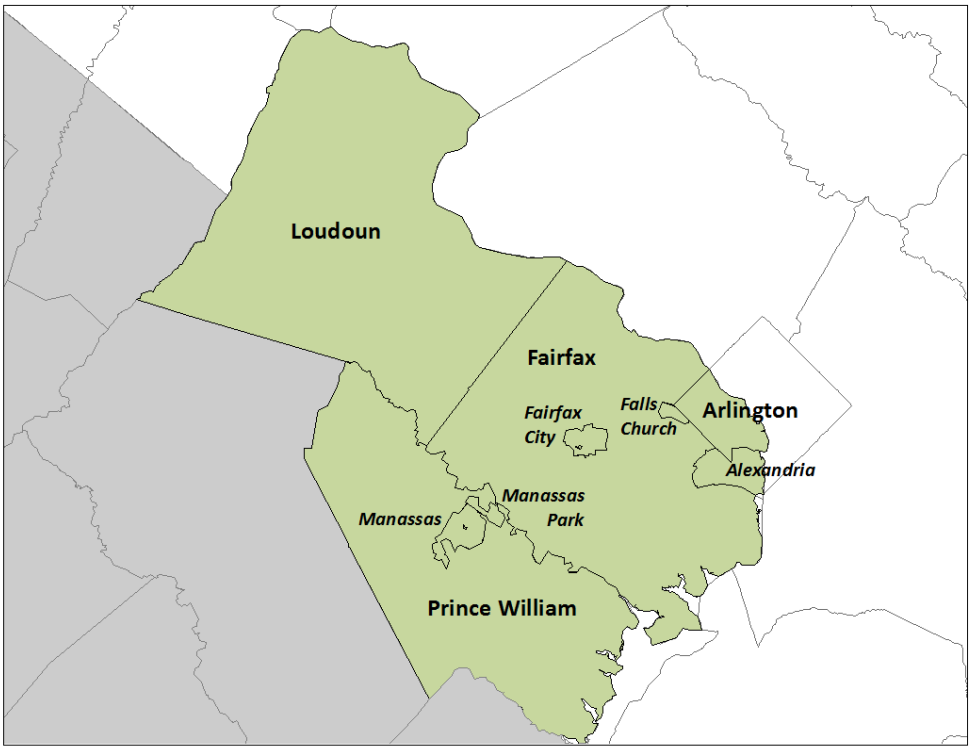

Economic Growth and Diversification Plan August 2019 Update

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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Executive Summary

The following is the 2019 update to the original Economic Growth and Diversification Plan (EGDP) adopted by the Region 7 (Northern Virginia) Council under the Virginia Growth and Opportunity Initiative. This plan update was prepared by the Center for Regional Analysis (CRA) at George Mason University with input and guidance from the Region 7 Council. The plan document includes updates to data, highlights key economic challenges facing the region, reiterates the priority goals established by the Council, and the introduction of an importance expansion in strategies to achieve the plan's workforce development goals. These modifications reflect knowledge and experience gained since the implementation of the original EGDP. (The original EGDP can be found at www.GOnorthernVA.com)

Key Characteristics of the Northern Virginia Economy

- The region's key economic development assets include:
  - Announcement of the location of Amazon's second headquarters (HQ2) in Arlington.
  - Highly educated workforce with 56 percent of the working age population possessing at least a bachelor's degree.
  - Federal government civilian workers exceed 98,000 in the region.
  - Rising federal procurement and nine Federally Funded Research and Development Centers.
  - Campuses of three Research 1 Universities (GMU, VT, UVA), and the announcement of Virginia Tech's new innovation campus.
  - Emerging bio-medical research centers.
  - Largest number of computer security analysts in the nation.
  - Sufficient inventory of office and industrial space to support growth in the regional economy.
- Region 7 has significant economic challenges:
  - The region remains over-reliant on federal spending.
  - The Department of Defense continues to geographically diversify their procurement of technology services.
  - While overall entrepreneurial activity is competitive in Region 7, by some measures the region's overall innovation ecosystem is underperforming, especially compared to other national technology industry hubs.
    - The region continues to lag in its ability to attract venture capital funding.
    - The region needs to improve gown-to-town collaborations between businesses and universities to enhance opportunities driven by university-based innovations.
  - Talent development, attraction and retention represent the key economic development challenge.

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. Only three clusters—financial services,

cybersecurity, and transportation & logistics—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:

- 57.9 percent of all jobs in the computer services cluster,
- 15.8 percent of research organization jobs,
- 15.0 percent of jobs at corporate headquarters,
- 11.2 percent of engineering services employment, and
- 9.8 percent of all consulting jobs.

- Data obtained from Economic Modeling Specialists, Inc (EMSI) shows more than 16,500 IT-related job openings in Region 7 and intense competition for many key occupations in targeted traded sectors of the economy.
- 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 NVTC 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. Solutions must include industry-recognized credentials and that meeting the demand for technology workers will require education programming starting at the earliest levels of elementary education and building through the entire K-12 system.
- Retaining talent in high cost of living areas is an increasing challenge for Region 7 employers, therefore the Region 7 Council will look to emphasize initiatives that can directly and indirectly enhance the value of remaining in Northern Virginia.

Priority Goals

Strategic priority industry clusters for the Economic Growth and Diversification Plan remain:

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

The Region 7 Council expects to continue encouraging grant proposals that will:

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.**

The descriptions below identify the types of strategies the regional council will consider. 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. More detailed descriptions of the strategies, potential partners, and sources of matching funds can be found in the Plan in Brief and main body of this report. (Items new to this plan update are bolded.)

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.

Strategies and Expected Outcomes

- **Strategy 1.1:** Strengthen and expand non-college degree programs (e.g., certifications and credentials) that allow workers to enter and advance in technology careers. ***This strategy is to be expanded to explicitly include k-12 public education-based initiatives.***
- **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.
- **Strategy 1.3:** Strengthen and expand programs that prepare veterans and exiting military personnel with the skills and certifications necessary to enter technology careers.
- **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.
- **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.
- **Strategy 1.6:** Organize regional cluster networks to promote collaborative workforce development and training solutions.
- **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.
- **Strategy 1.8: Explore and support opportunities for cross jurisdictional efforts to attract new Talent to Region 7.**

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: As noted in a recent report by TEConomy Partners, there is a pressing need to enhance the business startup eco-system. Even when startup eco-system support is present, many companies lack awareness of, and access to, the resources, facilities and expertise that would allow them to grow and expand in Northern Virginia.

Strategies and Expected Outcomes

- **Strategy 2.1:** Using non-grant resources, commission an entrepreneurial eco-system development plan for Region 7.
- **Strategy 2.2:** Build greater awareness and usage of existing business support programs and resources; expand these programs to include more companies from multiple Northern Virginia jurisdictions.
- **Strategy 2.3:** Support the expansion of programs designed to assist small- and medium-sized businesses (SMEs) enter new markets, both domestically and internationally.
- **Strategy 2.4:** Work with senior leadership at GMU, VT, NVCC and others on supporting activities that result in IP commercialization and new business formation among faculty, students, and university business partners.
- **Strategy 2.5:** 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.
- **Strategy 2.6:** Conduct regional survey/census of growth firms and business support programs.

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.

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.
- **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.
- **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.
- **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.

Project Pipeline

There are a number of challenges identified over the past two years in attracting viable grant applications that can be accepted by the Council, state GO-Virginia staff and the state board. The Region 7 Council will continue current and start several new initiatives for increasing the volume of high-quality grant applications that best meet the goals and strategies of this plan:

- The Education and Outreach Committee is empowered and provided resources to develop a strategic communication and education plan.
- The Project Committee, working with our Council members, council staff, and external advisors, will engage in a trial program to develop grant applications that specifically address tightly-defined EGDP goals.
- The Region 7 Council Executive Committee, along with members of the Project Committee, is engaging in efforts to enhance collaboration between Council Activities and funding opportunities with our two largest regional university partners, GMU and VT.
- Project applicant mentoring has increasingly been used to enhance the quality of grant applications.
- The Project Committee, working with staff and the Executive Committee, will continue to review project start-up challenges and impediments on projects previously awarded GO-Virginia funding.

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 recommendations.

Current Project Performance

At this writing, GO Northern VA's Council has successfully promoted the funding for four projects: Northern Virginia Tech Talent Pipeline (NVTTP), Alexandria / Arlington Strengthening Our Workforce; NVCC's Fab Lab, and the NVTTP Apprenticeship Initiative. Details on each project can be found below, with a chart outlining how the projects would address any of the Council's strategic goals as contained in the 2017 G&D Plan. In line with the experience of other GO Virginia regions, the start-up phase for these projects has taken longer than anticipated. The lessons learned will be applied to managing future grants and advising applicants on their proposed project timelines.

Influencing that delay was the initial completion of contracts among DHCD, the Council's Support Organization (Northern Virginia Regional Commission) and the project's lead agency. However, as that initial work is completed, future contracting should not take as long, and projects should begin implementation more rapidly following award, though not in every case. Procurement procedures have also impacted project performance. Specifically, the construction of the Fab Lab was slowed by certain state procurement activities outside of the GO Virginia involvement, and NVTTP consultant procurement took longer than anticipated. Experiences in these areas will inform and improve future projects performance.

Plan-In-Brief

The following is the 2019 update to the original Economic Growth and Diversification Plan (EGDP) adopted by the Region 7 (Northern Virginia) Council under the Virginia Growth and Opportunity Initiative. 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 promotes 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 among the jurisdictions included in Region 7 (Arlington County, Fairfax County, Loudoun County, Prince William County, and the independent cities of Alexandria, Fairfax City, Falls Church, Manassas, and Manassas Park). The implementation of the EGDP is guided by the Region 7 Council made up of business and community leaders, education institutions, economic and workforce development professionals, and elected officials.

This plan update was prepared by the Center for Regional Analysis (CRA) at George Mason University with input and guidance from the Region 7 Council. The plan document includes updates to data, highlights key economic challenges facing the region, reiterates the priority goals established by the Council, and the introduction of an importance expansion in strategies to achieve the plan's workforce development goals. These modifications reflect knowledge and experience gained since the implementation of the original EGDP. (The original EGDP can be found at www.GOnorthernVA.com)

Key Characteristics of the Northern Virginia Economy

- The Northern Virginia regional economy drives much of the state's economy representing about 40% of all Commonwealth economic output in 2016.
- The region is home to more than 2.5 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 average annual wages at $74,835 in 2018—a figure 36 percent higher than the state average.
- The region's key economic development assets include:
    - The announcement of the location of Amazon's second headquarters (HQ2) in Arlington.
    - Highly educated workforce with 56 percent of the working age population possessing at least a bachelor's degree.
    - Federal government civilian workers exceed 98,000 in the region.
    - Rising federal procurement spending since the passing of the FY2018 budget.
    - 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), and the announcement of Virginia Tech's innovation campus to be developed in the

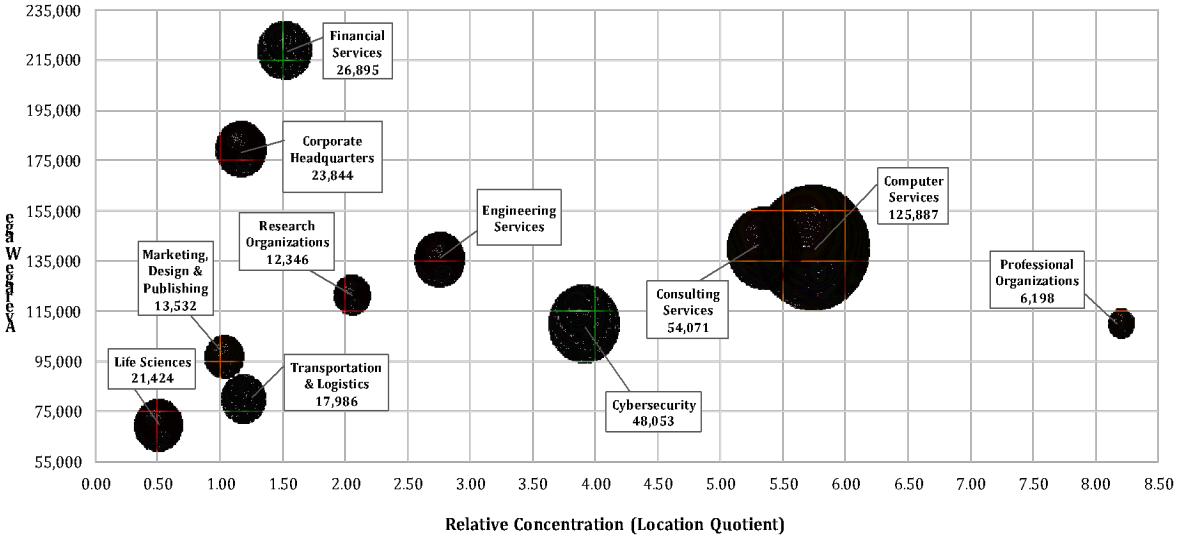
Arlington/Alexandria area and the potential expansion of GMU's Arlington campus for new and expanded information technology programs.
    - Emerging bio-medical research centers such as Inova Center for Personalized Medicine and Janelia Research Campus.
    - Largest number of computer security analysts in the nation.
- Region 7 has significant economic challenges:
    - While the region is less reliant on federal government activities and spending than a decade ago, it remains over-reliant on federal spending and therefore is susceptible to economic disruptions cause by government shutdowns, sequestration and shifting federal spending priorities.
    - The Department of Defense continues to geographically diversify their procurement of technology services to firms more likely located on the west coast.
    - The region continues to see the development of new innovative and entrepreneurial firms but continues to lag in its ability to attract venture capital funding; many of the most successful small firms are sold to out-of-area companies.
    - Common to many areas, the region needs to improve gown-to-town collaborations between businesses and universities to enhance economic opportunities driven by university-based innovations.
    - Talent attraction and retention represent the key economic development challenge.
        - With a local unemployment rate of about 2.1%, businesses report that growth is increasingly hampered by a lack of workers with requisite skills.
        - 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, requiring a high proportion of annual income to cover housing costs. This has contributed to domestic net out-migration over the past several years.

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, which has increased in the past two years, but are being constrained by labor force availability and an increasingly severe backlog of obtaining security clearances for persons in key occupations.
- Only three clusters—financial services, cybersecurity, and transportation & logistics—experienced growth in both employment and competitive positioning.

Northern Virginia's Industry Clusters



Sources: EMSI, US Cluster Mapping Project, Center for Regional Analysis

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:

- 57.9 percent of all jobs in the computer services cluster,
- 15.8 percent of research organization jobs,
- 15.0 percent of jobs at corporate headquarters,
- 11.2 percent of engineering services employment, and
- 9.8 percent of all consulting jobs.

- Information security analysts are more than nine times more concentrated in Region 7 than nationally.
- Data obtained from Economic Modeling Specialists, Inc (EMSI) shows more than 16,500 IT-related job openings in Region 7.
- 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 NVTC 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. It is increasingly recognized among businesses, economic development practitioners, and educators that meeting the demand for technology workers will require education programming that begins much earlier than traditional programs. Namely, future success in developing the required talent pipeline will begin skills development at the earliest levels of elementary

education and builds through the entire K-12 system. There is demonstratable demand for high school graduates with key information technology skills that offer important economic opportunities across a broad swath of the population and allow businesses to better realize market growth opportunities.

- While the region will continue to attract talent, the growing importance of industry-recognized skills presents opportunities for ***native Northern Virginia workers*** through high school IT programming, short courses, boot camps, and similar existing programs – including high quality, effective training programs targeting separating military personnel.
- Retaining talent in high cost of living areas is an increasing challenge for Region 7 employers, therefore the Region 7 Council will look to emphasize initiatives that can directly and indirectly enhance the value of remaining in Northern Virginia.
- Data on key occupations in targeted industries shows intense competition for information technology workers in Region 7 in keeping with information provided by Region 7 Council members and regional business leaders. (See Appendix E.)

Site Availability

State GO-Virginia Board guidelines require the EGDP plan to address site availability and readiness characteristics within Region 7 from the perspective of the Virginia Business Ready Site Program operated by the Virginia Economic Development Partnership. The targeted sectors of this EGDP focus on industries that most typically occupy commercial office space with some flex-space applications. With an understanding that the Northern Virginia office market does not align exactly with Region 7's boundaries, we can still observe the relative availability for space for companies in this region's targeted sectors. According the Delta Associates' second quarter of 2019 market report, there are currently more than 29 million square feet of office space vacant and available in Northern Virginia with a year-to-date space net absorption of 346,000 square feet. This space includes everything from large Class A spaces to co-working spaces provided by companies such as Industrious who occupy a portion of the former National Science Foundation offices in the Ballston submarket of Arlington County. In addition, the Virginia Economic Development Partnership reports substantial available Northern Virginia space for industrial development (1.9 million square feet in 36 buildings) and flex space (1.2 million square feet in 136 buildings.)

Vacant land is not as readily available with about 1,000 acres of industrial space across nine sites and more limited options for mixed-use sites and planned commercial districts. Nonetheless, Region 7 possesses available space for most business development/expansion activities that would be supported with GO-Virginia funding.

Entrepreneurial/Innovation in Region 7

Northern Virginia, with its outsized dependency on federal spending, is not often thought of as a major center for entrepreneurial activity. However, there are notable programs in place that encourage small businesses to compete for federal contracts, especially those businesses certified as women-owned or minority-owned. In addition, there is an increasing number of programs that are designed to assist veterans with business development activities. The nature of entrepreneurship in Region 7, on average, is different than entrepreneurship in northern California, Austin, Atlanta and other majors areas. Based on data presented in the TEconomy report, new business formation rates in Region 7 generally outpace the nation and Virginia,

especially since 2012 (see TEConomy report pages 17-24). The total number of startup firms in traded sectors in Region 7 varies substantially year to year, but shows consistent entrepreneurial engagement with almost 6,400 new start-ups in the 2014-2017 period.

While overall entrepreneurial activity is competitive in Region 7, by some measures the region's overall innovation ecosystem is underperforming, especially compared to other national technology industry hubs. Total patents issued to Region 7 entities grew from 2014 to 2016 (3,519 patents), but the rate of growth fell back in 2017 (2,546 patents) according to data reported by TEConomy. In percentage terms, overall regional research funding has increased at an impressive rate in recent years due largely to growth in research funding received by George Mason University, which recently became a Tier 1 Research Institution. However, GMU's/Region 7's success in commercializing university-based discoveries is substantially lagging competitor regions. This is an area of performance that will improve as GMU matures as a research university but could be boosted by targeted activities supported through GO-Virginia funding.

Priority Goals

The original EGDP was based on a highly collaborative and deliberative process involving members of the Region 7 Council and community stakeholders. The plan identified seven strategic priority industry clusters for the Economic Growth and Diversification Plan:

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

Throughout the past two years, the council has discussed these decisions when preparing to review applications received for GO Virginia funding, and as new information was presented at its regular meetings. Data and recommendations were also received from a regional review by TEConomy, provided each GO-Virginia council by the State GO-Virginia Board in 2018. Upon review of current data and further deliberation by the Region 7 Council, there are no recommendations in this update to revise the priority industry clusters.

The Region 7 Council expects to continue encouraging grant proposals that will:

4. **Strengthening Northern Virginia's technology workforce,**
5. **Accelerating the development of 'growth' companies, and**
6. **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, current and 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, and 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.

Project Pipeline

As to be shown later, the Region 7 Council has not been satisfied with the volume of high-quality grant applications received since its formation in 2017. There are a number of challenges identified over the past two years in attracting grant applications that have been carefully reviewed with state GO-Virginia staff and the state board. The Region 7 Council will continue or start several initiatives for increasing the volume of high-quality grant applications that best meet the goals and strategies of this plan:

- Empower and provide resources to the Education and Outreach Committee to develop a strategic communication and education plan. The Committee is authorized by the Council to lead solicitation for contract services to develop this plan, and to begin implementation including website improvements and overall communications activities to reach leaders and potential grant applicants in targeted sectors. The sSolicitation is due to be released in August 2019.
- The Project Committee, working with our Council members, council staff, and external advisors, will engage in a trial program that develops Requests for Proposal seeking grant applications that specifically address tightly-defined EGDP goals. In previous grant cycles, the call for applications has been more open to encourage applicant-driven ideas and approaches that broadly fit within defined priorities and goals. The Region 7 Council will continue the open call process, but this will be augmented by the release of targeted RFPs with the goal of increasing the total number of applications that best fit the EGDP plan.
- The Region 7 Council Executive Committee, along with members of the Project Committee, is engaging in efforts to enhance collaboration between Council Activities and funding opportunities with our two largest regional university partners, GMU and VT. To date, these activities have been largely information exchanges on university activities to:

a. Increase collaboration with area businesses to promote joint research and commercialization opportunities;
b. Identify the mechanisms by which GO-Virginia funding can be used to expand existing commercialization efforts of university IP;
c. Encourage grant applications that target entrepreneurial eco-system development related to student- and faculty-led business development.

- Early in the current program, the Region 7 Council engaged the Center for Regional Analysis (CRA) at George Mason University to develop a methodology for assessing project returns on investment. Applicants are strongly encouraged to engage with CRA staff early in the proposal development process to assist in identifying appropriate performance measures for the proposed project. This engagement can improve the quality of grant applications while enhancing efficiency for the proposing team. This process provides direct feedback to applicants, the Project Committee, and the Council which helps to ensure that the projects funded by GO-Virginia grants will achieve success as defined by the state board and enabling legislation.
- Project applicant mentoring has increasingly been used to enhance the quality of grant applications. This task is generally performed by members of the Project Committee, but with notable assistance from other members of the Council, staff, and others. This engagement with applicants AND potential applicants, supports the expansion of the project pipeline by lowering information-related barriers (perceived and real) to potential applicants.
- As noted above, in broad terms there is little evidence of site availability as an impediment to economic growth in Region 7; therefore, this element is not explicitly included in Region 7 plans and activities.
- The requirement to include the findings of the TEConomy Report into the project pipeline is addressed in Goal #2 described below.
- The Project Committee, working with staff and the Executive Committee, will continue to review project start-up challenges and impediments on projects previously awarded GO-Virginia funding. In this element of the Project Pipeline, the goal is to identify and make recommendations for improving processes and lowering barriers to project start up. The result will be to bolster program success and quicken the speed at which the state will realize a return on the investment of GO-Virginia funds.

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 recommendations.

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 available 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.
- Recognize and financially support programs that boost the pipeline on skilled workers through the public K-12 education system.
- Support qualifying activities that promote regional talent retention and explore opportunities to support current and new talent attraction initiatives.

Strategies and Expected Outcomes

- **Strategy 1.1:** Strengthen and expand non-college degree programs (e.g., certifications and credentials) that allow workers to enter and advance in technology careers. ***This strategy is to be expanded to specifically include k-12 public education-based initiatives.***
    - *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: $*

- **Strategy 1.8: Explore and support opportunities for cross jurisdictional efforts to attract new Talent to Region 7.**
    - *Performance measures:* New workers moving to the region.
    - *Improved measures of net domestic migration for Region 7.*
    - *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
- Economic Development Authorities
- Private sector companies with a direct interest in the traded sectors targeted by the Council

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: As noted in a recent report by TEConomy Partners, there is a pressing need to enhance the business startup eco-system. Even when startup eco-system support is present, 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. These do not include individual entrepreneurs or firms that are still in their initial product development stage.
- Among the most widely recognized challenges facing the Region 7 small-business eco-system is the relative dearth of Venture Capital funding, at all stages, available to the region's growth companies. The scale and scope of GO-Virginia programming and funding cannot meaningfully address this challenge but increasing the total number of growth companies in the region will increase the likelihood that venture capitalists will see Region 7 as fertile ground for investment opportunity.
- Increasing the number of growth companies includes programming that helps start-up businesses achieve growth.
    - Emphasize support for programs that 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.
    - As part of the eco-system for new firms, support expanded and new initiatives by local universities to promote business development based on the commercialization of IP by faculty and students at the region's universities.
- 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:** Using non-grant resources, commission an entrepreneurial eco-system development plan for Region 7.
    - *Performance measures:* Development of a plan to use GO-Virginia funds to address critical gaps identified in the TEConomy report tailored to the Region 7 economy.
    - *Funding required: $*$-$$$

- **Strategy 2.2:** 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 2.3:** 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 2.4:** Work with senior leadership at GMU, VT, NVCC and others on supporting activities that result in IP commercialization and new business formation among faculty, students, and university business partners.
    - *Performance measures:* Change in number of new business startups, increasing the value of commercialized IP based on university research
    - *Funding required:* $$-$$$

- **Strategy 2.5:** 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 2.6:** 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 and the development and implementation of a communications strategies plan,
- 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.

Achieving the goals of the GO-Virginia Initiative in Region 7 not only requires successful implementation of the strategies outlined above but also require tactical, strategic, and administrative flexibility in responding to the lessons learned as we enter the third year of Go-Virginia programming. This includes specifically addressing barriers and impediments to attracting applications for support of highly innovative and potentially impactful programs and activities. As existing grants mature in their implementation, a regular review of grantee and grantor performance will help ensure sustainable project outcomes.

Current Project Performance

At this writing, GO Northern VA's Council has successfully promoted the funding for four projects: Northern Virginia Tech Talent Pipeline (NVTTP), Alexandria / Arlington Strengthening Our Workforce; NVCC's Fab Lab, and the NVTTP Apprenticeship Initiative. Details on each project can be found below, with a chart outlining how the projects would address any of the Council's strategic goals as contained in the 2017 G&D Plan.

In line with the experience of other GO Virginia regions, the start-up phase for these projects has taken longer than anticipated. The lessons learned will be applied to managing future grants and advising applicants on their proposed project timelines.

Influencing that delay was the initial completion of contracts among DHCD, the Council's Support Organization (Northern Virginia Regional Commission) and the project's lead agency. However, as that initial work is completed, future contracting should not take as long, and projects should begin implementation more rapidly following award, though not in every case. Procurement procedures have also impacted project performance. Specifically, the construction of the Fab Lab was slowed by certain state procurement activities outside of the GO Virginia involvement.

These delays and slow performance prompted the Council to establish "work groups" made up of 2-3 Council members with expertise to benefit the projects in implementation. These work groups, subsets of the Projects Committee, meets regularly with the project leaders and communicates the progress, challenges, and successes of each project to the full Council at each meeting. Brief progress reports are included in each meeting package, that is more fully discussed during the meeting. This "hands on" approach is designed not only to keep the Council informed, but as importantly, to provide the projects with advice and mentoring to facilitate successful outcomes.

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.

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

[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.

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.

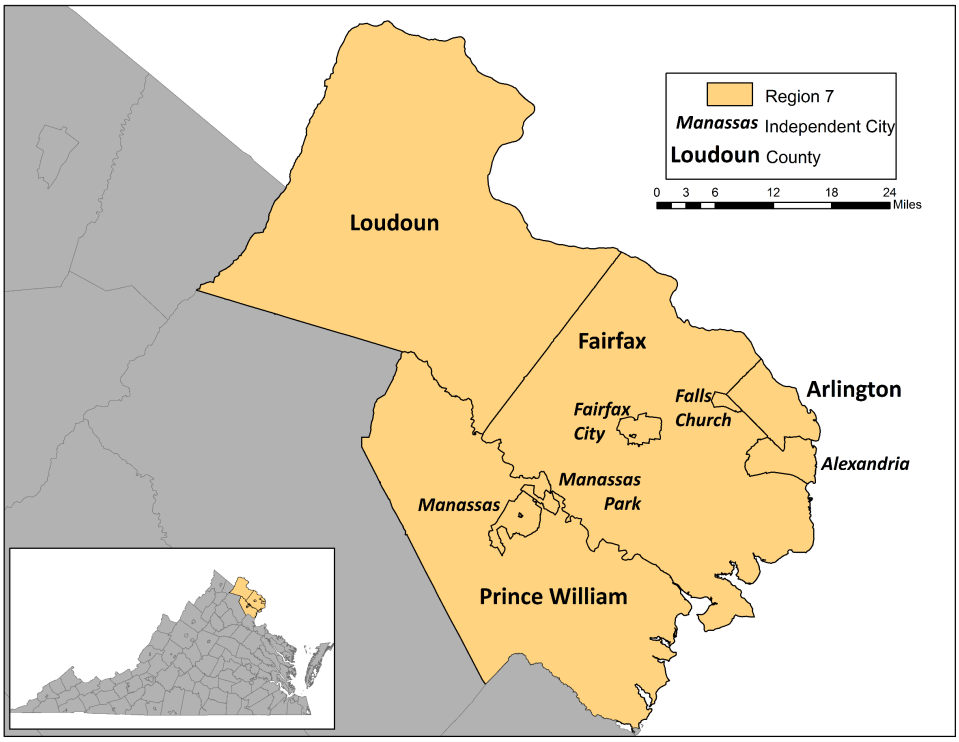
The GO Northern Virginia Regional Council (Region 7)—comprised of action-oriented individuals representing a wide range of organizations, local governments and institutions in the private, non-profit, and public sectors[3]—has been allotted over $3 million dollars[4] to fund projects designed to ultimately 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 wide range of community stakeholders to draft Northern Virginia's Economic Growth and Diversification Plan for review and approval by the GO Virginia board.

[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)



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.

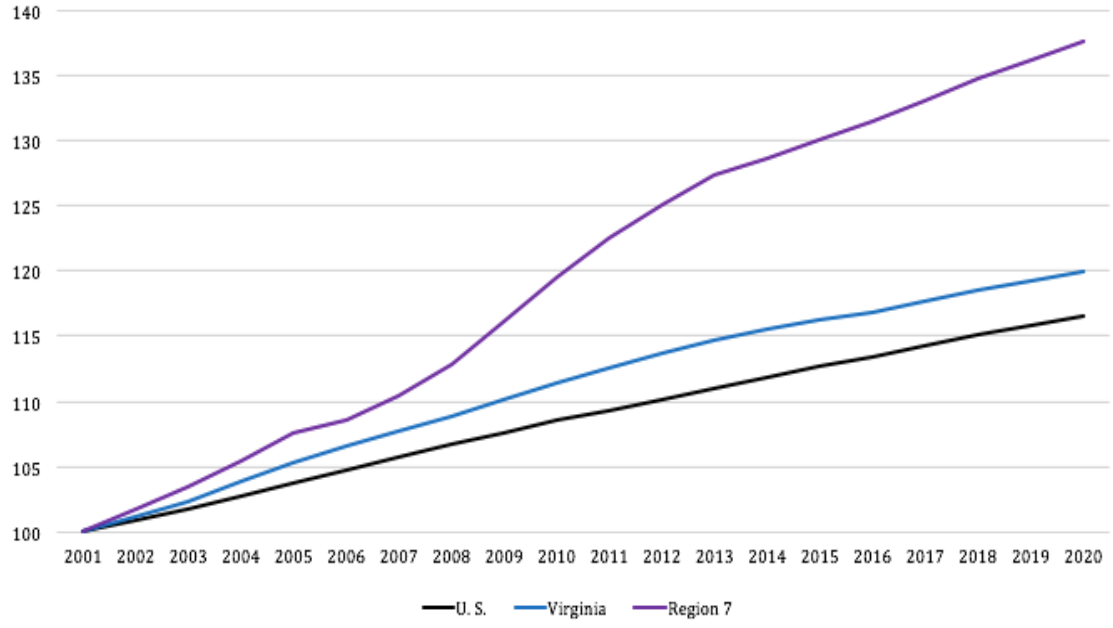
About the region

Northern Virginia is one of the Commonwealth's economic engines

The Northern Virginia regional economy drives much of the state's economy. In 2016, Northern Virginia's GDP ($179.6 billion) accounted for about 40% 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 2.53 million residents, or almost 30 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 2001. 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 1.15 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 one-third of the region's net new residents between 2010 and 2018.

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



Source: EMSI Economic Modeling Specialists, International; U. S. Census Bureau, Population Estimates Program

[5] Data Source: IMPLAN

In addition to being the Commonwealth's largest region, it is also its wealthiest. In 2016, the region's per capita annual income was $72,982—a figure 36 percent higher than the state average. Please note that even though there are well-recognized historical 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, those distinctions are increasingly less prevalent as Loudoun and Prince William counties diversify their economic based and increasingly compete for commercial/office developments. Importantly, the Economic Growth and Diversification Plan is a regional plan, which does not attempt to specify intraregional differences in opportunities, except where appropriate for plan implementation purposes.

Several other measures reflect the region's economic strength. Northern Virginia's unemployment rate was only 2.3 percent in late spring of 2019—a figure lower than any other Go Virginia region. Which has come to represent economic strength, but the increasing challenge faced by Region 7 employers – a lack of appropriately skilled workers. 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, Montgomery County, MD or Prince George's County Maryland (about 3.5% of total workers each). About 1.5% each work in the neighboring Virginia counties of Stafford or Fauquier.

The region's commute times are among the nation's longest. Average travel time from place of residence to employment is about 33.2 minutes,[7] ranging from 28.6 minutes in Arlington to 39.1 minutes in Prince William County. By comparison, the Virginia State average commute time is five minutes less at 28.2.

The region has a comparatively high median income level and low poverty rate that 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.

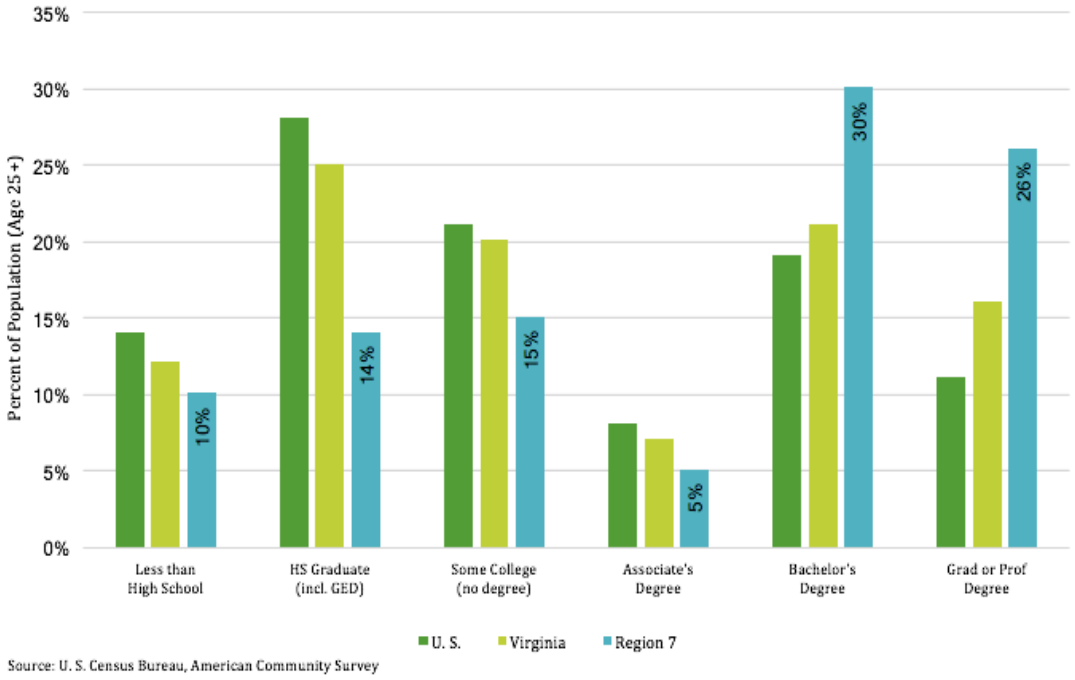
The region has assets to leverage in support of the region's economic development

The region's highly educated workforce contributes to its economic strength. Figure 3 shows that 56 percent of the region's working age population have a bachelor's degree or higher. This is more than 33% higher than the Virginia Average. 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. Arlington, Alexandria, and Falls Church all have more people with graduate degrees than 4-year degrees.

[6] Commuting patterns based on 2015 US Census Bureau, On The Map data
[7] US Census Bureau 2013-2017 ACS.

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 99,000 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.

Figure 3: Educational Attainment of Population Aged 25+



Source: U. S. Census Bureau, American Community Survey

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

[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. These data are not updated due to a data interface change at USA Spending.gov.
[9] https://www.nsf.gov/statistics/ffrdclist/

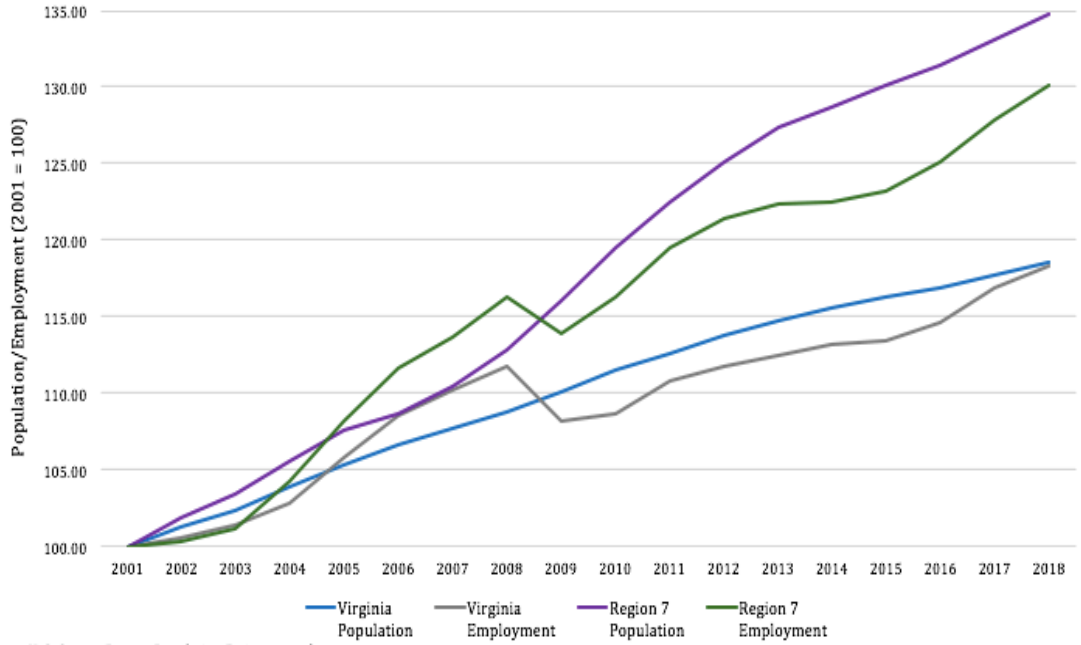
associated incubator—Inova Personalized Health Incubator) and the Janelia Research Campus in Loudoun County.

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. However, the pace of growth has since accelerated with the 2010-2018 average increase now at 1.7 percent.

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.

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



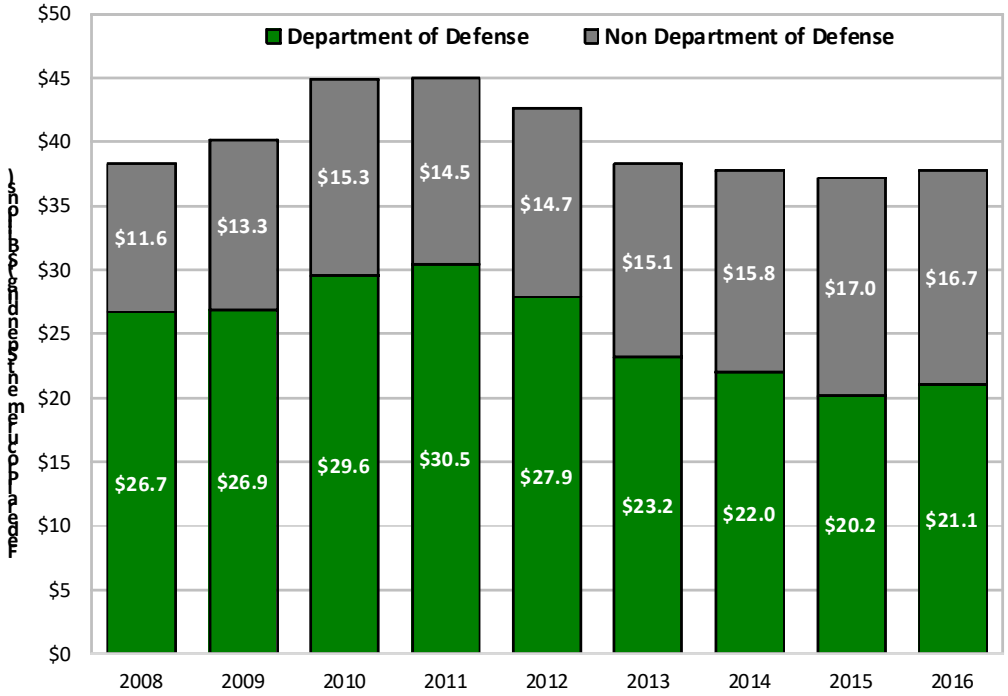
Sources: U. S. Census Bureau Population Estimates and
U. S. Bureau of Labor Statistics Local Area Unemployment Statistics

The region's per capita income of $72,982 in 2018 is much higher than state average of $53,723. However, these relatively high incomes are somewhat offset by the region's high cost of living. According to the EMSI Cost of Living Index, Region 7's cost of living is about 17 percent higher than state averages and 18 percent above 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 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.

The high cost of living also likely contributes to the region's continued net domestic out-migration. Figure 5 shows that since July of 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.

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*

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' 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.

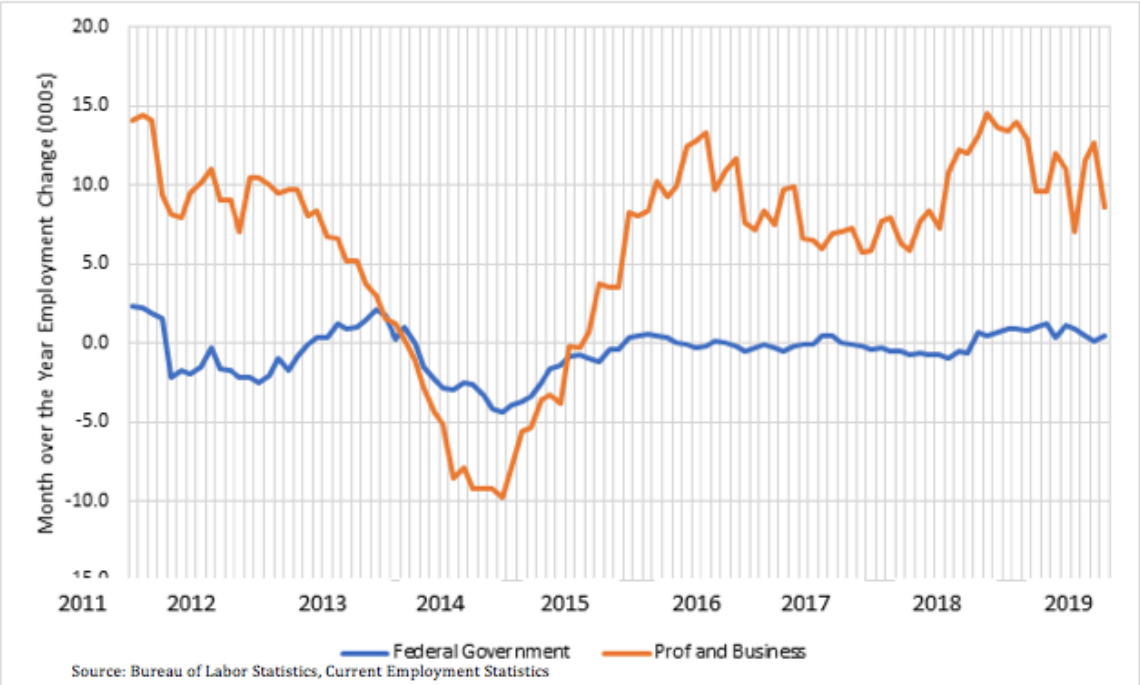
The reliance on federal spending poses a unique regional challenge because federal spending decisions are largely outside of local control. Figure 6 shows that in FY 2016 federal procurement spending in the region was $37.8 billion; more than 55 percent of this spending was defense-related. To place 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

[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*

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

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

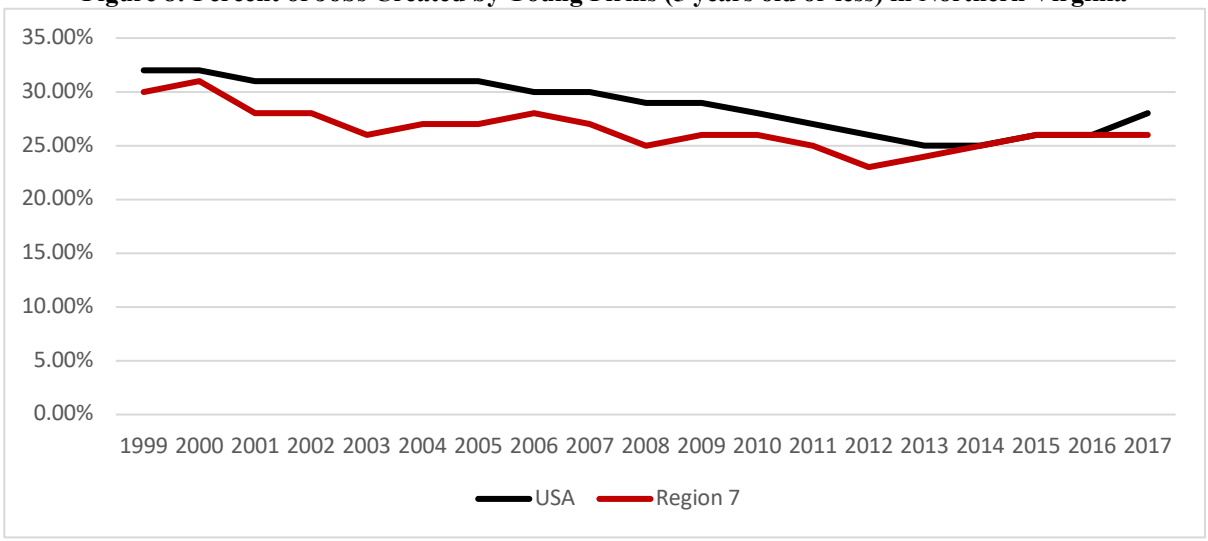


The professional and business services sector contains many of the region's technology workers, and these activities are also highly influenced by federal spending. One-third (32 percent) of 2016 federal procurement spending ($23.5 billion) in the DC metro area goes to computer-related industries. In 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.

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) increased for a few years, the trend has stabilized and one again Region 7 trails the national average of younger firms' contributions to total job change.

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.

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



Source: US Census Bureau

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

Economic and workforce analysis

Driven to a great degree by federal government contracting, Northern Virginia's professional and business services sector employs over 362,000 workers, and accounts for roughly 28 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 168,000 jobs in the region, with *average* salaries exceeding $138,000. 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 showed only modest growth. 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	Description	2019 Region 7			(2012 - 2019) Annual % Employment Change	
		Jobs	Avg. Annual Wages	Location Quotient	Region 7	United States
54151	Computer Systems Design and Related Services	118,106	$147,079	6.20	1.2%	4.9%
54161	Management Consulting Services	49,979	$138,672	4.63	0.3%	6.2%
55111	Management of Companies and Enterprises	23,849	$206,932	1.17	-2.1%	2.7%
54133	Engineering Services	23,399	$135,630	2.75	-1.8%	1.6%
54121	Accounting, Tax Preparation, Bookkeeping, and Payroll Services	21,099	$121,631	2.39	3.4%	1.6%
56161	Investigation, Guard, and Armored Car Services	12,652	$63,357	1.81	0.5%	2.4%
56132	Temporary Help Services	11,816	$60,724	0.46	4.5%	3.1%
54171	Research and Development in the Physical, Engineering, and Life Sciences	10,572	$144,258	1.94	-3.3%	1.4%
54111	Offices of Lawyers	8,133	$128,194	0.90	-0.6%	0.0%
56111	Office Administrative Services	7,283	$151,700	1.59	13.1%	3.4%

Source: EMSI Economic Modeling Specialists, International

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

[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

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:

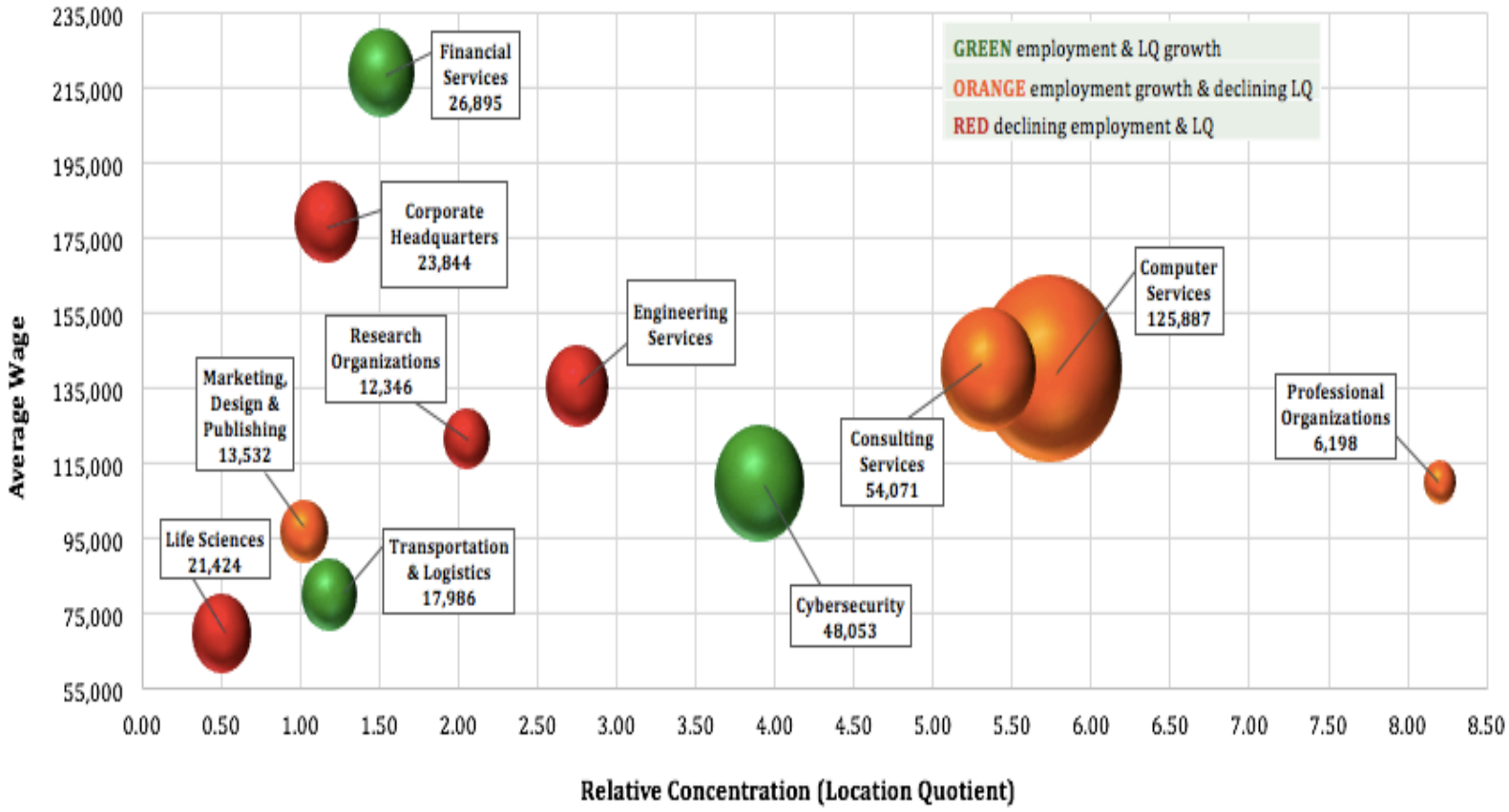
- ***Average wages:*** Average wages (on the Y-axis) provide an indication of the quality of opportunities available in the industries that make up that cluster.
- ***Relative concentration:*** We measure relative concentration (on the X-axis) using location quotients (LQ). LQs measure the relative percentage 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.

[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 EMSI Economic Modeling Specialists, International 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



Sources: EMSI Economic Modeling Specialists, International; U. S. Cluster Mapping Project's Benchmark Definitions (Delgado, Porter, Stern 2013)

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 are showing signs of stress due to labor availability. Recent trends in federal government funding with the budget that was passed in spring of 2018 have been positive, but growth rates are trailing national averages for these sectors. 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 125,000 jobs. Over the past half-decade, Northern Virginia's computer services cluster grew impressively—about 3 percent annually between 2014 and early 2019—but nationally this cluster grew even faster. The Location Quotient, a measure of relative industrial competitiveness, declined for the computer services cluster from 6.1 in 2014 to 5.7 in 2019.

The consulting services cluster is another high paying cluster ($140,000 annual average wage) that is highly dependent on federal spending. The cluster now employs about 54,000 workers, which is up about 3,000 jobs from where it stood five years ago. Much like the computer services cluster, this cluster remains highly concentrated in the region, but it is experiencing an erosion of its competitive advantage compared to national averages.

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. This cluster has added almost 6,000 jobs since 2014 and has remained very competitive with the location quotient remaining at about 3.9 over this period.
Only one cluster, financial services, experienced growth in both employment and relative concentration between 2014 and the most recent data. 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.

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, and it actually lost employment and competitive positioning over the past 5 years, even though it is a key target for most of the region's economic development agencies.

[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).

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, but they also represent critical components of other key regional clusters such as research organizations, corporate headquarters, engineering services, and consulting services.

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 50 percent as concentrated in the region's workforce as they are in the national workforce. Most notably, information security analysts are more than nine 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.

Figure 12: Computer Occupations in Northern Virginia

Position Title	2019 Jobs	2019 LQ	Median Earnings	Job CAGR 2012-2019	Projected Job CAGR 2019-2024 *	Current Position Openings *
Software Developers, Applications	25,078	3.11	$113,949	4.7%	8.8%	4,489
Computer Systems Analysts	17,016	3.20	$103,545	1.6%	4.6%	2,766
Software Developers, Systems Software	16,260	4.48	$128,486	-2.1%	1.2%	2,426
Network and Computer Systems Admins	11,304	3.31	$99,344	0.2%	2.0%	2,878
Information Security Analysts	10,284	9.74	$112,559	4.9%	8.3%	2,852
Computer User Support Specialists	9,890	1.61	$61,307	1.4%	3.8%	1,694
Computer Occupations, All Other	8,756	2.92	$110,077	8.3%	9.5%	2,970
Computer Network Architects	6,452	4.45	$126,227	-0.5%	3.6%	764
Computer Network Support Specialists	4,119	2.25	$82,409	-0.9%	2.9%	312
Computer Programmers	3,907	1.78	$98,563	-4.9%	-6.6%	1,031

Source: EMSI

Growth projections by occupation from EMSI suggests that, with the exception of computer programmers, computer occupations will continue to add jobs over the next few years. These

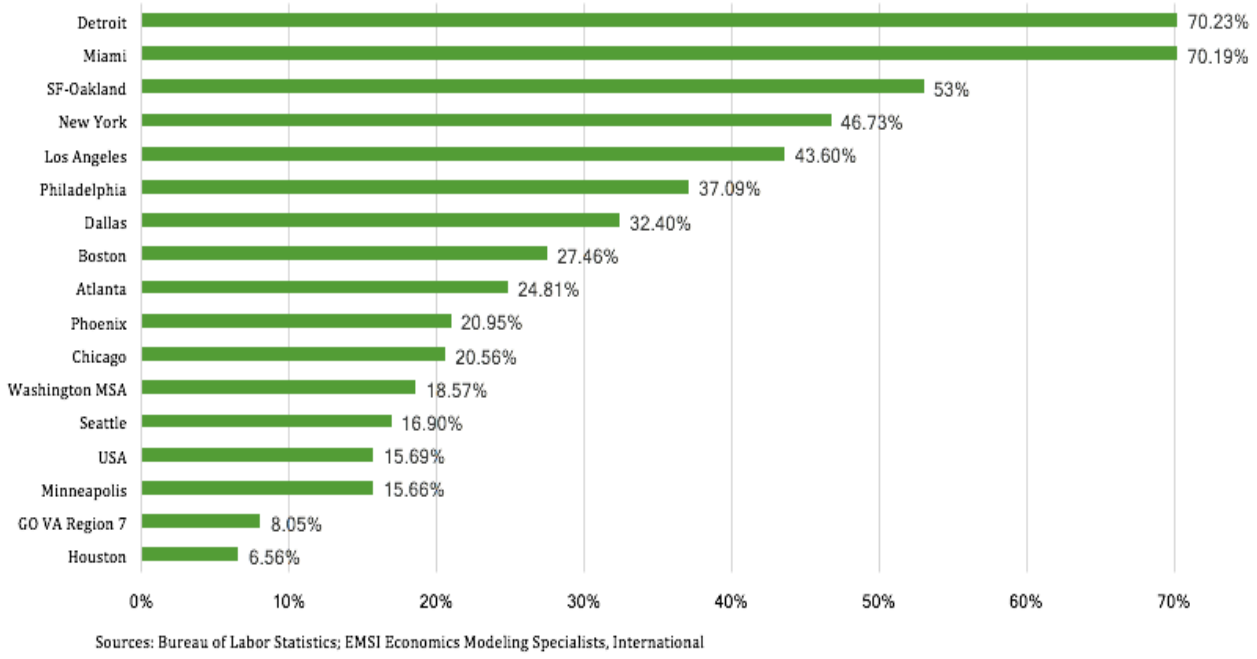
[18] E.g. White, M. "Assessing Alexandria/Arlington's Regional Labor Market", George Mason University Center for Regional Analysis, prepared for the Alexandria/Arlington Regional Workforce Council.; Northern Virginia Workforce Development Board (Area #11) Local Plan, and NVTC Greater Washington *Technology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

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

projections do not explicitly include hiring at Amazon HQ2 and thus the estimates of growth presented may be understated. The volume of job postings, again, shows the impediment to growth, there is much more demand for these occupations than the present pool of qualified workers.[20,21] Figure 13, however, clearly shows that Region 7 is lagging many of its direct competitors in job growth in computer related occupations.

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.[22]

Figure 13: Growth in computer-related occupations (SOC 15-1000), 2013-2018



Sources: Bureau of Labor Statistics; EMSI Economics Modeling Specialists, International

The region is facing a shortage of technology workers

As the region rebounded from the consequences of sequestration, challenges began to emerge. 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

[20] The job posting data come from EMSI and are designed to identify unique job postings that may appear across many sites.
[21] 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.
[22] 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/

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.[23] 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.

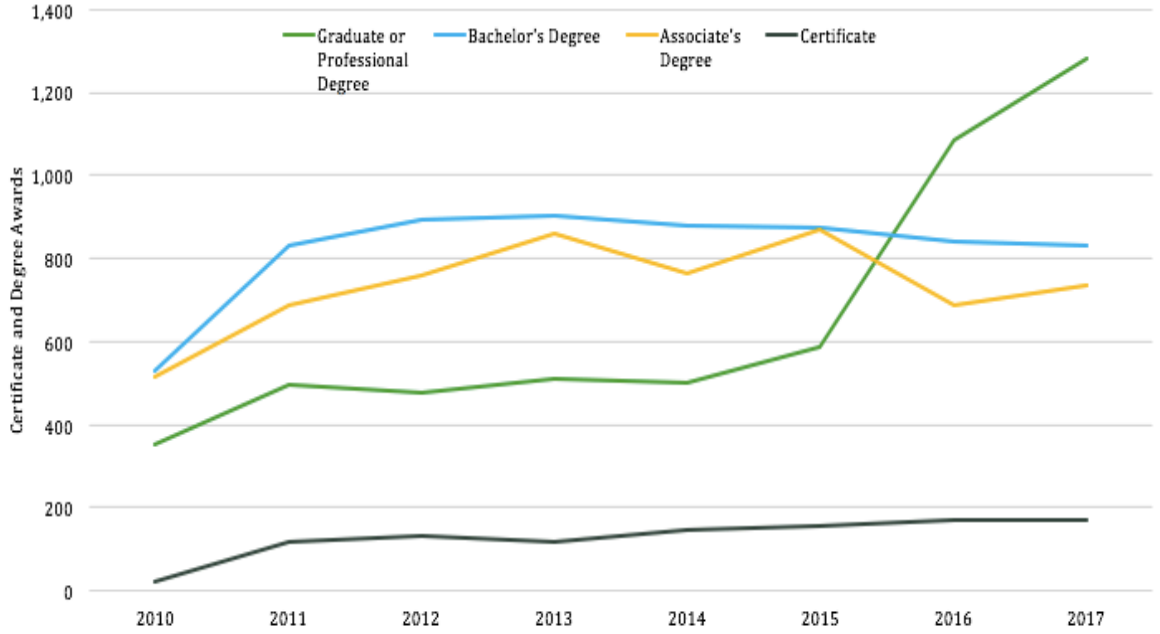
As part of this study, employers also noted that soft skills (e.g., written and verbal communication, problem solving and critical thinking, and relationship management) are also vital considerations. Employers also noted, depending on the nature of the work, the need for U.S. citizenship, security clearances, 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 2017, 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 were also significant numbers of completers from programs related to computer systems networking and network administration, and computer and information systems security.

Appendix E offers additional measures showing demand for key occupations in the targeted industry clusters. These data particularly demonstrate the level of competition in the Region 7 labor market for key information technology occupations.

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

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



Source: EMSI Economic Modeling Specialists, International

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	Graduate or Professional Degree	Total Awards
11.0401	Informatics	51	716	1,022	304	2093
11.0103	Information Technology	98	110	275	516	999
11.1002	System, Networking, and LAN/WAN Management/Manager	38	0	178	710	926
11.1003	Computer and Information Systems Security/Information Assurance	0	366	78	452	896
11.0501	Computer Systems Analysis/Analyst	109	11	33	209	362
11.0802	Data Modeling/Warehousing and Database Administration	5	135	0	119	259
11.0901	Computer Systems Networking and Telecommunications	42	34	50	0	126
11.0801	Web Page, Digital/Multimedia and Information Resources Design	0	0	0	94	94
11.0803	Data Modeling/Warehousing and Database Administration	0	53	0	0	53
11.0701	Computer Science	0	0	27	0	27
11.1006	Computer Support Specialist	0	0	9	0	9
11.0101	Computer and Information Sciences, General	0	0	0	0	0
11.0201	Computer Programming/Programmer, General	0	0	0	0	0
11.9999	Computer and Information Sciences and Support Services, Other	0	0	0	0	0

Source: EMSI Economic Modeling Specialists, International

Institutions such as George Mason University and Northern Virginia Community College were responsible for many of these graduates, as Bachelor's and Associate's 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[24] 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 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.[25]

Site/space availability not a growth impediment for Region 7

State GO-Virginia Board guidelines require the EGDP plan to address site availability and readiness characteristics within Region 7 from the perspective of the Virginia Business Ready Site Program operated by the Virginia Economic Development Partnership. The targeted sectors of this EGDP focus on industries that most typically occupy commercial office space with some flex-space applications. With an understanding that the Northern Virginia office market does not align exactly with Region 7's boundaries, we can still observe the relative availability for space for companies in this region's targeted sectors. According the Delta Associates' second quarter of 2019 market report, there are currently more than 29 million square feet of office space vacant

[24] Computer Technology Industry Association (CompTIA)
[25] http://www.nvcc.edu/workforce/uncommon-coders/index.html

and available in Northern Virginia with a year-to-date space net absorption of 346,000 square feet. This space includes everything from large Class A spaces to co-working spaces provided by companies such as Industrious who occupy a portion of the former National Science Foundation offices in the Ballston submarket of Arlington County. In addition, data from the Virginia Economic Development Partnership show substantial available Northern Virginia space for development (see Figure 16). Vacant land is not as readily available with about 1,000 acres of industrial space across nine sites and more limited options for mixed-use sites and planned commercial districts. Nonetheless, Region 7 possesses available space for most business development/expansion activities that would be supported with GO-Virginia funding. The level of space availability also means that even though rental rates are high compared to most Virginia regions, there is competitively priced space available when comparing rental rates to other major metropolitan areas. Commercially zoned land remains available for key growth sectors such as data centers especially in Loudoun (the traditional location) and increasingly in Prince William County. However, zoning and the speed at which local jurisdictions can process requests for zoning changes is an impediment to business attraction activities related to sites being "business ready." It is not clear the role that GO-Virginia programming could play in changing zoning processes, which are among the most jealously guarded purviews of local government.

Figure 16: Space Available Northern Virginia

Building Type	Space (sq.ft.)	# Buildings
Industrial (VEDP/LoopNet)	**1,910,067**	**36**
Office* (VEDP)	**2,965,785**	**57**
Office Space (Delta Assoc.)**	**29,080,000**	**N/A**
Flex (VEDP)	**1,165,981**	**43**
Total (not including Delta office data)	**6,041,833**	**136**
Land Type	**Acreage**	**# sites**
Agricultural	**246.05**	**3**
Business (general)	**37.38**	**2**
District (planned business)	**234.24**	**2**
District (planned mixed)	**16.43**	**1**
Industrial	**1,014.32**	**9**
Total	**1,548.42**	**17**

Notes:
* VEDP only shows sites that are voluntarily listed. This is not a market survey of all available properties.
** Northern Virginia data
*** LoopNet
Source: Virginia Economic Development Partnership, downloaded August 8, 2019

Entrepreneurial/Innovation in Region 7

Northern Virginia, with its outsized dependency on federal spending, is not often thought of as a major center for entrepreneurial activity. However, there are notable programs in place that encourage small businesses to compete for federal contracts, especially those businesses certified as women-owned or minority-owned. In addition, there is an increasing number of programs that are designed to assist veterans with business development activities. The nature of entrepreneurship in Region 7, on average, is different than entrepreneurship in northern California, Austin, Atlanta and other majors areas. Based on data presented in the TEconomy report, new business formation rates in Region 7 generally outpace the nation and Virginia, especially since 2012 (see TEConomy report pages 17-24). The total number of startup firms in

traded sectors in Region 7 varies substantially year to year, but shows consistent entrepreneurial engagement (see Figure 17).

Figure 17: Number of Start-Ups in Traded Sectors, Region 7

Founding Year of Cohort	Number of Start Ups
2007	1,377
2008	1,842
2009	1,060
2010	2,101
2011	895
2012	2,056
2013	2,175
2014	1,331
2015	1,663
2016	1,884
2017	1,500

Source: Regional Entrepreneurial Assessment Project: Final Briefing Report. Region 7: Northern Virginia, January 2019

While overall entrepreneurial activity is competitive in Region 7, by some measures the region's overall innovation ecosystem is underperforming, especially compared to other national technology industry hubs. Total patents issued to Region 7 entities grew from 2014 to 2016, but declined in 2017 (see Figure 18), though the region outpaced Virginia and national averages.

Figure 18: Patents Awarded, Region 7

Year	Total Patents
2014	2,737
2015	2,934
2016	3,519
2017	2,546

Source: Regional Entrepreneurial Assessment Project: Final Briefing Report. Region 7: Northern Virginia, January 2019, data sourced from U.S. Patent and Trademark Office and Thomson Reuters.

In percentage terms, overall regional research funding has increased at an impressive rate in recent years due largely to growth in research funding received by George Mason University, which recently became a Tier 1 Research Institution. However, GMU's/Region 7's success in commercializing university-based discoveries is substantially lagging competitor regions (see Figure 19). This is an area of performance that will improve as GMU matures as a research university but could be boosted by targeted activities supported through GO-Virginia funding.

Figure 19: Average Licenses/Options Executed per $10M University Research, 2014-2016

Area	Options/$10Million in Research Spending
GO VA Region 7	0.20
VA	1.12
US	1.14
Large Tech Hubs	1.54
Mid-sized Regions	1.03
Rural with Major Research Anchor	2.87

Source: Regional Entrepreneurial Assessment Project: Final Briefing Report. Region 7: Northern Virginia, January 2019, data sourced from SBIR.gov, Association of University Technology Managers, SCHEV.

Priority Goals

The challenges described above—losing competitive ground in key industry clusters driven largely by 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 improve 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 original Economic Growth and Diversification Plan. The process is described in more detail in Appendix B. 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. Most of these goals were presented in the original EGDP; however, we have augmented some goals and added requisite sections that expand on the Region 7 Council's previous goals of address specific challenges in the innovation eco-system. The priority industry clusters include:

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

Upon review of current data and deliberation by the Region 7 Council, there are no recommendations in this update to revise the priority industry clusters. The Region 7 Council expects to continue encouraging grant proposals that will:

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.**

The descriptions below identify the types of strategies the regional council will consider, current and 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.

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 available for 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 with 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.

Summary of Approach

- 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.
- Recognize and financially support programs that boost the pipeline on skilled workers through the public K-12 education system.
- Support qualifying activities that promote regional talent retention and explore opportunities to support current and new talent attraction initiatives.

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. ***This strategy is to be expanded to specifically include k-12 public education-based initiatives.***

  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. Education professionals are in broad agreement that focusing talent pipeline development on post-secondary education is insufficient to meet current and future demands. Boosting the availability of qualified tech workforce through k-12 programming (especially high school programs) will decrease the time lag for delivering skilled workers to the labor force and will broaden economic opportunity by supporting programs that provide skills without the expense or foregone income associated with higher education.

  - *Performance measures:* Certifications and credentials granted
  - *Funding required:* $-$$$
  - *Spillover effect:* An important spillover effect of boosting IT related education in the Region 7 K-12 education system has been identified. Many of the parents of children who will be engaged in K-12 IT initiatives are themselves IT workers. Having innovation education programs in our public-school system will help retain those households, even when they are presented with opportunities to relocate to lower-cost regions. Simply put, the superior education their children will receive at Region 7 school districts become a prime reason to stay.

- **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: $*

- **Strategy 1.8: Explore and support opportunities for cross jurisdictional efforts to attract new Talent to Region 7.**

  Competition for talent has emerged as a key elements of economic development planning in the 21st Century. Most of the major economic development competitors for Region 7 have established place marketing and promotion efforts targeted, largely, to educated millennials. Often these campaigns are based on quality of life, amenities, and other regional features in addition to the availability of career opportunities. The Fairfax County Economic Development Authority recently announced a new multi-million-dollar initiative addressing talent attraction strategies. The Region 7 Council will explore with relevant communities, businesses and jurisdictions appropriate programming and support to encourage cross-jurisdictional collaborations for helping to meet local demand for technology workers through talent attraction initiatives.

  - *Performance measures:* New workers moving to the region.
  - *Improved measures of net domestic migration for Region 7.*
  - *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, chambers of commerce)
- 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[26] A+ certification and introduce them to career opportunities within the rapidly growing cybersecurity industry.[27]

- 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.[28]
- 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.[29]
- 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.[30]
- 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.[31]
- The Incumbent Worker Training Initiative of Northern Virginia[32] 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.
- Fairfax County Economic Development Authority recently announced a new talent attraction initiative. First year funding is expected to be about $1 million with $800,000 in dedicated funding in subsequent years.
- 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.[33]
- US Chamber of Commerce Foundation, though not technically a regional organization, also has a tech talent pipeline initiative that provides training for businesses on supporting talent pipelines. This program may inform the Region 7 Council and grant applicants.

[26] Computer Technology Industry Association (CompTIA)
[27] http://www.nvcc.edu/news/press-releases/2016/cybersecurity-pathway.html
[28] http://www.myskillsource.org/pdf/AWSApprenticeshipFlyer.pdf
[29] http://www.nvcc.edu/workforce/uncommon-coders/index.html
[30] http://www.nvtc.org/veterans/
[31] http://www.nvcc.edu/systemic/whoweare.html
[32] https://workforcecouncil.arlingtonva.us/2016/09/incumbent-worker-training-initiative-northern-virginia/
[33] 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).[34]

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.[35]

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.[36] 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, government contracting, and exporting among others. The region is also

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[34] *2016 Startup Census Report, Greater Washington, DC Region.* www.fosterly.com

[35] *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/

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

home to Virginia's Center for Innovation Technology (CIT), which has a series of resources available to help Growth Companies including CIT GAP funds,[37] 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.[38] 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.

Summary of Approach

- 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.
- Among the most widely recognized challenges facing the Region 7 small-business eco-system is the relative dearth of Venture Capital funding, at all stages, available to the region's growth companies. The scale and scope of GO-Virginia programming and funding cannot meaningfully address this challenge but increasing the total number of growth companies in the region will increase the likelihood that venture capitalists will see Region 7 as fertile ground for investment opportunity.
- Increasing the number of growth companies includes programming that helps start-ups businesses achieve growth.
    - Emphasize support for programs that 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.

[37] http://www.cit.org/service-lines/cit-gap-funds/
[38] http://www.alexecon.org/sites/aedp/files/fact_sheet_-_boost_alexandria.pdf

    - As part of the eco-system for new firms, support expanded and new initiatives by local universities to promote business development based on the commercialization of IP by faculty and students at the region's universities.
- 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.
- As part of the eco-system for new firms, support expanded and new initiatives by local universities to promote business development based on the commercialization of IP by faculty and students at the region's universities.
- Other specific gaps in the current startup eco-system are not well known or well defined.

Strategies and Expected Outcomes

- **Strategy 2.1:** Using non-grant resources, commission an entrepreneurial eco-system development plan for Region 7.

  Guidelines for the revision of the EGDP require the development of a specific plan to address entrepreneurial eco-system challenges in Region 7. Many of these challenges have been identified in the previous plan and in deliberations of the Region 7 Council. The Strategy will be developed as a part of this planning process.
    - *Performance measures:* Development of a plan to use GO-Virginia funds to address critical gaps identified in the TEConomy report tailored to the Region 7 economy.
    - *Funding required:* $

- **Strategy 2.2:** 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:* $-$$

- **Strategy 2.3:** 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 2.4:** Work with senior leadership at GMU, VT, NVCC and others on supporting activities that result in new business formation among faculty, students, and university business partners.

  In recent meetings with Region 7 Council leadership, senior administrators from GMU and VT reviewed current on-campus efforts and those being developed to expand the take of university research to potential commercialization and the support of faculty and students with the potential to develop new businesses. The resulting programming around this strategy, which is still in development, will include efforts to broaden and deepen the connection between area businesses and the region's public universities. While the efforts to date have focused on public institutions, any higher education institution will be welcome to participate.

    - *Performance measures:* Change in number of new business startups, increasing the value of commercialized IP based on university research
    - *Funding required:* $$-$$$

- **Strategy 2.5:** 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 2.6:** 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, Virginia Tech, others)
- 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.[39]

- 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.[40]
- 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.

[39] http://exportvirginia.org/vital/
[40] 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.[41] 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[42], or state programs such as the Virginia Research Investment Fund.[43] Another example are Innovation Voucher programs that provide firms with 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.

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

[42] 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.

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

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.

Summary of Approach

- 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.

  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.[44]

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

- 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.[45]

- The Center for Innovative Technology (CIT) provides workshops and support concerning SBIR and STTR programs.[46]

- George Mason University has an Executive in Residence through the School of Business' Mason GovCon Initiative.[47]

[45] http://www.cit.org/initiatives/crcf/
[46] http://www.cit.org/events/?F_c=3
[47] http://business.gmu.edu/govcon/about/

Project Pipeline

As to be shown later, the Region 7 Council has not been satisfied with the volume of high-quality grant applications received. There are a number of challenges identified over the past two years in attracting grant applications that have been carefully reviewed with state GO-Virginia staff and the state board. The Region 7 Council will continue or start several initiatives for increasing the volume of high-quality grant applications that best meet the goals and strategies of this plan:

- **Empower and provide resources to the Education and Outreach Committee to develop a strategic communications and education plan:** The Committee is authorized by the Council to lead solicitation for contract services to develop a Strategic Communications and Education Plan. In its work to identify reasons why the number and types of applications received have not met the Councils overall goals, the Committee believes that th3e marketing strategies carried out by the state Board and DHCD should be supplemented with actions that are specific to the northern Virginia region and the goals of the Council. The Plan will likely include, and the Council would implement, improved website and other communications activities specifically targeting the industry leaders and other partners already in the sectors to which the Council intends to have the greatest impact. This action should be a key to the Council's intent to improve the level of projects GO Virginia funds should support. Solicitation is due to be released by August 2019.
- **Develop RFPs:** The Project Committee, working with our Council members, council staff, and external advisors, will engage in a trial program that develops Requests for Proposal seeking grant applications that specifically address tightly-defined EGDP goals. In previous grant cycles, the call for applications has been more open to encourage applicant-driven ideas and approaches that broadly fit within defined priorities and goals. The Region 7 Council will continue the open call process, but this will be augmented by the release of targeted RFPs with the goal of increasing the total number of applications that best fit the EGDP plan.
- **University Partner Engagement:** The Region 7 Council Executive Committee, along with members of the Project Committee, is engaging in efforts to enhance collaboration between Council Activities and funding opportunities with our two largest regional university partners, GMU and VT. To date, these activities have been largely information exchanges on university activities to:
    - Increase collaboration with area businesses to promote joint research and commercialization opportunities;
    - Identify the mechanisms by which GO-Virginia funding can be used to expand existing commercialization efforts of university IP;
    - Encourage grant applications that target entrepreneurial eco-system development related to student- and faculty-led business development.
- **Project/Application ROI:** Early in the current program, the Region 7 Council engaged the Center for Regional Analysis (CRA) at George Mason University to develop a methodology for assessing project returns on investment. Applicants are encouraged, but not required, to engage with CRA staff early in the proposal development process to assist in identifying appropriate performance measures for the proposed project. This engagement can improve the quality of grant applications while enhancing efficiency for

the proposing team. This process provides direct feedback to applicants, the Project Committee, and the Council which helps to ensure that the projects funded by GO-Virginia grants will achieve success as defined by the state board and enabling legislation.

- **Applicant Mentoring:** Project applicant mentoring has increasingly been used to enhance the quality of grant applications. This task is generally performed by members of the Project Committee, but with notable assistance from other members of the Council, staff, and others. This engagement with applicants AND potential applicants, supports the expansion of the project pipeline by lowering information-related barriers (perceived and real) to potential applicants.
- **Site Readiness**: As noted above, in broad terms there is little evidence of site availability from an infrastructure perspective being an impediment to economic growth in Region 7; therefore, this element is not explicitly included in Region 7 plans and activities.
- **Entrepreneurial Eco-System:** The requirement to include the findings of the TEConomy Report into the project pipeline is addressed in Goal #2 described below.
- **Continuous Process Review for Grant Applications:** The Project Committee, working with staff and the Executive Committee, will continue to review project start-up challenges and impediments on projects previously awarded GO-Virginia funding. In this element of the Project Pipeline, the goal is to identify and make recommendations for improving processes and lowering barriers to project start up. The result will be to bolster program success and quicken the speed at which the state will realize a return on the investment of GO-Virginia funds,
- **Encouraging partnerships:** The council's outreach efforts can help facilitate potential partnerships beyond those established with education institutions. The Council will encourage partnerships among localities and help identify potential matching resources.
- **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. In large measure, this task is dominated by the need to communicate the processes facing grant applicants in obtaining require local jurisdictional matches and encouraging applicants to not give up in the face of these processes.
- **Setting procedures for effective evaluation:** The Region 7 Council set up a project return-on-investment methodology for assessing grant applications and to evaluate grant recipient performance. As the nature of programs being funded expands, the Council, led by the Project Committee, will evaluate the need for revising approaches and methodologies in return on investment assessments to allow the opportunity for innovation in the promotion of economic opportunity.
- **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.

Project Performance

At this writing, GO Northern VA's Council has successfully promoted the funding for four projects: Northern Virginia Tech Talent Pipeline (NVTTP), Alexandria / Arlington Strengthening Our Workforce; NVCC's Fab Lab, and the NVTTP Apprenticeship Initiative.

NORTHERN VIRGINIA TECH TALENT PIPELINE - $487,500

This project will build upon Northern Virginia's existing computer services and cybersecurity clusters to create a workforce system that effectively attracts, prepares, and retains qualified candidates to fill high demand technology jobs in several targeted, high paying occupational areas: programming and software development; data and data warehousing; and networking and cybersecurity.

STRENGTHENING ALEXANDRIA/ARLINGTON'S TECHNOLOGY WORKFORCE - $201,896

This initiative is a combination of career pathway assistance, incumbent worker training, upskilling, on-the-job training and credentialing activities aimed to support computer services industry workers in newly located or newly established firms in Northern Virginia.

NOVA FABLAB - $250,000

Northern Virginia Community College in collaboration with Micron Technology, U.S. Army's Night Vision and Sensors Directorate, and BAE Systems presented this project to create a state-of-the-art engineering technology "Fabrication Laboratory" in Northern Virginia. This project will help create high-paying engineering jobs by leveraging established internship programs at Micron Technology and BAE Systems as well as the existing SySTEMic curriculum at Northern Virginia Community College

TECH TALENT PIPELINE APPRENTICESHIP PROGRAM - $1,000,000

A short-term solution to the IT talent shortage in our area lies in the Tech Talent Pipeline Apprenticeship Initiative (TPPA). The establishment of new apprenticeship models for IT jobs creates an alternative career pathway for tech talent, that takes less time than pursuing a four-year degree in IT generally does. The TPPA addresses four specific goals:

1. Establish new apprenticeship models for IT jobs
2. Bring 400 apprentices into the apprenticeship program
3. Work with 12 regional businesses to establish these programs, and
4. Build long-term sustainability for apprenticeships.

In actuality and as experienced in other GO Virginia regions, start-up for each of these projects has taken longer than anticipated. That learning will be incorporated into the reviews and expectations of future projects.

Influencing that delay was the initial completion of contracts among DHCD, the Council's Support Organization (Northern Virginia Regional Commission) and the project's lead agency. The review of contract details was initiated by NVRC on the Council's behalf and cooperative discussions followed. With initial work completed, contracting should not take as long and projects should begin implementation more rapidly following award (though not in every case).

Procurement procedures have also impacted upon project performance. One illustration -- the construction of the Fab Lab was slowed by state procurement activities outside of the GO Virginia involvement. Even with that delay, students were recruited to use other "borrowed" space, and 72 students have already enrolled in the program. When the Fab Lab is completed and students successfully have jobs-in-hand (with one semester completed, already 2 students were offered and accepted full-time internships to jobs with Micron), enrollment will increase.

To address these delays and slow performance, the Council established and assigned to each project "work groups" made up of 2-3 Council members with expertise to benefit the projects in implementation. These work groups, subsets of the Projects Committee, meet regular with the project leaders to discuss the projects and performance measured against contract. The work group members represent the progress, challenges, and successes of each project to the full Council at each meeting. Brief progress reports are included in each meeting package, that is more fully discussed during the meeting. This "hands on" approach is designed not only to keep the Council informed, but as importantly, to provide the projects with advice and mentoring to facilitate successful outcomes.

The following chart details the projects that meet certain Strategies as set out in the initial G&D Plan, and summarizes the outcomes are expected to be achieved. Overall, project completion dates are set in 2020.

Strategy	Project Funded	Planned Outcomes
Goal #1: Strengthen Northern Virginia's Technology Workforce		
Strategy 1.1: Strengthen and expand non-degree programs (e.g., certifications and credentials) that allow workers to enter and advance in technology careers.	• Northern Virginia Tech Talent Pipeline (NVTTP); • Alex / Arl Strengthening Our Workforce; • Fab Lab; and • NVTTP Apprenticeship	• Increase in number of credentials achieved by veteran, vet families, unemployed and encumbent workers • 20 employed & 40-68 unemployed gain credentials, and 10 incumbent workers in OJT training

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.	• Northern Virginia Tech Talent Pipeline (NVTTP); • Alex / Arl Strengthening Our Workforce; • Fab Lab; and • NVTTP Apprenticeship	• 80 students in pre-college cyber programs • Fab Lab will train 75 students in engineering technology • 400 Apprenticeships via NVTTP program; 12 businesses offering apprenticeships
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 Tech Talent Pipeline (NVTTP); • Alex / Arl Strengthening Our Workforce; and • NVTTP Apprenticeship	• NVTTP - Expanded NVTC Veterans Employment Initative • Alex / Arl Strenghtening Our Workforce both target veterans and their families
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.	• Northern Virginia Tech Talent Pipeline (NVTTP); • Alex / Arl Strengthening Our Workforce; • Fab Lab; and • NVTTP Apprenticeship	All the funded projects play a role in this space. NVTTP and Fab Lab, in particular, are to implement communications methodology designed to begin with high school students and their families to recognize this sector as viable, with or without college degrees. Summer camps for hands-on (400 students), and heavy use of social media methodologies, included.
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.	• Alex / Arl Strengthening Our Workforce	• Alex / Arl project targets very small and medium sized businesses to connect them with workers through their training programs
Strategy 1.6: Organize regional cluster networks to promote collaborative workforce development and training solutions.		

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.		
Goal #2: Accelerate the development of 'growth companies'		
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.	• Northern Virginia Tech Talent Pipeline (NVTTP) • Alex / Arl Strengthening Our Workforce	• NVTTP targets expanding businesses in the NVTC Tech Talent Employer Collaborative • Alex / Arl project targets very small businesses to connect them with workers through their training programs
Strategy 2.2: Support the expansion of programs designed to assist small- and medium-sized businesses (SMEs) enter new markets, both domestically and internationally.		
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.		
Strategy 2.4: Conduct regional survey/census of growth firms and business support programs.		
Goal #3: Enhance technology transfer and commercialization from research centers and institutions		
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.		
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.		
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.		
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.		

Appendix A: GO-Va Region 7 Council Members (July 1, 2019)

Name	Company/Agency	Sector
Executive Committee		
Tom Rust, Chair	Pennoni	Private Sector - Engineering
Sharon Virts, Vice-Chair	Founder, FCi Federal; Virts Miller Foundation	Private Sector - Entrepreneur
Sid Banerjee, Secretary **Projects Committee Chair**	Clarabridge	Private Sector - Technology
Hon. Marty Nohe, Treasurer	No. Virginia Transportation Authority, Prince William Co. Supervisor & Appliance Connection	Local Government & Private Sector - Retail
Paul Liberty, Governance Chair	George Mason University	Public Higher Education
Todd Yeatts, Outreach & Education Comm Chair	The Boeing Company	Private Sector – Government Contracting
Members - Private Sector		
Irma Bacerra, PhD	Marymount University	Private Sector – Higher Ed
Aneesh Chopra	CareJourney	Health Care Technology
Anup Ghosh	Accenture	Technology
Tom Gibson	Stratford Capital Group	Finance
David Guernsey	Guernsey Office Products	Retail & distribution
Nicholas Jordan	Capitol Bridge LLC	Finance
Greg Leisch	Newmark Grubb Knight Frank	Research & analytics
Matt McQueen	Peraton	Government Contracting
Brian Moore	Amazon	Technology
Carolyn Parent	LiveSafe, Inc.	Technology
Tom Pearson	Neustar	Technology
Todd Rowley	Old Dominion National Bank	Banking
Danny Vargas	VARCom Solution	Marketing
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. Ralph Buona	Loudoun Co. Board of Supervisors (& Telos Corporation)	Local government (& Technology)
Hon. Laurie DiRocco	NVRC & Mayor, City of Vienna	Planning District
Eileen Ellsworth	Community Foundation No. Virginia	Non-profit
Hon. John Foust	Fairfax Co. Board of Supervisors	Local government
Buddy Rizer	Loudoun Co. Econ. Dev. Authority	Economic Development Auth
Bobbie Kilberg	Northern Virginia Technology Council	Non-profit, Regional
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,[48] as well as those that speak to issues facing the Greater Washington metro area.[49] 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[50] 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 MWCOG has released two reports that highlight the region's demand, particularly for STEM-related occupations.[51]

[48] 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,
[49] *State of the Region: Economic Competitiveness Report 2016,* Metro Washington Council of Governments.
[50] https://www.mwcog.org/community/planning-areas/regional-planning/region-forward/goals/
[51] https://www.mwcog.org/documents/2016/10/25/trends-in-workforce-demand/

- **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*.[52] 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.[53] 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.[54] 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[55] 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 federal government spending. The information contained in this report is currently being used to update the region's Comprehensive Economic Development Strategy (CEDS).[56]

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[52] https://www.mwcog.org/documents/2017/01/11/greater-washington-metro-export-plan/
[53] Stephen S. Fuller, *The Roadmap for the Washington Region's Future Economy,* December 2015
[54] Inforum, University of Maryland, Roadmap for the Washington Region's Economic Future: Seven Key Economic Clusters, 2015.
[55] White, M. "Assessing Alexandria/Arlington's Regional Labor Market", George Mason University Center for Regional Analysis, prepared for the Alexandria/Arlington Regional Workforce Council.
[56] The region's previous CEDS was drafted in 2011, which is available here: https://workforcecouncil.arlingtonva.us/alexandriaarlington-comprehensive-economic-development-strategy/

- **The Northern Virginia Workforce Development Board (Area #11) Local Plan[57]:** 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.

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

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

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 25, 2017.

Revising the plan

The Council extended its contract with GMU's Center for Regional Analysis to support its efforts to revise the original plan in 2019l. The Council determined that its executive committee would serve as its Plan Revision Committee, and that work would be accomplished in time for full Council review and approval in time for the August 1, 2019 deadline. Dr. Terry Clower, CRA's director, worked closely with both the Staff Director, Sue Rowland, and the Executive Committee. The GO Virginia Growth & Diversification Plan Amendment Guidelines were used in developing the revisions, as required. Over the course of its work, the Executive Committee received updates on data analysis, met with representatives of GMU and VT along with VRIC, reviewed listening session notes held by the Northern Virginia Regional Commission with the region's school superintendents, met with TEConomy staff to review its study findings, revisited the Council's discussions on improving the process for developing GO Virginia projects in the region, and posted the draft Plan on its website for comment. The full Council received the final draft and a presentation from Dr. Clower at its June 27th meeting, from which additional input was provided prior to the final draft. The Plan was resubmitted for full Council review and adopted by the Council at its July 25, 2019 meeting with the Executive Committee authorized to approve any additional components to the Plan as recommended by the Council. Actions by the Executive Committee on its behalf were [to be] ratified at the October 23rd Council meeting.

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[58]. 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[59] A+ certification and introduce them to career opportunities within the rapidly growing cybersecurity industry.[60]
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.[61] • 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[62]. Ford NGL is the education initiative of the Ford Motor Company Fund and works with school districts to establish the framework for career exploration and work-based learning through business partnerships.[63]

[58] http://worksourcemontgomery.com/news-articles/worksource-montgomery-to-help-better-prepare-workers-for-careers-in-it-and-cybersecurity/
[59] Computer Technology Industry Association (CompTIA)
[60] http://www.nvcc.edu/news/press-releases/2016/cybersecurity-pathway.html
[61] http://www.myskillsource.org/pdf/AWSApprenticeshipFlyer.pdf
[62] http://www.dailypress.com/news/education/dp-nws-academies-of-hampton-comparison-20170814-story.html
[63] https://fordngl.com/about

Strategy	Examples
	• 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.[64] 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.[65] • 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.[66] • 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 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.[67] • 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

[64] http://www.creatingitfutures.org/developing-programs/it-ready
[65] http://www.nvcc.edu/workforce/uncommon-coders/index.html
[66] http://www.nvtc.org/veterans/
[67] https://www.uschamberfoundation.org/center-education-and-workforce/talent-pipeline-management-learning-network

Strategy	Examples
	program a structure for Missouri community colleges to implement training for careers in manufacturing, information technology, health services/health sciences and science support.[68] The program focuses their coursework, counseling, and career exploration around career pathways and stackable credentials.[69] • 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.[70]
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.[71] • The Incumbent Worker Training Initiative of Northern Virginia[72] 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	• Northern Virginia Technology Council's (NVTC) Tech Talent Initiative (TTI) provides a series of complimentary

[68] http://www.mowins.org/mostemwins.html
[69] https://www.missourieconomy.org/regional/mowins.stm
[70] http://www.nvcc.edu/systemic/whoweare.html
[71] http://www.nccommerce.com/Portals/11/Policy%20Statements/1-NCWorks%20IW%20PY%202014%20Guidelines%20for%20Businesses%20Final.pdf
[72] https://workforcecouncil.arlingtonva.us/2016/09/incumbent-worker-training-initiative-northern-virginia/

Strategy	Examples
promote collaborative workforce development and training solutions.	programs and activities addressing the shared current and future talent needs of the region's technology employers to certification, skill and competency development.[73] • 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 was based on a cluster mapping initiative sponsored by ReInvent Hampton Roads.[74]
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.[75] • 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.[76]
Strategy 2.1: Build greater awareness and usage of existing business support programs and resources;	• 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

[73] http://www.nvtc.org/resources/tech_talent_initiative.php
[74] http://reinventhr.org/industryClusters.html
[75] http://www.fldoe.org/accountability/fl-edu-training-placement-info-program/
[76] http://www.charlestonregionaldata.com/

Strategy	Examples
expand these programs to include more companies from multiple Northern Virginia jurisdictions.	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.[77] • 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.[78]
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.[79] • 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.[80] • 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

[77] http://www.kcsourcelink.com/about-us/about-kcsourcelink
[78] http://www.1millioncups.com/about
[79] http://exportvirginia.org/vital/
[80] https://www.genedge.org/resources/programs/exportech-virginia

Strategy	Examples
	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.
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.[81] 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.[82]
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.[83]
Strategy 3.1: Provide counseling, mentoring and other instructional programs for technology and venture-backed startups, to facilitate innovators bringing new	• 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

[81] http://commerce.maryland.gov/fund/programs-for-businesses/advance-maryland
[82] http://www.growfl.com/about/history/
[83] http://kclifesciences.org/wp-content/uploads/2015-KCALSI-CENSUS-FINAL.pdf

Strategy	Examples
technologies to the marketplace.	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.[84] • 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.[85]
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.[86] • 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.[87] • The Tennessee RevV! program connects Tennessee manufacturers to experts with at Oak Ridge National Laboratory (ORNL).[88] 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.[89]
Strategy 3.3: Provide grants to encourage companies to	• The *Kentucky SBIR-STTR Matching Funds Program* is funded by the Cabinet for Economic Development, (CED),

[84] https://www.virginiasbdc.org/programs/icap/
[85] http://www.cit.org/initiatives/crcf/
[86] http://commerceri.com/finance-business/taxes-incentives/innovation-vouchers/
[87] https://mn.gov/deed/business/financing-business/deed-programs/voucher/
[88] https://www.ornl.gov/programs/revv
[89] http://www.nmsbaprogram.org/

Strategy	Examples
prepare and submit Small Business Innovation Research (SBIR) and Small Business Technology Transfer Research (STTR) grant applications.	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.[90] 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.[91] • The Center for Innovative Technology (CIT) provides workshops and support concerning SBIR and STTR programs.[92]
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.[93] • 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).[94] • George Mason University has an Executive in Residence through the School of Business' Mason GovCon Initiative.[95]

[90] http://ksef.kstc.com/index.php/funding-programs/ky-sbirsttr-matching
[91] http://www.kysbir.com/index.php
[92] http://www.cit.org/events/?F_c=3
[93] http://www.plsg.com/business-growth-programs/executive-program/
[94] http://www.njeda.com/Press-Room/News-Articles/Press-Releases/EDA-Announces-Launch-of-New-Executive-in-Residence
[95] http://business.gmu.edu/govcon/about/

Appendix D: Cluster Definitions and Supplemental Data

NAICS (2012)	Cluster/Subcluster Names and NAICS Descriptions	Reg. 7 2014 Jobs	Reg. 7 2019 Jobs	Reg. 7 Jobs CAGR	U. S. 2014 Jobs	U. S. 2019 Jobs	U. S. Jobs CAGR	2014 LQ	2019 LQ	2014-2019 LQ Δ	Reg. 7 Average Earnings Per Job
	Business Support services	**13,226**	**14,276**	**1.6%**	**1,420,038**	**1,570,002**	**2.1%**	**1.08**	**1.06**	**-0.02**	**$84,207**
533110	Lessors of Nonfinancial Intangible Assets (except Copyrighted Works)	128	129	0.2%	23,888	23,197	-0.6%	0.62	0.65	0.03	$104,816
541199	All Other Legal Services	444	363	-3.7%	23,828	29,925	5.1%	2.16	1.41	-0.75	$89,319
541214	Payroll Services	587	316	-9.2%	181,261	175,401	-0.6%	0.38	0.21	-0.17	$89,891
541930	Translation and Interpretation Services	977	1,192	4.4%	29,167	43,596	9.9%	3.88	3.18	-0.70	$109,356
541990	All Other Professional, Scientific, and Technical Services	3,012	5,072	13.7%	122,051	179,689	9.4%	2.86	3.28	0.42	$112,634
561210	Facilities Support Services	4,844	4,530	-1.3%	134,362	156,934	3.4%	4.18	3.36	-0.82	$110,431
561330	Professional Employer Organizations	766	1,144	9.9%	355,829	367,210	0.6%	0.25	0.36	0.11	$55,160
561421	Telephone Answering Services	99	97	-0.4%	34,777	37,160	1.4%	0.33	0.30	-0.03	$32,642
561422	Telemarketing Bureaus and Other Contact Centers	1,722	464	-14.6%	465,585	500,849	1.5%	0.43	0.11	-0.32	$54,618
561920	Convention and Trade Show Organizers	646	968	10.0%	49,291	56,040	2.7%	1.52	2.01	0.49	$83,204

NAICS (2012)	Cluster/Subcluster Names and NAICS Descriptions	Reg. 7 2014 Jobs	Reg. 7 2019 Jobs	Reg. 7 Jobs CAGR	U. S. 2014 Jobs	U. S. 2019 Jobs	U. S. Jobs CAGR	2014 LQ	2019 LQ	2014-2019 LQ Δ	Reg. 7 Average Earnings Per Job
	Computer services	**109,691**	**125,887**	**3.0%**	**2,093,364**	**2,551,128**	**4.4%**	**6.07**	**5.74**	**-0.34**	**$140,691**
518210	Data Processing, Hosting, and Related Services	7,853	7,782	-0.9%	276,843	337,983	4.4%	3.29	2.68	-0.61	$163,813
541511	Custom Computer Programming Services	25,303	27,752	9.7%	784,668	966,130	4.6%	3.74	3.34	-0.40	$144,502
541512	Computer Systems Design Services	70,850	82,654	16.7%	869,696	1,050,642	4.2%	9.44	9.14	-0.30	$149,605
541513	Computer Facilities Management Services	1,229	1,601	30.2%	56,044	78,331	8.0%	2.54	2.38	-0.17	$111,331
541519	Other Computer Related Services	4,457	6,099	36.8%	106,113	118,043	2.2%	4.87	6.00	1.14	$134,202
	Consulting services	**51,012**	**54,071**	**1.2%**	**969,187**	**1,174,372**	**4.2%**	**6.10**	**5.35**	**-0.75**	**$140,329**
541611	Administrative Management and General Management Consulting Services	31,411	33,325	1.2%	480,715	651,161	7.1%	7.57	5.95	-1.62	$140,161
541612	Human Resources Consulting Services	1,231	1,267	0.6%	78,894	85,600	1.7%	1.81	1.72	-0.09	$138,328
541614	Process, Physical Distribution, and Logistics Consulting Services	9,169	10,052	1.9%	106,170	135,344	5.5%	10.01	8.63	-1.38	$134,425
541618	Other Management Consulting Services	3,702	3,423	-1.5%	91,357	101,507	2.2%	4.70	3.92	-0.78	$152,256
541690	Other Scientific and Technical Consulting Services	5,498	6,004	1.8%	212,050	200,759	-1.1%	3.00	3.48	0.48	$136,474

NAICS (2012)	Cluster/Subcluster Names and NAICS Descriptions	Reg. 7 2014 Jobs	Reg. 7 2019 Jobs	Reg. 7 Jobs CAGR	U. S. 2014 Jobs	U. S. 2019 Jobs	U. S. Jobs CAGR	2014 LQ	2019 LQ	2014-2019 LQ Δ	Reg. 7 Average Earnings Per Job
	Corporate Headquarters	**24,772**	**23,844**	**-0.7%**	**2,154,136**	**2,379,081**	**2.1%**	**1.33**	**1.16**	**-0.17**	**$179,660**
551111	Offices of Bank Holding Companies	<10	<10	0.0%	15,345	13,418	-2.5%	0.01	0.05	0.03	Insf. Data
551112	Offices of Other Holding Companies	472	379	-3.9%	71,447	74,535	0.9%	0.77	0.59	-0.17	$151,470
551114	Corporate, Subsidiary, and Regional Managing Offices	24,300	23,465	-0.7%	2,067,343	2,291,129	2.2%	1.36	1.19	-0.17	$207,849
	Engineering services	**24,140**	**23,399**	**-0.6%**	**914,978**	**988,715**	**1.6%**	**3.06**	**2.75**	**-0.31**	**$135,630**
541330	Engineering services	24,140	23,399	-0.6%	914,978	988,715	1.6%	3.06	2.75	-0.31	$135,630

NAICS (2012)	Cluster/Subcluster Names and NAICS Descriptions	Reg. 7 2014 Jobs	Reg. 7 2019 Jobs	Reg. 7 Jobs CAGR	U. S. 2014 Jobs	U. S. 2019 Jobs	U. S. Jobs CAGR	2014 LQ	2019 LQ	2014-2019 LQ Δ	Reg. 7 Average Earnings Per Job
	Financial services	**19,918**	**26,895**	**7.0%**	**1,948,047**	**2,068,238**	**1.2%**	**1.18**	**1.51**	**0.33**	**$210,377**
561450	Credit Bureaus	498	672	7.0%	19,577	22,145	2.6%	2.95	3.53	0.58	$112,456
522120	Savings Institutions	155	132	-3.0%	157,295	106,759	-6.4%	0.11	0.14	0.03	$146,778
522190	Other Deposit Credit Inter	<10	23	31.5%	11,865	10,682	-2.0%	0.07	0.25	0.19	$786,203
522210	Credit Card Issuing	1,404	4,679	46.7%	87,622	86,472	-0.3%	1.86	6.29	4.43	$180,501
522220	Sales Financing	236	152	-7.2%	89,766	95,448	1.3%	0.31	0.18	-0.12	$196,467
522291	Consumer Lending	334	363	1.7%	99,878	104,533	0.9%	0.39	0.40	0.02	$132,996
522292	Real Estate Credit	2,706	2,904	1.5%	202,591	245,234	4.2%	1.55	1.38	-0.17	$143,657
522293	Int'l Trade Financing	19	67	51.7%	5,823	5,735	-0.3%	0.37	1.37	0.99	$182,789
522294	Secondary Market Financing	4,940	5,983	4.2%	18,697	18,240	-0.5%	30.62	38.13	7.51	$179,259
522298	Oth Nondeposit Credit Inter	375	472	5.2%	67,318	70,472	0.9%	0.65	0.78	0.13	$138,636
522320	Fin Trans Processing,	963	1,495	11.0%	124,127	140,732	2.7%	0.90	1.23	0.34	$166,439
522390	Other Credit Intermediation	2,170	2,845	6.2%	90,053	85,206	-1.1%	2.79	3.88	1.09	$173,750
523910	Misc. Intermediation	124	406	45.2%	26,290	29,209	2.2%	0.55	1.61	1.06	$168,359
523920	Portfolio Management	820	1,173	8.6%	182,993	215,762	3.6%	0.52	0.63	0.11	$242,305
523930	Investment Advice	2,358	2,391	0.3%	174,874	203,159	3.2%	1.56	1.37	-0.19	$200,218
523991	Trust, Fiduciary, Activities	29	75	32.2%	19,937	18,346	-1.6%	0.17	0.47	0.31	$121,822
523999	Misc. Financial Activities	95	168	15.6%	26,414	29,918	2.7%	0.41	0.65	0.24	$177,474
525910	Open-End Investment Funds	<10	11	5.0%	421	1,323	42.9%	0.34	0.99	0.64	$339,781
525990	Other Financial Vehicles	34	28	-3.1%	1,835	5,374	38.6%	2.13	0.62	-1.51	$531,287
521110	Monetary Author. Central	26	0	-20%	18,361	19,358	1.1%	0.17	0.00	-0.17	$0
522310	Mortg & Nonmortg Brokers	673	702	0.9%	72,058	93,722	6.0%	1.08	0.87	-0.21	$115,910
523110	Investment Banking	298	245	-3.5%	144,840	152,272	1.0%	0.24	0.19	-0.05	$258,806
523120	Securities Brokerage	1,576	1,824	3.1%	274,890	280,255	0.4%	0.66	0.76	0.09	$270,969
523130	Commodity Contracts Deal'g	14	18	5.8%	13,420	13,879	0.7%	0.12	0.15	0.03	$114,325
523140	Com Contracts Brokerage	30	<10	-14%	10,688	8,817	-3.5%	0.32	0.06	-0.27	N/D
523210	Securities &Comm Exch	40	64	11.8%	6,420	5,188	-3.8%	0.73	1.44	0.71	$178,241

NAICS (2012)	Cluster/Subcluster Names and NAICS Descriptions	Reg. 7 2014 Jobs	Reg. 7 2019 Jobs	Reg. 7 Jobs CAGR	U. S. 2014 Jobs	U. S. 2019 Jobs	U. S. Jobs CAGR	2014 LQ	2019 LQ	2014-2019 LQ Δ	Reg. 7 Average Earnings Per Job
	Marketing, Design & Publishing	**13,045**	**13,532**	**0.7%**	**1,356,505**	**1,533,000**	**2.6%**	**1.11**	**1.03**	**-0.09**	**$97,062**
541810	Advertising Agencies	1,289	1,209	-1.2%	200,643	214,351	1.4%	0.74	0.66	-0.09	$124,100
541850	Outdoor Advertising	66	66	0.2%	38,267	40,011	0.9%	0.20	0.19	-0.01	$99,676
541860	Direct Mail Advertising	966	695	-5.6%	49,603	43,942	-2.3%	2.26	1.84	-0.42	$78,777
541870	Advertising Material Distribution Services	35	52	10.0%	11,838	12,695	1.4%	0.34	0.48	0.14	$43,671
541890	Other Services Related to Advertising	1,211	1,357	2.4%	100,322	105,053	0.9%	1.40	1.50	0.10	$50,345
541410	Interior Design Services	346	397	2.9%	36,648	47,307	5.8%	1.09	0.97	-0.12	$78,655
541420	Industrial Design Services	121	14	-18%	14,318	20,335	8.4%	0.98	0.08	-0.90	$81,591
541430	Graphic Design Services	494	490	-0.2%	63,008	62,555	-0.1%	0.91	0.91	0.00	$78,177
541490	Other Specialized Design Services	60	49	-3.9%	14,687	16,632	2.6%	0.48	0.34	-0.14	$55,166
541613	Marketing Consulting Services	1,675	1,912	2.8%	204,073	280,109	7.5%	0.95	0.79	-0.16	$110,435
541820	Public Relations Agencies	954	1,224	5.7%	58,639	62,629	1.4%	1.89	2.27	0.39	$131,056
541830	Media Buying Agencies	158	147	-1.3%	15,220	18,420	4.2%	1.20	0.93	-0.27	$118,290
541840	Media Representatives	158	136	-2.8%	27,299	22,143	-3.8%	0.67	0.71	0.04	$116,642
541910	Marketing Research and Public Opinion Polling	779	774	-0.1%	102,593	91,530	-2.2%	0.88	0.98	0.10	$109,913
511120	Periodical Publishers	2,202	1,890	-2.8%	102,978	85,359	-3.4%	2.48	2.57	0.10	$124,594
511130	Book Publishers	130	104	-4.0%	64,252	58,060	-1.9%	0.23	0.21	-0.03	$112,653
511140	Directory and Mailing List Publishers	63	28	-11.0%	25,924	17,286	-6.7%	0.28	0.19	-0.09	$78,098
511199	All Other Publishers	79	31	-12%	9,881	8,900	-2.0%	0.92	0.41	-0.51	$149,461
519110	News Syndicates	175	328	17.5%	12,115	11,539	-0.9%	1.67	3.30	1.63	$65,171
519120	Libraries and Archives	27	99	54.2%	27,369	29,207	1.3%	0.11	0.40	0.28	$50,146
519130	Internet Publ. & Broadcast and Web Search Portals	1,791	1,991	2.2%	161,289	261,029	12.4%	1.29	0.89	-0.40	$174,740
519190	All Other Information Services	267	539	20.4%	15,541	23,910	10.8%	1.99	2.62	0.63	$103,999

NAICS (2012)	Cluster/Subcluster Names and NAICS Descriptions	Reg. 7 2014 Jobs	Reg. 7 2019 Jobs	Reg. 7 Jobs CAGR	U. S. 2014 Jobs	U. S. 2019 Jobs	U. S. Jobs CAGR	2014 LQ	2019 LQ	2014-2019 LQ Δ	Reg. 7 Average Earnings Per Job
	Professional Organizations	**5,962**	**6,198**	**3.9%**	**81,623**	**87,811**	**8%**	**8.46**	**8.20**	**-0.26**	**$110,113**
813920	Professional Organizations	5,962	6,198	3.9%	81,623	87,811	8%	8.46	8.20	-0.26	$110,113
	Research Organizations	**14,177**	**12,346**	**-2.6%**	**639,322**	**698,503**	**1.9%**	**2.57**	**2.05**	**-0.52**	**$121,742**
541720	Research and Development in the Social Sciences and Humanities	1,687	1,774	1.0%	60,642	63,819	1.0%	3.22	3.23	0.01	$113,958
541713	Research and Development in Nanotechnology	74	82	1.9%	22,605	21,066	-1.4%	0.38	0.45	0.07	$107,068
541714	Research and Development in Biotechnology (except Nanobiotechnology)	667	675	0.2%	146,485	201,175	7.5%	0.53	0.39	-0.14	$119,780
541715	Research and Development in the Physical, Engineering, and Life Sciences (except Nanotechnology and Biotechnology)	11,748	9,815	-3.3%	409,590	412,443	0.1%	3.32	2.77	-0.56	$146,161

NAICS (2012)	Cluster/Subcluster Names and NAICS Descriptions	Reg. 7 2014 Jobs	Reg. 7 2019 Jobs	Reg. 7 Jobs CAGR	U. S. 2014 Jobs	U. S. 2019 Jobs	U. S. Jobs CAGR	2014 LQ	2019 LQ	2014-2019 LQ Δ	Reg. 7 Average Earnings Per Job
	Transportation & Logistics	**16,144**	**17,986**	**2.3%**	**1,595,037**	**1,766,747**	**2.2%**	**1.17**	**1.18**	**0.01**	**$80,138**
481111	Scheduled Passenger Air Transportation	10,434	10,802	0.7%	396,395	450,814	2.7%	3.05	2.78	-0.27	$110,538
481112	Scheduled Freight Air Transportation	364	400	2.0%	12,455	11,638	-1.3%	3.39	4.00	0.61	$66,168
481212	Nonscheduled Chartered Freight Air Transportation	<10	12	6.7%	6,917	9,830	8.4%	0.01	0.14	0.13	$81,390
488111	Air Traffic Control	0	<10	n/a	2,677	2,048	-4.7%	0.00	0.07	0.07	N/D
488119	Other Airport Operations	2,384	3,729	11.3%	71,683	105,601	9.5%	3.85	4.10	0.25	$32,687
488190	Other Support Activities for Air Transportation	1,129	1,128	0.0%	100,571	119,385	3.7%	1.30	1.10	-0.20	$79,032
485210	Interurban and Rural Bus Transportation	232	250	1.5%	18,438	19,033	0.6%	1.46	1.53	0.07	$65,554
485510	Charter Bus Industry	223	315	8.2%	29,742	29,236	-0.3%	0.87	1.25	0.38	$57,075
488210	Support Activities for Rail Transportation	<10	<10	0.0%	31,808	34,941	2.0%	0.02	0.02	0.00	N/D
488490	Other Support Activities for Road Transportation	104	174	13.6%	35,940	39,505	2.0%	0.33	0.51	0.18	$47,449
488510	Freight Transportation Arrangement	828	627	-4.9%	195,276	229,992	3.6%	0.49	0.32	-0.17	$97,221
488991	Packing and Crating	61	75	4.4%	18,206	19,313	1.2%	0.39	0.45	0.06	$65,231
488999	All Other Support Activities for Transportation	46	75	12.6%	11,801	14,360	4.3%	0.45	0.60	0.15	$105,672
481211	Nonscheduled Chartered Passenger Air Transportation	149	111	-5.1%	26,403	30,570	3.2%	0.66	0.42	-0.23	$114,463
481219	Other Nonscheduled Air Transportation	24	20	-3.5%	3,969	5,659	8.5%	0.71	0.41	-0.30	$142,010
484121	General Freight Trucking, Long-Distance, Truckload	77	153	19.8%	503,389	505,898	0.1%	0.02	0.04	0.02	$68,453
484230	Specialized Freight (except Used Goods) Trucking, Long-Distance	88	114	5.9%	129,369	138,922	1.5%	0.08	0.10	0.02	$69,130

NAICS (2012)	Cluster/Subcluster Names and NAICS Descriptions	Reg. 7 2014 Jobs	Reg. 7 2019 Jobs	Reg. 7 Jobs CAGR	U. S. 2014 Jobs	U. S. 2019 Jobs	U. S. Jobs CAGR	2014 LQ	2019 LQ	2014-2019 LQ Δ	Reg. 7 Average Earnings Per Job
	Life Sciences *	**23,549**	**21,424**	**-1.8%**	**4,624,290**	**4,961,824**	**1.5%**	**0.59**	**0.50**	**-0.09**	**$69,836**
111000	Crop Production	294	354	4.1%	557,083	553,607	-0.1%	0.06	0.07	0.01	$21,103
325199	All Other Basic Organic Chemical Manufacturing	<10	<10	N/D	36,126	39,904	2.1%	0.00	0.02	0.01	N/D
325311	Nitrogenous Fertilizer Manufacturing	0	0	n/a	7,795	8,312	1.3%	0.00	0.00	0.00	$0
325314	Fertilizer (Mixing Only) Manufacturing	0	0	n/a	8,230	8,763	1.3%	0.00	0.00	0.00	$0
325320	Pesticide and Other Agricultural Chemical Manufacturing	0	0	n/a	14,011	13,151	-1.2%	0.00	0.00	0.00	$0
325411	Medicinal and Botanical Manufacturing	<10	<10	N/D	22,616	31,108	7.5%	0.02	0.00	-0.02	N/D
325412	Pharmaceutical Preparation Manufacturing	102	180	15.2%	206,731	201,742	-0.5%	0.06	0.10	0.05	$85,241
325414	Biological Product (except Diagnostic) Manufacturing	<10	<10	N/D	28,254	36,302	5.7%	0.01	0.01	0.00	N/D
327215	Glass Product Manufacturing Made of Purchased Glass	<10	38	N/D	41,410	46,751	2.6%	0.01	0.09	0.08	$50,959
333314	Optical Instrument and Lens Manufacturing	1,051	81	-18.5%	19,185	20,320	1.2%	6.35	0.46	-5.88	$74,395
334510	Electromedical and Electrotherapeutic Apparatus Manufacturing	17	64	53.1%	55,119	69,722	5.3%	0.04	0.11	0.07	$63,064
334513	Instruments and Related Products Manufacturing for Measuring, Displaying, and Controlling Industrial Process Variables	211	236	2.4%	62,837	62,535	-0.1%	0.39	0.44	0.05	$72,463
334516	Analytical Laboratory Instrument Manufacturing	131	97	-5.2%	33,681	36,685	1.8%	0.45	0.31	-0.14	$91,252
334517	Irradiation Apparatus Manufacturing	22	38	14.9%	12,893	14,073	1.8%	0.20	0.31	0.12	$60,840

NAICS (2012)	Cluster/Subcluster Names and NAICS Descriptions	Reg. 7 2014 Jobs	Reg. 7 2019 Jobs	Reg. 7 Jobs CAGR	U. S. 2014 Jobs	U. S. 2019 Jobs	U. S. Jobs CAGR	2014 LQ	2019 LQ	2014-2019 LQ Δ	Reg. 7 Average Earnings Per Job
	Life Sciences Continued										
339112	Surgical and Medical Instrument Manufacturing	388	708	16.5%	118,928	129,131	1.7%	0.38	0.64	0.26	$89,652
339113	Surgical Appliance and Supplies Manufacturing	59	101	14.1%	100,783	102,577	0.4%	0.07	0.11	0.05	$56,995
339114	Dental Equipment and Supplies Manufacturing	16	18	2.5%	16,024	15,787	-0.3%	0.12	0.13	0.02	$124,138
339115	Ophthalmic Goods Manufacturing	31	51	12.6%	26,564	25,411	-0.9%	0.14	0.23	0.10	$74,089
339116	Dental Laboratories	272	376	7.6%	44,015	45,916	0.9%	0.72	0.95	0.24	$45,549
423450	Medical, Dental, and Hospital Equipment and Supplies Merchant Wholesalers	611	856	8.0%	190,805	242,986	5.5%	0.37	0.41	0.04	$108,110
424210	Drugs and Druggists' Sundries Merchant Wholesalers	150	86	-8.5%	195,389	229,186	3.5%	0.09	0.04	-0.05	$83,786
541380	Testing Laboratories	380	428	2.5%	169,211	172,462	0.4%	0.26	0.29	0.03	$79,325
541713	Research and Development in Nanotechnology	74	82	1.9%	22,605	21,066	-1.4%	0.38	0.45	0.07	$107,068
541714	Research and Development in Biotechnology (except Nanobiotechnology)	667	675	0.2%	146,485	201,175	7.5%	0.53	0.39	-0.14	$119,780
541715	Research and Development in the Physical, Engineering, and Life Sciences (except Nanotechnology and Biotechnology)	11,748	9,815	-3.3%	409,590	412,443	0.1%	3.32	2.77	-0.56	$146,161
611310	Colleges, Universities, and Professional Schools	4,940	4,288	-2.6%	1,895,914	2,013,637	1.2%	0.30	0.25	-0.05	$58,848
621511	Medical Laboratories	2,383	2,852	3.9%	182,008	207,073	2.8%	1.52	1.60	0.08	$63,249

NAICS (2012)	Cluster/Subcluster Names and NAICS Descriptions	Reg. 7 2014 Jobs	Reg. 7 2019 Jobs	Reg. 7 Jobs CAGR	U. S. 2014 Jobs	U. S. 2019 Jobs	U. S. Jobs CAGR	2014 LQ	2019 LQ	2014-2019 LQ Δ	Reg. 7 Average Earnings Per Job
SOC	**Cybersecurity #**	**42,119**	**48,053**	**2.8%**	**1,262,583**	**1,431,247**	**2.7%**	**3.87**	**3.90**	**0.04**	**$109,984.91**
15-1121	Computer Systems Analysts	15,225	17,016	2.4%	537,741	617,819	3.0%	3.28	3.20	-0.08	$103,544.98
15-1122	Information Security Analysts	7,423	10,284	7.7%	86,365	122,663	8.4%	9.96	9.74	-0.21	$112,558.87
15-1141	Database Administrators	2,972	2,997	0.2%	117,681	124,911	1.2%	2.93	2.79	-0.14	$108,250.13
15-1142	Network and Computer Systems Administrators	10,649	11,304	1.2%	375,432	397,347	1.2%	3.29	3.31	0.02	$99,343.91
15-1143	Computer Network Architects	5,850	6,452	2.1%	145,365	168,506	3.2%	4.66	4.45	0.21	$126,226.65

Source: EMSI Economic Modeling Specialists, International; U. S. Cluster Mapping Project's Benchmark Definitions (Delgado, Porter, Stern 2013)

* 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.

Appendix E: Additional Labor Market Analysis (Targeted Occupations)

In this analysis we examined current (2019) market conditions for key occupations in the targeted industry clusters identified for Region 7 (Computer Services, Cybersecurity, Financial Services, Engineering Services, Research & Development, and Life Sciences. To be included, the occupation must represent at least 2 percent of total employment in one or more of the targeted industries and have median hourly pay at or above $36 per hour. Several of the occupations span multiple target industries. The data reported show the current number of jobs by occupation, current job postings based on on-line advertising, the estimated number of workers in occupation who are aged 55+ (retiring soon), unique job postings over the past 12 months, the number of employers posting ads for the occupation, and the number of degrees or formal certificates awarded to students in fields related to the occupation by Region 7 institutions. The completions data are not unique to an occupation. For example, for several of the computer occupations the actual degrees or certificates overlap greatly, so data in the last column is not additive.

SOC	Description	Total Employed in Region	Current Job Postings	Retiring Soon (55+)	Unique Job Postings in past 12 months	# Employers Posting for the Job in past 12 months	Degree/Certificate Completions in 2017 from Regional Institutions (all levels)
13-1111	Management Analysts	30,369	1,582	7,627	18,988	3,105	3,485
15-1132	Software Developers, Applications	24,380	5,053	3,283	60,632	5,951	1,731
11-1021	General and Operations Managers	22,109	542	5,025	6,498	1,991	3,835
15-1133	Software Developers, Systems Software	19,582	688	2,727	8,257	1,149	2,193
13-2011	Accountants and Auditors	19,395	994	3,814	11,928	2,011	457
13-1199	Business Operations Specialists, All Other	15,817	747	3,874	8,961	1,938	-
15-1121	Computer Systems Analysts	15,374	1,438	2,899	17,257	2,922	1,730
11-9199	Managers, All Other	13,582	1,014	3,681	12,166	3,006	4,799
15-1142	Network and Computer Systems Admin.	10,583	2,615	1,475	31,380	4,311	679
15-1122	Information Security Analysts	10,260	2,802	1,870	33,628	3,081	2,536
13-1161	Market Research Analysts and Specialists	9,976	576	1,299	6,912	2,066	117
15-1199	Computer Occupations, All Other	9,338	3,152	1,539	37,819	4,923	1,559
11-3021	Computer & Information Systems Mgs	8,596	854	1,630	10,246	1,464	2,729
11-3031	Financial Managers	8,024	610	1,695	7,319	1,236	295
15-1143	Computer Network Architects	6,066	155	837	1,856	609	2,536
17-2051	Civil Engineers	5,287	241	1,483	2,894	565	111

SOC	Description	Total Employed in Region	Current Job Postings	Retiring Soon (55+)	Unique Job Postings in past 12 months	# Employers Posting for the Job in past 12 months	Degree/Certificate Completions in 2017 from Regional Institutions (all levels)
13-2051	Financial Analysts	5,033	313	600	3,753	915	295
13-2072	Loan Officers	4,301	100	768	1,203	252	191
15-1131	Computer Programmers	4,041	285	765	3,418	1,398	538
17-2141	Mechanical Engineers	2,923	302	704	3,627	803	7
15-1141	Database Administrators	2,728	359	515	4,310	1,337	746
17-2071	Electrical Engineers	2,727	319	792	3,833	802	120
11-9041	Architectural and Engineering Managers	1,998	290	627	3,474	818	771
13-2052	Personal Financial Advisors	1,521	66	327	792	177	191
19-1042	Medical Scientists, Except Epidemiologists	448	50	90	595	222	103

Source: EMSI