important state, national, and international problems through technology research, development, and commercialization.[47]

- The Center for Innovative Technology (CIT) provides workshops and support concerning SBIR and STTR programs.[48]

- George Mason University has an Executive in Residence through the School of Business' Mason GovCon Initiative.[49]

[46] https://www.virginiasbdc.org/programs/icap/

[47] http://www.cit.org/initiatives/crcf/

[48] http://www.cit.org/events/?F_c=3

[49] http://business.gmu.edu/govcon/about/

Implementing Northern Virginia's GO Virginia Economic Growth and Diversification Plan

As the Northern Virginia's GO Virginia efforts move from the planning phase to implementation, the regional council will undertake several activities to advance it efforts and achieve its goals. These activities will include:

- **Ongoing outreach:** The regional council will continuously work to build awareness of the region's GO Virginia efforts. Regional council members and representatives will ensure that key stakeholders groups (e.g. local elected officials, city and county staff, business groups, economic and workforce development organizations, etc.) throughout the region are aware of GO Virginia opportunities. This outreach can be used to generate interest in submitting GO Virginia proposals. The more proposals the regional council receives, the more likely it will be able to fund high quality projects with greater likelihood of success. Outreach efforts will also allow the regional council to identify potential opportunities, such as successful local initiatives that could be scaled up to, for instance, train more workers, serve more companies or deliver to a wider set of jurisdictions, both in Northern Virginia and throughout the Commonwealth.

- **Encouraging partnerships:** The council's outreach efforts can help facilitate potential partnerships if different groups are working on similar efforts that would benefit from collaboration. On August 1 the Council announced a request for letters of interest for projects. A project review committee will review incoming concepts and identify the most promising in terms of impact, goals alignment, and partnership opportunities. The Council will encourage partnerships among localities and help identify potential matching resources.

- **Increasing administrative efficiencies:** The Council will actively encourage administrative efficiencies in all projects. Review criteria for prospective projects will include a factor for administrative efficiency and cost savings. The Project Review Committee will identify opportunities for cost savings and administrative cost reductions as part of the screening process. Projects that increase the footprint of existing initiatives are likely to provide strong opportunities for increasing the impact on the region, without significantly increasing the administrative costs. Moreover, this increased regional collaboration and avoiding redundant efforts will likely reduce regional competition.

- **Laying the groundwork for financial sustainability:** In its selection of projects, the Council will emphasize matching resources to meet the requirements for GO Virginia funding. The Executive Committee and project review committees will continue to identify resources to support plan implementation. The Council is also currently examining the best options and procedures for securing matching fund contributions from the participating localities. The Council budget for its second year (FY2018-2019) will lay out the matching resources for projects and Capacity Building funds.

- **Setting procedures for effective evaluation:** Information gathering will be vital to the plan's implementation. It will be important for the regional council to track the outputs of its investments (e.g., number of workers trained, companies served), but also the outcomes of these efforts (e.g., growth of key clusters, rising wages) and how those outcomes demonstrate that the region is achieving its stated goals. The Economic Growth and Diversification Plan identifies some potential performance metrics and expected outcomes for each of the strategies. However, a key consideration when reviewing the proposals will be the proposer's ability to identify and describe how they will track outcome and output measures. It will be particularly important for them to demonstrate their ability to collect information on core measures such as jobs created/wage levels or increased sales because these are the measures that will quantify the broader economic impacts of the GO Virginia investments.[50] As the GO Virginia program gets off the ground, the regional council will largely be defined by the projects in which it invests and the early successes emerging from those investments. The council believes it is vital for the region to demonstrate quantifiable successes and impacts.

- **Promoting successful investments:** The region council will also make dedicated efforts to promote the impact of its GO Virginia investments. Given that GO Virginia is a new program, the council will actively promote its accomplishments through presentations to regional groups and traditional and social media. The council will produce an annual report that describes the economic impacts of the regional council's investments and provides narratives to put a face on the data. All of these communication activities will be important to build the standing and credibility of the GO Virginia program in Northern Virginia, in addition to generating greater interest in contributing to the council's work and projects.

- **Routinely revisiting and adapting the plan:** The Economic Growth and Diversification Plan will be a living document. As the GO Virginia effort moves forward, there will be several sources of feedback that will allow the regional council to adjust the plan to better guide its investments. For instance, the types of proposals submitted will provide additional insights into where there is regional interest and capacity for action. The impact measures will highlight how effective the strategies have been in achieving their intended goals. The region may have proposals made to the state GO Virginia board rejected, and any failures can provide an important opportunity for learning and adaptation. This feedback, particularly over the first year, will be incorporated into the plan to ensure it remains current and is serving the region's needs. As a result, the regional council should revisit the plan twice during the first year of implementation and annually thereafter.

The early stages of GO Virginia implementation will be critical for the effort's long-term success. Initial success will largely be defined by the projects in which the Council invests. However, in order to be a sustainable entity and perceived as something more than just a source of state funding, these initial

[50] Jobs, labor income, and sales are key inputs for economic impact modeling software such as IMPLAN (www.implan.com).

projects must effectively and demonstrably address the region's priority goals, and the regional council itself must demonstrate that it has been an effective steward of the public's dollars. Early tangible results will go a long way to determining future sustainability.

Appendix A: GO Northern Virginia Regional Council (Region 7) Members

Name	Company/Agency	Sector
Executive Committee		
Carolyn Parent, Chair	LiveSafe, Inc.	Private sector - Technology
Matt McQueen, Vice-Chair	Northrop Grumman Corporation	Private sector - Government contracting
Todd Rowley, Secretary	United Bank	Private sector - Banking
Hon. Marty Nohe, Treasurer	Northern Virginia Transportation Authority, Prince William Co. Board of Supervisors & Appliance Connection	Local Government & small business
Paul Liberty, Governance Chair	George Mason University	Higher education
Plan Review Committee		
Hon. Ralph Buona	Loudoun Co. Board of Supervisors & Telos Corporation	Local government & Technology
Eileen Ellsworth	Community Foundation for Northern Virginia	Non-profit
Members - Private Sector		
John Backus	NAV.VC	Financial Services
Sid Banerjee	Clarabridge	Consulting
Tim O'Brien	Micron Corporation	Manufacturing
Jim Cole	Virginia Hospital Center	Healthcare
Hon. Tom Davis	Deloitte	Consulting
David Guernsey	Guernsey Office Products	Retail & distribution
Michele Kang	Cognosante	Health IT
Greg Leisch	Newmark Grubb Knight Frank	Research & analytics
Hon. Tom Rust	Pennoni	Engineering
Danny Vargas	VARCom Solution	Marketing
Sharon Virts	FCiFederal	Technology
Charlene Wheeless	Bechtel	Engineering
John Wood	Telos Corporation	Technology
Todd Yeats	The Boeing Company	Government contracting
Members - Public Sector or Non-Profit		
Dr. Scott Brabrand	Fairfax Co. Public Schools	K-12
Hon. Laurie DiRocco	NVRC & Mayor, City of Vienna	Planning District
Hon. John Foust	Fairfax Co. Board of Supervisors	Local government
Gerald Gordon	Fairfax Co. Econ. Development Authority	Authority- Econ. development
Bobbie Kilberg	Northern Virginia Technology Council	Non-profit
Jack Potter	Metropolitan Washington Airports Authority	Authority - Transportation
Scott Ralls	Northern Virginia Community College	Higher education
Jen Siciliano	Inova	Healthcare

Appendix B: The Plan Development Process

The process for completing the GO Northern Virginia Regional Council's Economic Growth and Diversification Plan began in earnest in June 2017, when the George Mason University Center for Regional Analysis (CRA) was contracted to develop the plan. To support the plan development, a small plan review committee was established to assist CRA by providing early feedback on presentation materials and plans for engaging the regional council. This plan review committee was also tasked with reviewing the initial draft of the Economic Growth and Diversification Plan. CRA also leveraged scheduled meetings to work with the GO Northern Virginia Regional Council. These meetings, described in more detail below, involved facilitated discussions to arrive at consensus decisions about regional priorities and goals.

Research, analysis, and outreach

The consulting team solicited input from regional stakeholders, such as economic development organizations, workforce investment boards, higher education, local jurisdictions, and other groups that might be involved in supporting future GO Virginia efforts (e.g., Mason Enterprise Center). These stakeholder conversations included discussions about key issues facing the region and areas of opportunity, as well as ongoing initiatives and partnerships. This engagement continued throughout the process.

Review of existing plans

CRA also reviewed other existing regional documents to identify the trends, issues, and ongoing regional initiatives most relevant to the goals of the Go Virginia. The region is uniquely positioned not only as a Virginia region, but also as part of the National Capital region. As a result, the process included reviewing reports specific to Northern Virginia and its jurisdictions,[51] as well as those that speak to issues facing the Greater Washington metro area.[52] These reports provided additional input on regional priorities, issues and ongoing regional efforts. Several of these relevant plans are described below, with particularly emphasis placed on the elements that either specifically or more generally address the three goals prioritized by the GO Northern Virginia Regional Council.

- **Metro Washington Council of Governments *Region Forward:*** MWCOG's Regional Forward Initiative[53] established shared goals among business, nonprofits and elected leaders in the metro Washington region to address key regional issues related to land use, transportation, climate and energy, the environment, education, housing, health and human services, and the economy. The economic goals speak to the need for a more diversified, stable and competitive economy. The importance of having a skilled workforce is an issue of growing importance and

[51] E.g. White, M. "Assessing Alexandria/Arlington's Regional Labor Market", George Mason University Center for Regional Analysis, prepared for the Alexandria/Arlington Regional Workforce Council.; Northern Virginia Workforce Development Board (Area #11) Local Plan,

[52] *State of the Region: Economic Competitiveness Report 2016*, Metro Washington Council of Governments.

[53] https://www.mwcog.org/community/planning-areas/regional-planning/region-forward/goals/

MWCOG has released two reports that highlight the region's demand, particularly for STEM-related occupations.[54]

- **Global Cities Initiative, *Greater Washington Metro Export Plan:*** The Brookings Institution and JP Morgan Chase Global Cities Initiative—supported by the Metro Washington Council of Governments (MWCOG), the Greater Washington Board of Trade, and the Consortium of Universities of Greater Washington—encouraged the region's public and private leadership to become more globally engaged. The result of this effort was a *Greater Washington Metro Export Plan*.[55] This plan laid out four strategic objectives to increase exports from the region including:

    1. Strengthen global engagement of mid-sized firms in the biotech, cybersecurity, and IT sectors;
    2. Promote and market Greater Washington's global advantages to grow exports and attract trade and investment;
    3. Streamline and enhance Greater Washington's export assistance ecosystem; and
    4. Drive participation in exporting from Greater Washington's small and midsized professional services firms.

- **The 2030 Group's *Roadmap for the Washington Region's Economic Future:*** The 2030 Group commissioned the Roadmap for the Washington Region's Economic Future to identify Greater Washington's competitive strengths and weaknesses and the export-based, high value-added industry clusters that could spur economic growth and development throughout the region.[56] The research team identified advocacy services, information and communications technology services, science and security technology services, biological and health technology services, business and financial services, media and information services, and business and leisure travel as the export-based clusters that could spur growth in the Greater Washington Area.[57] Interviews with regional business leaders in these clusters all identified talent as one of the primary factors affecting the growth potential of these clusters.

- **Alexandria/Arlington Regional Workforce Council's *Assessing Alexandria/Arlington's Regional Labor Market:*** This report[58] provided the regional workforce council with information about the trends shaping the Arlington and Alexandria's regional workforce and identifies current and future sources of labor demand. The major themes highlighted in this report direct stakeholders to some kind of action to improve collaboration between the region's workforce boards, focus investments on key service sectors (e.g., IT, cybersecurity, hospitality), and continuing to collaborate with other regional stakeholder to diversify the economy to reduce dependency on

[54] https://www.mwcog.org/documents/2016/10/25/trends-in-workforce-demand/

[55] https://www.mwcog.org/documents/2017/01/11/greater-washington-metro-export-plan/

[56] Stephen S. Fuller, *The Roadmap for the Washington Region's Future Economy*, December 2015

[57] Inforum, University of Maryland, Roadmap for the Washington Region's Economic Future: Seven Key Economic Clusters, 2015.

[58] White, M. "Assessing Alexandria/Arlington's Regional Labor Market", George Mason University Center for Regional Analysis, prepared for the Alexandria/Arlington Regional Workforce Council.

federal government spending. The information contained in this report is currently being used to update the region's Comprehensive Economic Development Strategy (CEDS).[59]

- **The Northern Virginia Workforce Development Board (Area #11) Local Plan[60]:** The NVWDB plan emphasizes the region's shortage of skilled IT talent. Both public and private sector employers struggle to find qualified candidates, and must either engage in bidding wars for talented employees or find the IT services from outside the region. One of the organizations key strategic goals is to expand and improve the talent pipeline of youth and adults for businesses, and as a result it supports activities designed to:

    - Strengthen workforce development strategies for adults that link education and career pathways to employment opportunities;
    - Establish strong linkages with post-secondary institutions to align programming with career pathways and labor market demand; and
    - Promote registered apprenticeship programs.

Regional analysis

GO Virginia Economic Growth and Diversification Plans must be data-driven strategies. To that end, CRA analyzed a number of regional economic and demographic trends. Prior to formally starting the economic growth and diversification planning process, CRA presented baseline indicators data at the May 10th regional council meeting. This information covered topics such as the region's dependence on federal procurement spending (particularly Department of Defense spending), a reliance on the federal government to drive regional innovation, and net domestic out-migration, which indicates potential threats exist to the region's ability to retain its most skilled workers. Given this earlier presentation and subsequent stakeholder input, CRA prepared more focused information in advance of the June regional council meeting. This analysis focused on the region's key 'export' clusters and high-demand occupations (i.e., clusters that bring new money into the region and, unlike sectors like retail, are not driven primarily by population growth).

Selecting priority clusters and identifying areas for action

The June 21st GO Northern Virginia Regional Council meeting was used to present the research described above and then work with the regional council to select priority clusters and potential areas for action. After reviewing the information presented about the region's leading clusters, regional council members were asked to identify the clusters that they viewed as the highest priority for Region 7's GO Virginia plan. There was consensus about the importance of the region's leading professional and business services clusters, and specifically the computer services cluster. Several council members also expressed support for several emerging regional clusters related to research and life sciences.

[59] The region's previous CEDS was drafted in 2011, which is available here: https://workforcecouncil.arlingtonva.us/alexandriaarlington-comprehensive-economic-development-strategy/

[60] http://www.myskillsource.org/page/id/94

CRA also asked regional council members to prioritize the regional issues that will be addressed in the Economic Growth and Diversification Plan. There was consensus on the need to strengthen the region's capacity to train and prepare technology workers. There are many ways the region might address this issue. Strategies might include promoting technology-related careers to students and new workers, supporting boot camps that provide workers with industry-recognized certifications, or executive training that enables current technology workers to advance in their careers. Given that the availability of appropriately-skilled workers is a cross-jurisdictional and cross-industry issue, council members identified this issue as a high priority concern both in the short- and long-term. Moreover, this was an issue that can fit within the scale of the GO Virginia resources.

Beyond the unmet demand for skilled labor, regional council members identified several other issues as regional priorities. For instance, the regional council might consider using GO Virginia funding on programs that facilitate the growth of innovation firms. The region could address this issue by supporting economic gardening programs. These programs connect successful small businesses—that have a desire to grow—with the resources and information necessary to create jobs and expand their markets. Regional council members also noted the importance of encouraging entrepreneurship and connecting entrepreneurs to support programs. Whereas producing more skilled workers is an immediate, short-term priority, enterprise growth and development strategies represent important medium to long-term strategies for diversifying the regional economy. It was also noted that stronger technology transfer from regional universities (e.g., George Mason University), would benefit both entrepreneurs and growth companies.

Council members discussed several other issues. The issue of jointly marketing the region was raised, but it was not seen as an effective use of GO Virginia funding. After having been raised at the May 10 meeting, the regional council discussed the role that regulations play on business formation and growth. This is an issue that the Virginia Chamber of Commerce has been working on extensively, and Chamber representatives will be invited to review their efforts and discuss potential roles for the regional council in Chamber initiatives as a future council meeting. However, addressing these issues was seen as generally outside the scope of the GO Virginia mission.

Selecting priority goals

At the July 20th GO Northern Virginia Regional Council meeting, council members were tasked with selecting the priority goals that will drive the region's economic growth and diversification plan. Based on the input provided at the June 21st work session and in subsequent comments and stakeholder interviews, the regional council was presented with 4 potential priority goals:

- Strengthen the pool of technology workers
- Diversify the markets of federal contractors
- Support the efforts of 'growth companies' to expand
- Enhance technology transfer and commercialization from research centers and institutions

To arrive at a consensus about the priority goals, each council member was given 10 pennies to "invest" in the 4 proposed goals. Facilitators were posted at the 4 corners of the room to take input on edits/enhancements to the goals, specific actions or projects, appropriate measures, potential

partnerships and funding sources. Thirty minutes were set aside for the breakout sessions. The CRA team collected member ideas to incorporate in the next plan draft.

At the end of the interactive session, Chair Carolyn Parent reconvened the meeting for a report out. The result of the "penny investment" exercise was tabulated:

- Strengthen the pool of technology workers: $0.90
- Diversify the markets of federal contractors: $0.18
- Support the efforts of 'growth companies' to expand: $0.55
- Enhance technology transfer and commercialization from research centers and institutions: $0.35

Many members noted the difficulty to diversify the markets of federal contractors and the long-time horizon that would be required. Federal contractors must develop unique capabilities or intellectual properties to have success in business-to-business markets. It was agreed to remove this as a stand-alone goal and to incorporate these kinds of efforts within the latter two goals. Several council members advocated restricting the goals further to just one or two goals. However, the council ultimately arrived at the decision to retain the three goals to in order to provide program flexibility. It was also agreed to indicate that the goal of strengthening the pool of technology workers was the region's primary goal, but it would remain open to consider good ideas that could impact the other two goals. Members were asked to send any additional suggestions or reflections to the GMU team over the following ten days.

Drafting the plan

A draft plan was prepared in early August and initially reviewed by the Plan Review Committee (Eileen Ellsworth, Ralph Buona, Interim Director Martha Marshall, and Director Sue Rowland) to provide initial comments and direction. The Council's Executive Committee also provided review and comment. CRA made edits to the plan based on this initial feedback. The completed draft plan was circulated to all members several days before the planned adoption on August 24th. Final edits were completed before the Northern Virginia Economic Growth and Diversification Plan was submitted to the Department of Housing and Community Development on August 25th.

Appendix C: Strategy Examples

Strategy	Examples
Strategy 1.1: Strengthen and expand non-degree programs (e.g., certifications and credentials) that allow workers to enter and advance in technology careers.	• Via a $5.6 million America's Promise grant, WorkSource Montgomery and Montgomery College in Maryland are providing IT and cybersecurity training for students[61]. Montgomery College, in partnership with Frederick and Prince George's Community Colleges, will provide IT and Cybersecurity workers with short-term trainings to create a pipeline of talent for local companies. The grant money will help to underwrite the costs of workers getting the training they need to secure key certifications such as Certified Information Systems Security Professional (CISSP) or Information Technology Management Certification. • A $100,000 Capital One Foundation grant was used by Northern Virginia Community College (NVCC) to work with students from Prince William County to receive CompTIA[62] A+ certification and introduce them to career opportunities within the rapidly growing cybersecurity industry.[63]
Strategy 1.2: Establish and expand internships, apprenticeships and other work-based learning opportunities that prepare workers and provide them with experience in technology careers.	• As a part of the Amazon Web Services (AWS) training initiative, the Northern Virginia AWS Solutions Architect Apprenticeship allows service members and veterans to work directly with Amazon to go through a technical training program over 16 weeks. Following the training, members participate in a 12 month paid apprenticeship with Amazon which often leads to full-time roles at Amazon or elsewhere.[64] • Hampton City, VA Schools are overhauling their high school curriculum and structure, using the Ford Next Generation Learning (NGL) model to focus on career and college-prep pathways[65]. Ford NGL is the education initiative of the Ford Motor Company Fund and

[61] http://worksourcemontgomery.com/news-articles/worksource-montgomery-to-help-better-prepare-workers-for-careers-in-it-and-cybersecurity/

[62] Computer Technology Industry Association (CompTIA)

[63] http://www.nvcc.edu/news/press-releases/2016/cybersecurity-pathway.html

[64] http://www.myskillsource.org/pdf/AWSApprenticeshipFlyer.pdf

[65] http://www.dailypress.com/news/education/dp-nws-academies-of-hampton-comparison-20170814-story.html

Strategy	Examples
	works with school districts to establish the framework for career exploration and work-based learning through business partnerships.[66] • The IT- Ready program is a free education, training and career placement program supported by a network of non-profit collaborators. It gives people the knowledge and skills they need for a successful IT career, and then connects them to an on-the-job experience opportunity.[67] The program is run by the nonprofit Creating IT Futures and has a Washington DC program out of Silver Spring, MD.
Strategy 1.3: Strengthen and expand programs that prepare veterans and exiting military personnel with the skills and certifications necessary to enter technology careers.	• Northern Virginia Community College's 'Uncommon Coders' program is a 12-week program directed in part to support veterans and transitioning military with the purpose of helping them move into private sector IT jobs. The program is supported by local businesses, workforce boards, and the Northern Virginia Technology Council.[68] • The Northern Virginia Technology Council's (NVTC) Veterans Employment Initiative aims to accelerate veterans' transition to civilian life by providing better employment opportunities within Virginia's technology community. The Initiative matches veterans with jobs, internships, mentorships and certifications, while also providing support to member companies in their efforts to hire, train and retain qualified veteran employees.[69] • See Amazon Web Services (AWS) training initiative above.
Strategy 1.4: Identify and/or develop programs recognizing career pathways.	• The Greater Houston Partnership (GHP) is focusing on analyzing demand in the region for the construction industry to better understand the ebbs and flows and help businesses plan for their needs. In the petrochemical industry, GHP is mapping where employers are

[66] https://fordngl.com/about

[67] http://www.creatingitfutures.org/developing-programs/it-ready

[68] http://www.nvcc.edu/workforce/uncommon-coders/index.html

[69] http://www.nvtc.org/veterans/

Strategy	Examples
	sourcing talent using the "talent flow analysis" concept and then working to build a common language of competencies and credentials to create and share best practices for the top three jobs in the industry.[70] • Missouri Science Technology Engineering and Math Workforce Innovations Network (MoSTEMWINs) is part of a federal grant-funded initiative helping Missourians earn job training for in-demand careers. The MoSTEMWINs program a structure for Missouri community colleges to implement training for careers in manufacturing, information technology, health services/health sciences and science support.[71] The program focuses their coursework, counseling, and career exploration around career pathways and stackable credentials.[72] • SySTEMic Solutions is Northern Virginia Community College's STEM outreach program to develop a sustainable STEM pipeline in the region with the collaboration among school divisions, university partners, businesses and community organizations.[73]
Strategy 1.5: Strengthen and expand technology-oriented incumbent worker training programs that keep the workforce of small and medium-sized firms current and competitive.	• The North Carolina NCWorks Incumbent Worker Training Grant is a competitive training grant through which qualifying businesses can address employees' skill gaps and impact company stability. These skills gaps can be a result of a worker's changing responsibilities or requirements in her/his job, or for a worker whose job may potentially be eliminated and skill upgrading is needed to accept new responsibilities. The maximum amount is $10,000 per grant, with a lifetime funding limit of $40,000. The program is administered through the State's Local Workforce Development Boards (LWDB) and the North Carolina Department of Commerce's Division of Workforce Solutions.[74]

[70] https://www.uschamberfoundation.org/center-education-and-workforce/talent-pipeline-management-learning-network

[71] http://www.mowins.org/mostemwins.html

[72] https://www.missourieconomy.org/regional/mowins.stm

[73] http://www.nvcc.edu/systemic/whoweare.html

[74] http://www.nccommerce.com/Portals/11/Policy%20Statements/1-NCWorks%20IW%20PY%202014%20Guidelines%20for%20Businesses%20Final.pdf

Strategy	Examples
	• The Incumbent Worker Training Initiative of Northern Virginia[75] is a collaborative effort of the Alexandria-Arlington Regional Workforce Council, the Northern Virginia Workforce Development Board, and Northern Virginia Community College. This program—funded in part through a federal grant—helps to offset the cost of incumbent worker training (50-90 percent depending on the size of the firm) for companies with fewer than 250 workers that are involved in IT and cybersecurity.
Strategy 1.6: Organize regional cluster networks to promote collaborative workforce development and training solutions.	• Northern Virginia Technology Council's (NVTC) Tech Talent Initiative (TTI) provides a series of complimentary programs and activities addressing the shared current and future talent needs of the region's technology employers to certification, skill and competency development.[76] • The Hampton Roads region has formed several cluster groups around the region's key economic drivers including ship building and repair, port operations and logistics and advanced manufacturing among others. These groups exist to provide a venue for firms in these clusters to discuss and address common issues of concern (e.g., workforce, infrastructure, etc.) that affect the cluster's relative competitiveness in the region. The development of these cluster groups were based on a cluster mapping initiative sponsored by ReInvent Hampton Roads.[77]

[75] https://workforcecouncil.arlingtonva.us/2016/09/incumbent-worker-training-initiative-northern-virginia/

[76] http://www.nvtc.org/resources/tech_talent_initiative.php

[77] http://reinventhr.org/industryClusters.html

Strategy	Examples
Strategy 1.7: Develop a regional data system to continuously track and monitor the availability of technology workers with the region's education and training pipeline.	• The Florida Education and Training Placement Information Program (FETPIP) is a data collection and consumer reporting system to provide follow-up data on former students and program participants who have graduated, exited or completed a public education or training program within the State of Florida.[78] • The Charleston Regional Competitiveness Center data portal is designed to provide up-to-date economic and workforce information on Berkeley, Charleston and Dorchester counties in South Carolina. The Regional Competitiveness Center is a public website that provides information on the area, providing users with the significant leading indicators, research, and data trends they need to make both business and policy decisions. For example, students and job seekers can review occupational data to discover what occupations are available and growing in the region and employers can access data about fast-growing industries, local demographics, wage information, and available workforce by occupation.[79]
Strategy 2.1: Build greater awareness and usage of existing business support programs and resources; expand these programs to include more companies from multiple Northern Virginia jurisdictions.	• KCSourceLink's mission is to connect the individuals, organizations and institutions that support entrepreneurship to one another and the community at large to grow a vibrant entrepreneurial ecosystem in Kansas City. KCSourceLink connects 245 business-building organizations across the 18-county bi-state metro. Through KCSourceLink, thousands of entrepreneurs and business owners are able to gain access to the right resource at the right time to start, grow and accelerate their businesses.[80] • One Million Cups is a free program developed by the Kauffman Foundation designed to educate, engage, and connect entrepreneurs with their communities. Every week, entrepreneurs present their startup companies to their communities and learn how their community can help support their business to flourish.[81]

[78] http://www.fldoe.org/accountability/fl-edu-training-placement-info-program/

[79] http://www.charlestonregionaldata.com/

[80] http://www.kcsourcelink.com/about-us/about-kcsourcelink

[81] http://www.1millioncups.com/about

Strategy	Examples
Strategy 2.2: Support the expansion of programs designed to assist small and medium-sized businesses enter new markets, both domestically and internationally.	• An initiative managed by the Virginia Economic Development Partnership (VEDP), Virginia International Trade Alliance (VITAL) aims to increase international trade in Virginia. VITAL expands international trade programs via formal partnerships with Virginia's public universities, industry associations and the Virginia Chamber of Commerce to serve their member companies as they expand international sales.[82] • The ExporTech program helps companies enter or expand into global markets. This program leads companies through a facilitated process that will help them address key challenges such as developing an international business growth plan, having experts review their plans, and connecting these companies with organizations that will help them move quickly from planning to export sales in specific targeted markets. The program is a national program developed by the US Commerce Department's National Institute of Standards and Technology Manufacturing Extension Partnership (NIST MEP). The Genedge Alliance (Virginia's NIST MEP affiliate) delivers the ExporTech Program.[83] • The Alexandria Economic Development Partnership sponsors the BOOST Alexandria business acceleration program. The BOOST program uses proven accelerator models and curriculum to help Alexandria-based startups form and grow. The program is intended to increase business development activity and greater economic resiliency in Alexandria. The first BOOST cohort included 12 startups ranging from seed stage to series A. • The Mason Enterprise Center's Defense Export Sales Initiative assists government contractors looking to move into global markets. The initiative was a one-year cooperative undertaking, consisting of seminars, on-going counseling, plus access to industry experts and government specialists with knowledge of specific markets and suitable customers.

[82] http://exportvirginia.org/vital/

[83] https://www.genedge.org/resources/programs/exportech-virginia

Strategy	Examples
Strategy 2.3: Develop economic gardening programs that provide established small businesses (in the priority clusters) with customized competitive market and business intelligence on markets, customers, competitors, business processes, and innovation.	• ADVANCE Maryland is a program for second-stage entrepreneurs that helps businesses address their unique challenges and identify new opportunities. The program provides a research team that analyzes information in market dynamics, strategy, sales leads, and innovation. Participant companies must employ between 10 and 99 employees and have annual revenues between $1 million and $50 million.[84] The program is a partnership of the Maryland Department of Business and Economic Development (DBED), the Economic Alliance of Greater Baltimore (EAGB) and the National Center for Economic Gardening. • Florida Economic Gardening Institute's GrowFL technical assistance program works to help second-stage growth companies create employment through sophisticated business tools. GrowFL has assisted more than 900 companies since its implementation in 2009.[85]
Strategy 2.4: Conduct regional survey/census of growth firms and business support programs.	• The Kansas City Area Life Sciences Institute (KCALSI) commissions an industry census of the region's life sciences companies every three years to define the regional composition of life sciences companies and to define the scope of economic activity in this vital sector of the region's economy.[86]
Strategy 3.1: Provide counseling, mentoring and other instructional programs for technology and venture-backed startups, to facilitate innovators bringing new technologies to the marketplace.	• Innovation Commercialization Assistance Program (ICAP) is a Virginia-wide technology commercialization and incubation assistance program that supports academic, government and commercial incubators in their support of innovators bringing new technologies to the marketplace. The program provides counseling, access to mentors with domain expertise and lean startup-based instructional programs with specific focus on IT, big data, and cybersecurity firms. ICAP is a program of Virginia's Small Business Development Council (SBDC) Network.[87]

[84] http://commerce.maryland.gov/fund/programs-for-businesses/advance-maryland

[85] http://www.growfl.com/about/history/

[86] http://kclifesciences.org/wp-content/uploads/2015-KCALSI-CENSUS-FINAL.pdf

[87] https://www.virginiasbdc.org/programs/icap/

Strategy	Examples
	• The Center for Innovative Technology's (CIT) Commonwealth Research Commercialization Fund (CRCF) accelerates innovation and economic growth in Virginia by advancing solutions to important state, national, and international problems through technology research, development, and commercialization.[88]
Strategy 3.2: Create an innovation voucher program that would provide small, established technology companies with discreet amounts of funding ($5,000 to $15,000) to access not-for-profit expertise from universities, national laboratories, and/or nonprofit research centers. These grants would enable companies to prepare assessments of research needs, analyze technology transfer options or identify technology solutions.	• Through the Rhode Island Commerce Corporation's Innovation voucher program enterprises with fewer than 500 employees can receive grants of up to $50,000 to fund R&D assistance from a Rhode Island university, research center or medical center.[89] • Minnesota Employment and Economic Development's is piloting an Innovation Voucher Program that provides up to $25,000 in financing to help small businesses purchase technical assistance and services necessary to advance research, development or commercialization of new or innovative products and services.[90] • The Tennessee RevV! program connects Tennessee manufacturers to experts with at Oak Ridge National Laboratory (ORNL).[91] The RevV! program provides manufacturers with vouchers so that they can work with these experts to solve challenges in product development and process innovation. It is a $2.5 million program, and is a partnership between the State of Tennessee, University of Tennessee and ORNL. It is based in part on the New Mexico Small Business Assistance program that connects New Mexico companies to the resources and experts at Los Alamos and Sandia national labs.[92]

[88] http://www.cit.org/initiatives/crcf/

[89] http://commerceri.com/finance-business/taxes-incentives/innovation-vouchers/

[90] https://mn.gov/deed/business/financing-business/deed-programs/voucher/

[91] https://www.ornl.gov/programs/revv

[92] http://www.nmsbaprogram.org/

Strategy	Examples
Strategy 3.3: Provide grants to encourage companies to prepare and submit Small Business Innovation Research (SBIR) and Small Business Technology Transfer Research (STTR) grant applications.	• The *Kentucky SBIR-STTR Matching Funds Program* is funded by the Cabinet for Economic Development, (CED), Office of Commercialization and Innovation (OCI) and is administered by The Kentucky Science and Technology Corporation (KSTC). The Matching Funds Program provides Matching Funds up to $150,000 for Phase I and up to $500,000 for Phase II (up to two years). These Matching Funds are to be used for new and additional work tasks that are complementary to existing Federal SBIR-STTR Award.[93] In Addition, Kentucky offers a *SBIR/STTR Resource Center* to help Kentucky innovators, entrepreneurs, and technology-oriented small businesses navigate the SBIR/STTR process proposal development, writing assistance, and post award guidance.[94] • The Center for Innovative Technology (CIT) provides workshops and support concerning SBIR and STTR programs.[95]
Strategy 3.4: Support executive-in-residence programs that connect emerging technology companies with experienced technology industry executives. These executives will embed with emerging firms to lead them through the commercialization and capital fundraising process.	• The Pittsburgh Life Sciences Greenhouse (PLSG) Executive Program offers emerging life sciences companies seasoned C-level executives who can direct business formation and growth through the commercialization and capital fundraising processes. The PLSG Executive Program provides executive talent to help form companies, subject matter experts to guide them, leaders to run companies, and program managers and directors to help them to grow.[96] • New Jersey Economic Development Authority's (EDA) Executive-in-Residence program connects the State's broad pool of life science talent with promising companies located at the EDA's Commercialization Center for Innovative Technologies (CCIT).[97]

[93] http://ksef.kstc.com/index.php/funding-programs/ky-sbirsttr-matching

[94] http://www.kysbir.com/index.php

[95] http://www.cit.org/events/?F_c=3

[96] http://www.plsg.com/business-growth-programs/executive-program/

[97] http://www.njeda.com/Press-Room/News-Articles/Press-Releases/EDA-Announces-Launch-of-New-Executive-in-Residence

Strategy	Examples
	• George Mason University has an Executive in Residence through the School of Business' Mason GovCon Initiative.[98]

[98] http://business.gmu.edu/govcon/about/

Appendix D: Cluster Definitions and Supplemental Data

NAICS	Cluster	2012 Emp.	2017 Emp.	Ann. % Change in Region 7 Emp. (12-17)	2012 US Emp	2017 US Emp	Ann. % Change in US Emp. (12-17)	2012 LQ	2017 LQ	Change in LQ 12-17	Avg Wage
	Computer services	**115,439**	**118,231**	**0.5%**	**1,935,988**	**2,426,421**	**4.6%**	**6.61**	**5.62**	**-0.99**	**$125,226**
518210	Data Processing, Hosting, and Related Services	6,591	8,270	4.6%	270,908	326,925	3.8%	3.39	3.00	-0.39	$131,698
541511	Custom Computer Programming Services	28,021	27,152	-0.6%	724,044	913,836	4.8%	4.16	3.53	-0.63	$124,165
541512	Computer Systems Design Services	73,111	75,925	0.8%	763,768	991,025	5.3%	11.03	9.09	-1.94	$126,107
541513	Computer Facilities Management Services	1,359	1,487	1.8%	58,770	73,787	4.7%	2.81	2.39	-0.42	$97,290
541519	Other Computer Related Services	6,357	5,397	-3.2%	118,498	120,848	0.4%	5.05	5.30	0.25	$115,959
	Consulting services	**54,739**	**53,969**	**-0.3%**	**1,018,059**	**1,227,143**	**3.8%**	**5.96**	**5.07**	**-0.89**	**$116,012**
541611	Administrative Management and General Management Consulting Services	29,561	32,288	1.8%	505,711	672,545	5.9%	7.08	5.70	-1.38	$115,316
541612	Human Resources Consulting Services	1,572	1,517	-0.7%	87,974	89,167	0.3%	1.91	2.02	0.11	$111,760
541614	Process, Physical Distribution, and Logistics Consulting Services	13,923	9,831	-6.7%	105,704	127,584	3.8%	10.31	9.14	-1.17	$115,682
541618	Other Management Consulting Services	4,413	4,231	-0.8%	101,920	109,057	1.4%	4.60	4.60	0.00	$128,416
541690	Other Scientific and Technical Consulting Services	5,270	6,102	3.0%	216,750	228,790	1.1%	3.12	3.17	0.05	$112,683
	Financial services	**20,283**	**24,751**	**4.1%**	**1,985,357**	**2,097,786**	**1.1%**	**1.13**	**1.36**	**0.23**	**$154,021**
521110	Monetary Authorities-Central Bank	31	0	-100.0%	18,174	19,082	1.0%	0.00	0.00	0.00	n/a
522120	Savings Institutions	251	158	-8.8%	180,769	121,963	-7.6%	0.10	0.15	0.05	$111,598
522190	Other Depository Credit Intermediation	13	10	-5.1%	13,255	11,055	-3.6%	0.08	0.11	0.03	$90,618
522210	Credit Card Issuing	514	3,282	44.9%	104,200	87,701	-3.4%	3.49	4.44	0.95	$138,765

522220	Sales Financing	119	239	15.0%	79,659	96,663	3.9%	0.33	0.29	-0.04	$148,469
522291	Consumer Lending	215	400	13.2%	91,502	108,224	3.4%	0.48	0.44	-0.04	$89,647
522292	Real Estate Credit	3,416	2,988	-2.6%	207,535	242,910	3.2%	1.60	1.46	-0.14	$132,927
522294	Secondary Market Financing	5,011	5,400	1.5%	18,704	18,222	-0.5%	32.02	35.17	3.15	$206,372
522298	All Other Nondepository Credit Intermediation	591	698	3.4%	64,979	70,700	1.7%	1.19	1.17	-0.02	$110,510
522310	Mortgage and Nonmortgage Loan Brokers	552	763	6.7%	62,030	90,773	7.9%	1.36	1.00	-0.36	$116,094
522320	Financial Transactions Processing, Reserve, and Clearinghouse Activities	830	1,150	6.7%	112,338	129,076	2.8%	1.14	1.06	-0.08	$110,079
522390	Other Activities Related to Credit Intermediation	2,240	2,405	1.4%	93,582	86,718	-1.5%	2.85	3.29	0.44	$129,444
523110	Investment Banking and Securities Dealing	380	237	-9.0%	154,609	147,134	-1.0%	0.17	0.19	0.02	$187,460
523120	Securities Brokerage	1,676	1,815	1.6%	287,183	285,706	-0.1%	0.70	0.75	0.05	$195,428
523130	Commodity Contracts Dealing	43	20	-14.2%	13,569	15,059	2.1%	0.16	0.16	0.00	$152,686
523140	Commodity Contracts Brokerage	33	5	-31.4%	13,413	10,565	-4.7%	0.04	0.06	0.02	$37,288
523210	Securities and Commodity Exchanges	29	47	10.1%	8,205	5,527	-7.6%	0.64	1.01	0.37	$188,102
523910	Miscellaneous Intermediation	151	418	22.6%	32,933	35,723	1.6%	1.41	1.39	-0.02	$121,904
523920	Portfolio Management	1,060	1,211	2.7%	161,126	222,017	6.6%	0.83	0.65	-0.18	$159,944
523930	Investment Advice	2,222	2,877	5.3%	171,747	216,420	4.7%	1.86	1.58	-0.28	$146,523
523991	Trust, Fiduciary, and Custody Activities	47	61	5.4%	21,412	20,338	-1.0%	0.32	0.36	0.04	$98,626
523999	Miscellaneous Financial Investment Activities	129	179	6.8%	23,789	30,924	5.4%	0.83	0.69	-0.14	$108,437
525910	Open-End Investment Funds	52	2	-47.9%	21,654	766	-48.7%	0.01	0.32	0.31	$201,189
525990	Other Financial Vehicles	57	22	-17.3%	9,181	3,148	-19.3%	0.27	0.81	0.54	$240,052
561450	Credit Bureaus	621	364	-10.1%	19,809	21,372	1.5%	2.04	2.02	-0.02	$118,500
541330	**Engineering services**	**28,546**	**24,528**	**-3.0%**	**968,851**	**1,024,803**	**1.1%**	**3.27**	**2.76**	**-0.51**	**$117,275**
	Corporate HQs	**26,151**	**24,073**	**-1.6%**	**1,937,407**	**2,246,516**	**3.0%**	**1.50**	**1.24**	**-0.26**	**$145,219**
551111	Offices of Bank Holding Companies	71	41	-10.4%	15,723	12,877	-3.9%	0.29	0.38	0.09	$129,551

551112	Offices of Other Holding Companies	286	553	14.1%	66,680	74,023	2.1%	0.92	0.89	-0.03	$150,310
551114	Corporate, Subsidiary, and Regional Managing Offices	25,794	23,479	-1.9%	1,855,004	2,159,616	3.1%	1.40	1.29	-0.11	$145,126
	Trans. & logistics	**17,217**	**17,861**	**0.7%**	**1,717,966**	**1,874,836**	**1.8%**	**1.11**	**1.10**	**-0.01**	**$73,733**
481111	Scheduled Passenger Air Transportation	10,554	9,727	-1.6%	405,635	423,072	0.8%	2.66	2.73	0.07	$89,500
481112	Scheduled Freight Air Transportation	317	445	7.0%	12,157	12,064	-0.2%	4.06	4.37	0.31	$41,560
481211	Nonscheduled Chartered Passenger Air Transportation	91	150	10.5%	32,138	31,357	-0.5%	0.52	0.57	0.05	$81,804
481212	Nonscheduled Chartered Freight Air Transportation	43	14	-20.1%	8,342	8,934	1.4%	0.19	0.19	0.00	$77,193
481219	Other Nonscheduled Air Transportation	63	17	-23.0%	3,920	6,061	9.1%	0.48	0.34	-0.14	$101,766
484121	General Freight Trucking, Long-Distance, Truckload	248	280	2.5%	564,074	591,611	1.0%	0.06	0.06	0.00	$61,663
484230	Specialized Freight (except Used Goods) Trucking, Long-Distance	114	126	2.0%	116,722	139,421	3.6%	0.12	0.11	-0.01	$54,289
485210	Interurban and Rural Bus Transportation	263	228	-2.8%	22,682	23,431	0.7%	1.11	1.15	0.04	$57,264
485510	Charter Bus Industry	185	289	9.3%	31,477	30,998	-0.3%	1.02	1.11	0.09	$48,740
488111	Air Traffic Control	685	574	-3.5%	23,890	19,553	-3.9%	2.66	3.49	0.83	$159,303
488119	Other Airport Operations	2,127	3,664	11.5%	90,050	119,320	5.8%	4.51	3.64	-0.87	$31,865
488190	Other Support Activities for Air Transportation	1,163	1,023	-2.5%	99,595	110,023	2.0%	1.14	1.10	-0.04	$66,372
488210	Support Activities for Rail Transportation	10	10	0.0%	25,964	33,682	5.3%	0.04	0.03	-0.01	$31,149
488490	Other Support Activities for Road Transportation	266	219	-3.8%	54,535	59,252	1.7%	0.45	0.44	-0.01	$43,951
488510	Freight Transportation Arrangement	986	953	-0.7%	195,908	230,190	3.3%	0.54	0.49	-0.05	$71,907
488991	Packing and Crating	92	103	2.3%	18,976	19,552	0.6%	0.60	0.63	0.03	$47,461
488999	All Other Support Activities for Transportation	10	39	31.3%	11,901	16,315	6.5%	0.36	0.28	-0.08	$53,904
	Business support services	**16,658**	**17,737**	**1.3%**	**1,614,238**	**1,805,551**	**2.3%**	**1.14**	**1.13**	**-0.01**	**$81,590**

533110	Lessors of Nonfinancial Intangible Assets (except Copyrighted Works)	93	149	9.9%	24,129	23,392	-0.6%	0.68	0.76	0.08	$103,747
541199	All Other Legal Services	424	392	-1.6%	23,078	28,361	4.2%	1.88	1.64	-0.24	$89,026
541214	Payroll Services	550	372	-7.5%	159,088	169,892	1.3%	0.26	0.26	0.00	$62,938
541930	Translation and Interpretation Services	1,480	1,455	-0.3%	39,355	51,519	5.5%	4.10	3.35	-0.75	$75,946
541990	All Other Professional, Scientific, and Technical Services	5,961	7,699	5.3%	349,155	398,514	2.7%	2.45	2.29	-0.16	$95,007
561210	Facilities Support Services	5,449	4,496	-3.8%	144,826	157,731	1.7%	3.44	3.38	-0.06	$79,651
561330	Professional Employer Organizations	710	1,140	9.9%	371,405	360,352	-0.6%	0.34	0.38	0.04	$53,194
561421	Telephone Answering Services	101	185	12.9%	41,527	39,194	-1.1%	0.49	0.56	0.07	$31,983
561422	Telemarketing Bureaus and Other Contact Centers	1,161	931	-4.3%	407,003	510,041	4.6%	0.25	0.22	-0.03	$44,863
561920	Convention and Trade Show Organizers	729	918	4.7%	54,672	66,555	4.0%	1.86	1.64	-0.22	$70,798
	Marketing, design & publishing	**15,604**	**16,455**	**1.1%**	**1,546,993**	**1,773,390**	**2.8%**	**1.12**	**1.07**	**-0.05**	**$89,089**
511120	Periodical Publishers	1,955	1,882	-0.8%	121,833	103,580	-3.2%	1.71	2.16	0.45	$96,699
511130	Book Publishers	224	152	-7.5%	74,436	64,842	-2.7%	0.23	0.28	0.05	$60,273
511140	Directory and Mailing List Publishers	192	88	-14.4%	32,735	20,788	-8.7%	0.30	0.50	0.20	$55,501
511199	All Other Publishers	107	117	1.8%	12,070	11,421	-1.1%	1.08	1.21	0.13	$89,692
519110	News Syndicates	162	192	3.5%	13,417	13,141	-0.4%	1.59	1.74	0.15	$98,107
519120	Libraries and Archives	919	883	-0.8%	164,775	166,239	0.2%	0.59	0.63	0.04	$41,615
519130	Internet Publishing and Broadcasting and Web Search Portals	1,798	1,929	1.4%	127,121	224,121	12.0%	1.68	1.02	-0.66	$124,996
519190	All Other Information Services	374	552	8.1%	13,791	22,196	10.0%	4.44	2.95	-1.49	$82,463
541410	Interior Design Services	685	663	-0.7%	58,792	71,864	4.1%	1.25	1.10	-0.15	$59,215
541420	Industrial Design Services	144	53	-18.1%	15,583	20,806	6.0%	0.38	0.30	-0.08	$58,213
541430	Graphic Design Services	948	838	-2.4%	98,375	100,500	0.4%	0.94	0.99	0.05	$63,213
541490	Other Specialized Design Services	105	115	1.8%	16,928	20,570	4.0%	0.75	0.66	-0.09	$69,478
541613	Marketing Consulting Services	2,581	3,010	3.1%	211,415	287,535	6.3%	1.58	1.24	-0.34	$100,801
541810	Advertising Agencies	1,024	1,316	5.1%	190,126	216,575	2.6%	0.77	0.72	-0.05	$110,592
541820	Public Relations Agencies	1,061	993	-1.3%	62,404	70,478	2.5%	1.76	1.67	-0.09	$105,142

541830	Media Buying Agencies	106	202	13.8%	13,517	17,714	5.6%	1.66	1.35	-0.31	$106,961
541840	Media Representatives	148	147	-0.1%	28,180	25,589	-1.9%	0.58	0.68	0.10	$150,142
541850	Outdoor Advertising	86	88	0.5%	36,406	40,149	2.0%	0.27	0.26	-0.01	$70,423
541860	Direct Mail Advertising	890	863	-0.6%	53,085	47,995	-2.0%	1.80	2.13	0.33	$59,371
541870	Advertising Material Distribution Services	35	26	-5.8%	14,062	11,737	-3.6%	0.21	0.26	0.05	$84,889
541890	Other Services Related to Advertising	1,083	1,465	6.2%	73,296	104,953	7.4%	2.22	1.66	-0.56	$53,328
541910	Marketing Research and Public Opinion Polling	977	881	-2.0%	114,646	110,597	-0.7%	0.85	0.95	0.10	$89,794
	Research organizations	**16,942**	**13,687**	**-4.2%**	**663,819**	**721,263**	**1.7%**	**2.83**	**2.19**	**-0.64**	**$119,837**
541711	Research and Development in Biotechnology	697	688	-0.3%	142,189	177,307	4.5%	0.54	0.46	-0.08	$95,645
541712	Research and Development in the Physical, Engineering, and Life Sciences (except Biotechnology)	14,554	11,076	-5.3%	462,098	480,661	0.8%	2.66	2.73	0.07	$125,368
541720	Research and Development in the Social Sciences and Humanities	1,691	1,923	2.6%	59,532	63,295	1.2%	3.58	3.61	0.03	$96,638
813920	**Professional organizations**	**5,767**	**6,203**	**1.5%**	**78,597**	**86,401**	**1.9%**	**8.14**	**8.28**	**0.14**	**$93,299**
	Life Sciences*	**9,256**	**9,644**	**0.8%**	**2,414,127**	**2,576,214**	**1.3%**	**0.43**	**0.44**	**0.01**	**$72,687**
111000	Crop Production (15%)*	406	309	-5.3%	287,131	280,237	-0.5%	0.18	0.13	-0.05	$8,763
325199	All Other Basic Organic Chemical Manufacturing	28	25	-2.1%	33,911	37,425	2.0%	0.10	0.08	-0.02	$102,308
325311	Nitrogenous Fertilizer Manufacturing	1	1	0.5%	7,581	8,150	1.5%	0.02	0.01	-0.01	$14,478
325314	Fertilizer (Mixing Only) Manufacturing	1	1	-1.9%	8,352	8,440	0.2%	0.01	0.02	0.01	$17,211
325320	Pesticide and Other Agricultural Chemical Manufacturing	1	1	8.2%	13,892	12,818	-1.6%	0.01	0.01	0.00	$17,211
325411	Medicinal and Botanical Manufacturing	8	1	-30.5%	19,528	28,191	7.6%	0.05	0.01	-0.04	$18,106
325412	Pharmaceutical Preparation Manufacturing	56	70	4.7%	204,470	203,295	-0.1%	0.03	0.04	0.01	$120,339
325414	Biological Product (except Diagnostic) Manufacturing	130	128	-0.3%	26,729	31,788	3.5%	0.61	0.48	-0.13	$104,686

327215	Glass Product Manufacturing Made of Purchased Glass (20%)*	34	32	-1.0%	40,814	47,885	3.2%	0.10	0.08	-0.02	$53,141
333314	Optical Instrument and Lens Manufacturing (10%)*	2,196	366	-30.1%	21,750	19,502	-2.2%	12.58	2.23	-10.35	$83,228
334510	Electromedical and Electrotherapeutic Apparatus Manufacturing	70	24	-19.1%	59,750	64,334	1.5%	0.15	0.04	-0.11	$55,537
334513	Instruments and Related Products Manufacturing for Measuring, Displaying, and Controlling Industrial Process Variables (3%)*	61	58	-1.2%	59,374	60,894	0.5%	0.13	0.11	-0.02	$87,659
334516	Analytical Laboratory Instrument Manufacturing	116	89	-5.1%	31,992	35,285	2.0%	0.45	0.30	-0.15	$102,249
334517	Irradiation Apparatus Manufacturing	173	42	-24.7%	13,057	13,319	0.4%	1.65	0.37	-1.28	$107,579
339112	Surgical and Medical Instrument Manufacturing	274	460	10.9%	118,430	121,737	0.6%	0.29	0.45	0.16	$114,860
339113	Surgical Appliance and Supplies Manufacturing	74	91	4.2%	99,715	100,563	0.2%	0.09	0.11	0.02	$70,603
339114	Dental Equipment and Supplies Manufacturing	7	10	8.0%	16,442	15,648	-1.0%	0.05	0.08	0.03	$55,389
339115	Ophthalmic Goods Manufacturing	27	44	10.0%	28,713	26,253	-1.8%	0.12	0.20	0.08	$42,973
339116	Dental Laboratories	285	393	6.7%	48,094	48,647	0.2%	0.74	0.96	0.22	$44,795
423450	Medical, Dental, and Hospital Equipment and Supplies Merchant Wholesalers	394	704	12.3%	192,551	201,465	0.9%	0.25	0.41	0.16	$99,204
424210	Drugs and Druggists' Sundries Merchant Wholesalers (82%)*	304	153	-12.8%	188,626	202,820	1.5%	0.20	0.09	-0.11	$108,631
541380	Testing Laboratories (10%)*	328	372	2.6%	155,851	168,380	1.6%	0.26	0.26	0.00	$73,096
541711	Research and Development in Biotechnology	697	688	-0.3%	142,189	177,307	4.5%	0.61	0.46	-0.15	$95,645
541712	R & D in the Physical, Engineering, and Life Sciences (except Biotechnology) (5%)*	14,554	11,076	-5.3%	462,098	480,661	0.8%	3.92	2.73	-1.19	$125,368
611310	Colleges, Universities, and Professional	12,204	12,805	1.0%	2,827,079	2,971,908	1.0%	0.54	0.51	-0.03	$56,871

	Schools (Private) (25%)*										
621511	Medical Laboratories	2,481	2,722	1.9%	169,651	200,563	3.4%	1.82	1.61	-0.21	$60,599
	Cybersecurity #	**37,417**	**37,612**	**0.1%**	**1,242,094**	**1,395,977**	**2.4%**	**3.45**	**3.20**	**-0.25**	**$104,900**
15-1121	Computer Systems Analysts	14,748	14,932	0.2%	533,558	607,866	2.6%	3.16	2.92	-0.24	$102,300
15-1122	Information Security Analysts	5,300	5,310	0.0%	92,218	103,591	2.4%	6.57	6.08	-0.49	$108,400
15-1141	Database Administrators	2,568	2,598	0.2%	109,870	121,993	2.1%	2.67	2.53	-0.14	$99,700
15-1142	Network and Computer Systems Administrators	9,566	9,591	0.1%	354,538	393,336	2.1%	3.09	2.89	-0.20	$102,900
15-1143	Computer Network Architects	5,235	5,181	-0.2%	151,910	169,191	2.2%	3.94	3.63	-0.31	$118,000

Source: Chmura Economics JobsEQ, 2017 Q1; Clusters defined by US Cluster Mapping Project

* Total employment for the Life Sciences cluster was calculated using a percentage of certain Industries, in order to represent only the portion of that industry performing work within Life Sciences. The individual employment figures for each 6-digit NAICS industry reflect the total for that industry, not the percentage used to calculate the overall cluster total.

The Cybersecurity cluster was tabulated using occupational employment as opposed to industry employment. This was to reflect the industry crosscutting nature of Cybersecurity jobs.