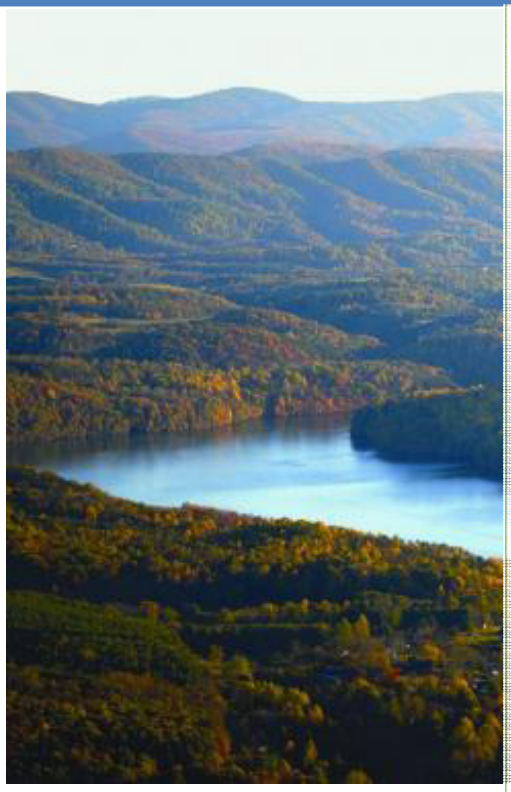
2016

Target Industry Analysis : NRVEDA



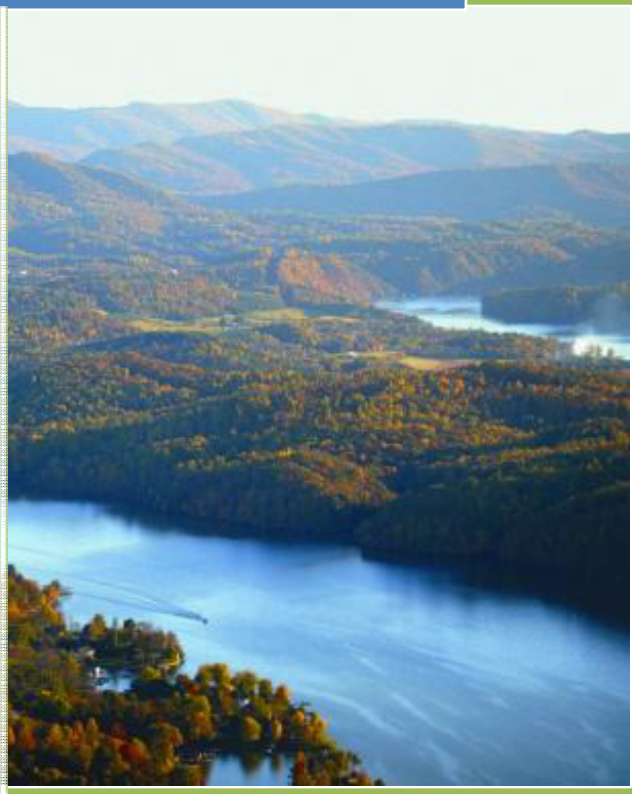


Photo credit: http://nrvrc.org

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UAP5774 Economic Development Studio

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Table of Contents

Executive Summary

The fall semester 2016 Economic Development Studio at Virginia Tech (VT) was asked to perform an industry analysis to aid the New River Valley Economic Development Alliance (NRVEDA) in developing a more targeted comprehensive strategy to attract and retain world-class jobs, investment and talent in the New River Valley (NRV) (see figure 1). This targeted approach will help the alliance meet its mission as well as strategic plans (see figure 2 and 3). Prior to this analysis, the NRVEDA was targeting thirteen existing industries. A data-driven approach was used to examine the NRV's suitability for specific existing, emerging and potential industries. The following criteria were used to evaluate industries: fifty or more employees, notable job growth, above-average location quotient (LQ), robust business activity of more than one company in the industry, and growing wages that are above the region's median annual salary of approximately $30,000.[1]

Our analysis identified three existing sectors most suitable for targeting for future growth: agriculture, advanced manufacturing and information technology (IT). In addition, five emerging opportunities were identified that are not yet well-established, but show potential for significant economic opportunities in the NRV. These emerging opportunities include: food manufacturing, unmanned systems, hops production and processing, industrial hemp production, and materials. This report provides information on each recommended target sector and emerging opportunity and how these may serve to expand the region's economy, while employing a diverse range of workers and building regional assets.

[1] "EMSI," Labor Market Database, (n.d.), http://www.economicmodeling.com/.

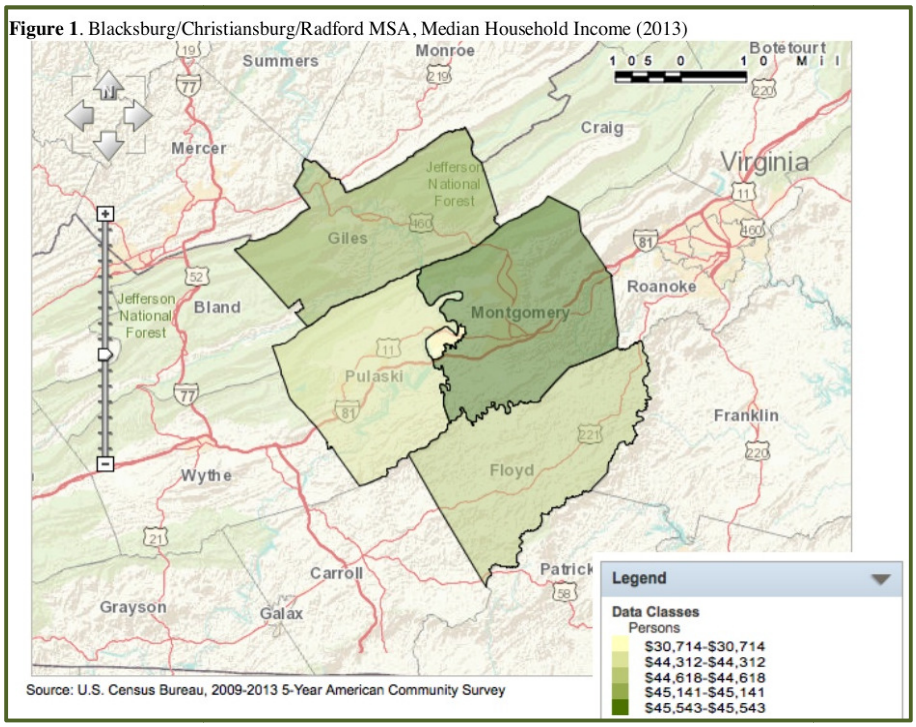
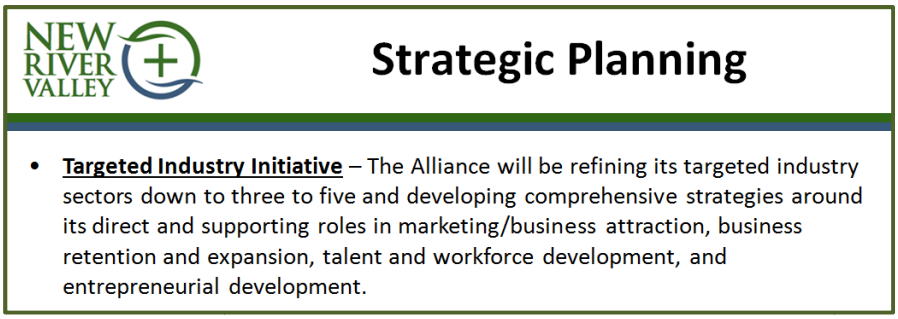


Figure 1. Blacksburg/Christiansburg/Radford MSA, Median Household Income (2013)

Figure 2.

Source: Jewel, Charlie. "Expanding Virginia's New River Valley." Presentation 9/14/16.

Figure 3.



Source: Jewel, Charlie. "Expanding Virginia's New River Valley." Presentation 9/14/16.

Introduction

The NRV is a naturally beautiful area comprised of rolling hills and mountain land, streams and a major river; it is situated in Southwestern Virginia. Our history and culture is rooted in Appalachian music, coal mining, agriculture and education. The NRV provides abundant outdoor recreation, including the New River, many creeks and streams, The Appalachian Trail, The New River Trail and Claytor Lake State Parks, among many others. Our area is a conglomeration of small communities, remotely located, yet a place where one can obtain a world-class education and maintain a high quality of life. The citizens of the NRV value the clean environment, ease of mobility around the region and friendly neighbors. They enjoy being "out of the way," yet also having the international, arts, cultural and sporting influences and activities provided by the universities. Many people say they can live a life here that they thought was no longer possible.

Virginia Tech, Jugbusters Old-time Band, NRV farm, New River, Radford University, Christiansburg Aquatic Center[2]

The NRVEDA is appreciated as an entity that facilitates connections and business opportunities throughout the four counties, one city and ten towns in the valley. Local industry

[2] Cecile Newcomb, *Photos of the NRV*, Photographs, December 13, 2016, https://www.google.com/imghp?hl=en&tab=wi&ei=T1NQWJjcMYTbmQHj3oTACw&ved=0EKouCBgoAQ.

and economic development professionals see opportunity for the alliance to be a conduit for information and networks that generate beneficial partnerships between business and education interests. Our objective has been to perform an industry analysis to aid the NRVEDA in developing a more targeted comprehensive strategy to attract and retain world-class jobs, investment and talent in the NRV. Future economic development should attract additional employers within industries that strengthen the region and capitalize on competitive advantages by the following:

- Expanding the economic base
- Creating quality jobs where the sector average wage is at least the regional average wage
- Creating quality investment that adds to the local government tax base
- Aligning with the assets of the NRV
- Complementing existing industries
- Having a good growth trajectory locally, nationally and internationally
- Providing opportunities for a wide range of employees (from unskilled to college educated)
- Providing opportunities for localities throughout the NRV
- Helping to diversify the regional economy

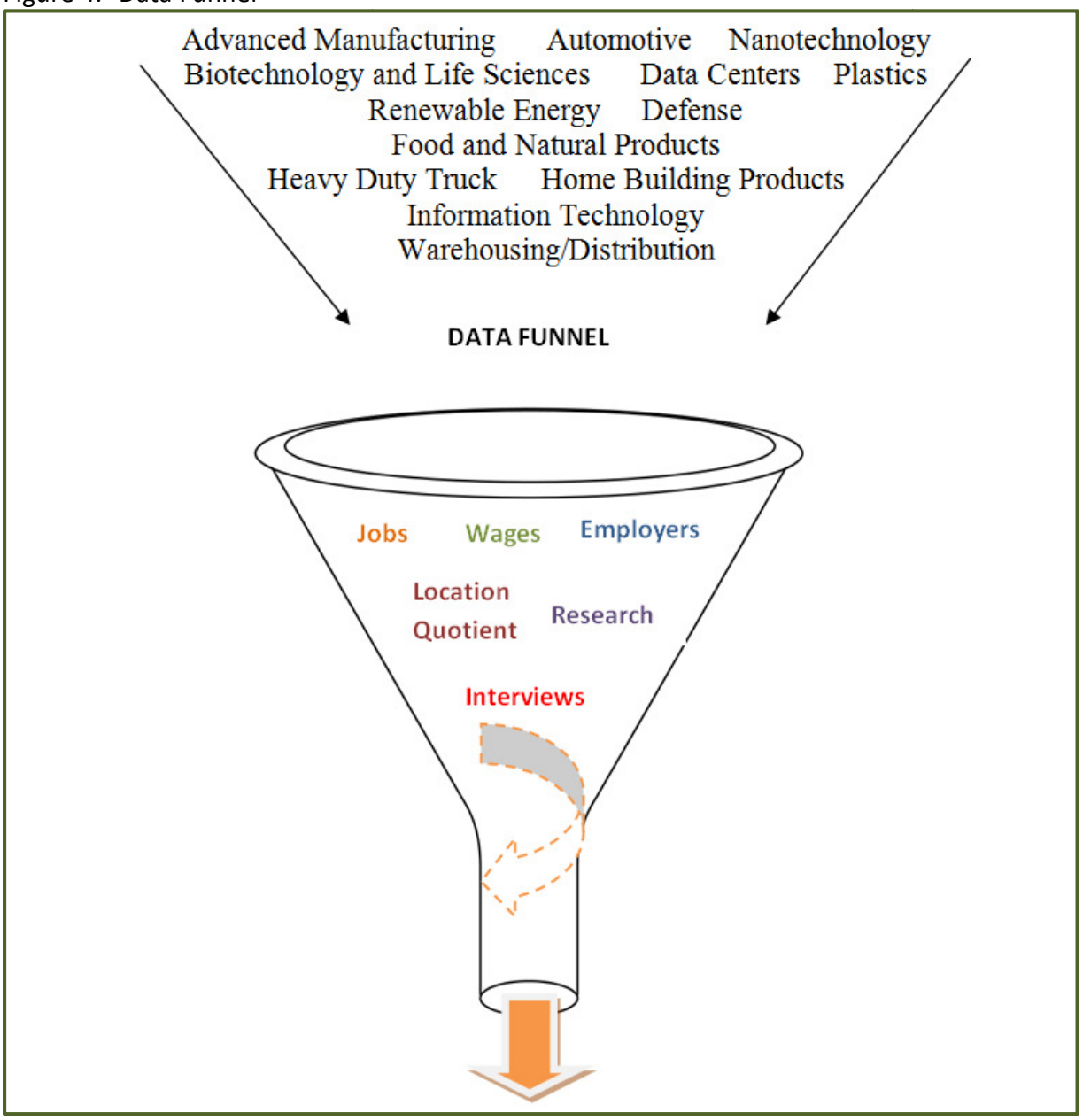
Source: http://efastfacts.com/blog/wp-content/uploads/2013/11/Expanding-Your-Business.jpg. Jewel, Charlie. "Expanding Virginia's New River Valley." Presentation 9/14/16.

Methodology

Developing evidence-based target recommendations was accomplished by gaining understanding of the regional economy on the macro and micro levels through a mixed methods approach. In order to narrow our focus, we processed existing, emerging and potential sectors and industries through a quantitative and qualitative data funnel at the state and federal levels (see figure 4). We then took our narrowed choices and compared staffing patterns in the NRV to the Extended Labor Area (ELA) (see figure 5). This information narrowed our choices to the final targets of advanced manufacturing, agriculture, and information technology.

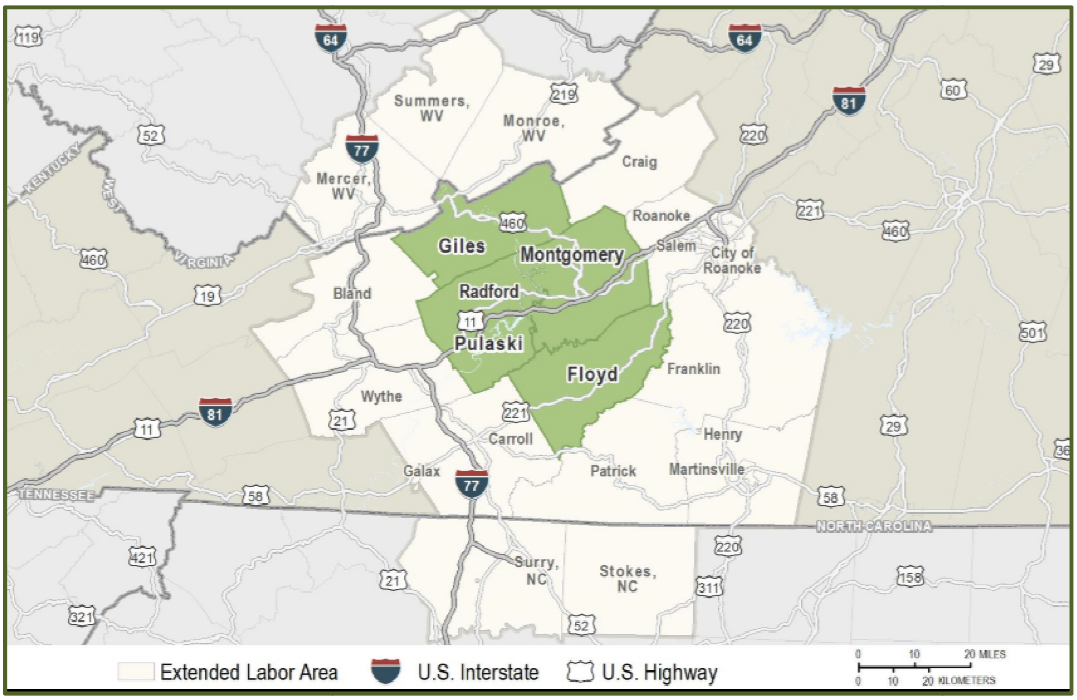
Quantitative and qualitative data included EMSI labor market industry data, staffing patterns, research, and interviews with economic developers in local government, business and higher education. Industry site selection criteria were compared to potential and available sites in the NRV. Strength, Weakness, Opportunities, and Threat (SWOT) analyses were also completed for each industry, and the area as a whole.

Figure 4.[3] Data Funnel



[3] Cecile Newcomb, *Data Funnel*, Microsoft Office, November 2016.

Figure 5. NRV surrounded by the Extended Labor Area



Source: Virginia Economic Development Partnership

Quantitative Data

The thirteen industries that were previously targeted, plus additional industries suggested by NRVEDA provided a starting point for a numerical analysis at the local, state, and national levels (see figure 4). EMSI labor market data at the sector and industry levels showed employment, LQ, number of establishments, and wage trends from 2010 to 2015. The following criteria were used to filter out potential North American Industry Classification System (NAICS) industry targets:

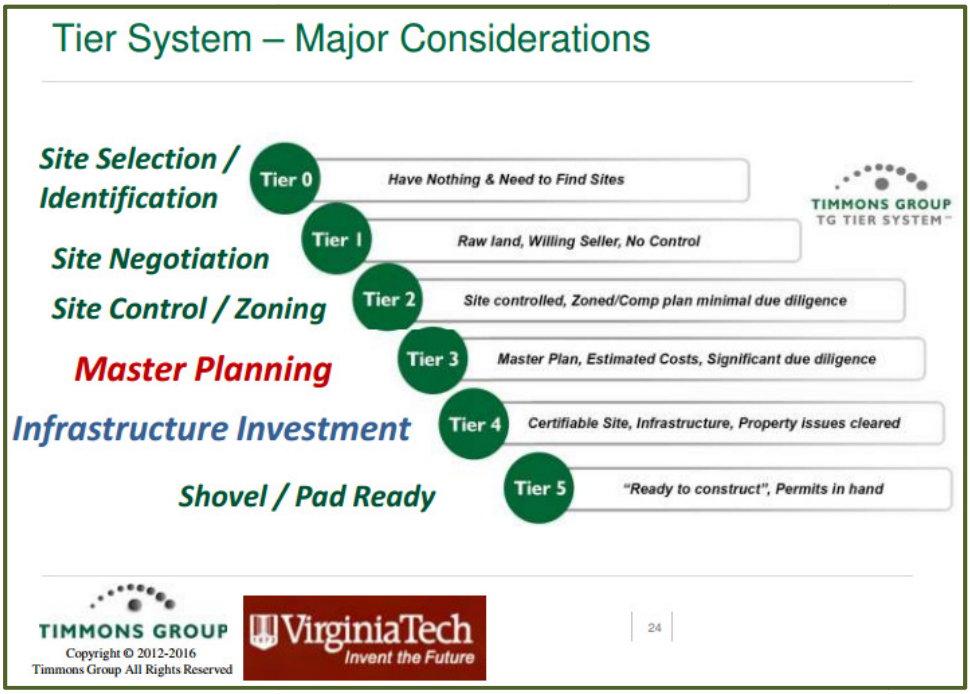
- 50 or more employees
- Experienced at least 10% job growth
- Above-average location quotient of 2 or more
- Robust business activity
- Growing wages above the region median of about $30,000

Staffing patterns were evaluated for industries that met the criteria above. EMSI data per industry provides data regarding occupations, job change, median earnings, and required education and experience. The Virginia Economic Development Partnership defines the NRV

Extended Labor Area (ELA) as neighboring and nearby counties in Virginia, North Carolina, and West Virginia (see figure 5). Jobs in the NRV were compared to the ELA primarily in terms of quantity and pay.

Site selection is also an important consideration both for businesses that plan to expand in the NRV, as well as new businesses considering locating here. The Timmons Group's site selection tier system indexes sites in relation to their preparedness for building construction (see figure 6).[4] This system was applied to currently available sites in the NRV.

Figure 6.[5]



Qualitative Data

Stakeholders including local government, business, and university representatives possess knowledge that provides valuable qualitative data. The group conducted stakeholder interviews which included a series of questions in a semi-structured format, meaning that respondents at times directed the conversation away from the original question and discussed

[4] Joseph C. Hines, "Economic Development 101: Are Your Sites and Community Prospect Ready?" (educational, Economic Development Studio, Virginia Tech, September 27, 2016).
[5] Ibid.

additional information as they saw appropriate (see appendix A). Interviews sought to identify the strengths, weaknesses, opportunities, and threats of the region, with questions ranging from their work experience to a future vision for the region, as well as suggestions for ways in which NRVEDA can provide valuable services to local businesses. Interviewees provided empirical information about the region's business climate, quality of life, speculative technologies and more.

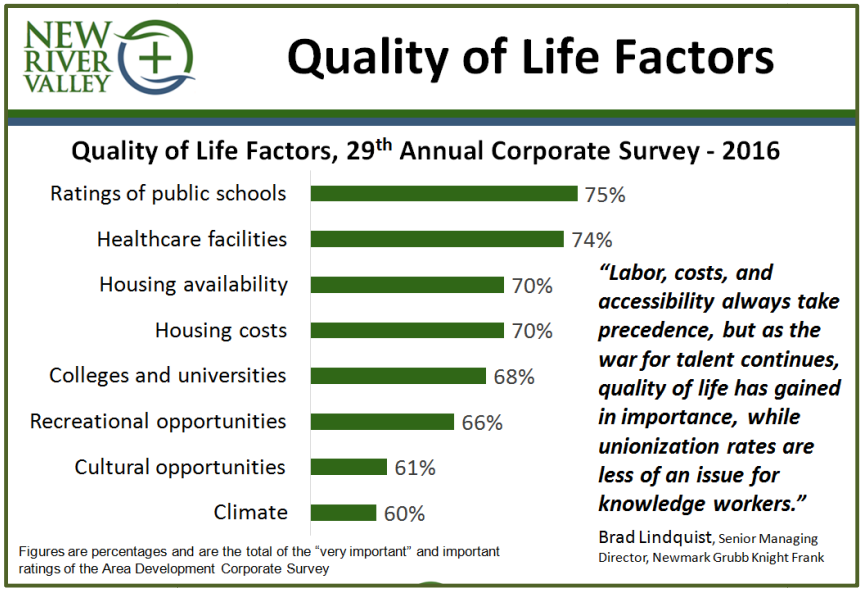
Research was also conducted to obtain additional qualitative data. Emerging opportunities in this report represent new technologies and mature industries that are not currently operating, or are not yet well-established in the region. When investigating such technologies and industries, we took into account any quantitative measures available, but we largely relied on stakeholder interviews and trade research.

Quality of Life

Quality of life elements are increasingly important in site selection, expansion and employee recruitment for businesses across all sectors.[6] Assets of the NRV are attractive to both employers and employees; these include the area's high quality of life elements, workforce capacity, and responsible local governments (see figure 7).[7] For example, municipal utilities are a selling point for companies reliant upon sustained power with limited outages and the ability to quickly recover from outages. Towns such as Blacksburg enhance quality of life by providing specialized shops, restaurants, entertainment, cultural and university-affiliated events. Local school systems and the cost of living within the region also foster and retain a quality workforce in the NRV. One interviewee coined the NRV as a "hidden gem" because of its potential for a variety of industry, market, and lifestyle opportunities. In a quest for economic growth, state and local economic developers must exercise caution so as not to ruin the quality of life elements that attract industries to the NRV.

[6] Charlie Jewell, "Virginia's New River Valley" (slide presentation, Economic Development Studio Class, Virginia Tech, September 2016).
[7] B. McMeekin, "Site Selectors: 5 Trends Impacting Economic Development," Industry Blog, *Business Climate*, (September 29, 2016), http://www.businessclimate.com/site-selectors-5-trends-impacting-economic-development/.

Figure 7.



Source: Jewel, Charlie. "Expanding Virginia's New River Valley." Presentation 9/14/16.

Cascade Falls, Giles County
Sources: NRVliving.com

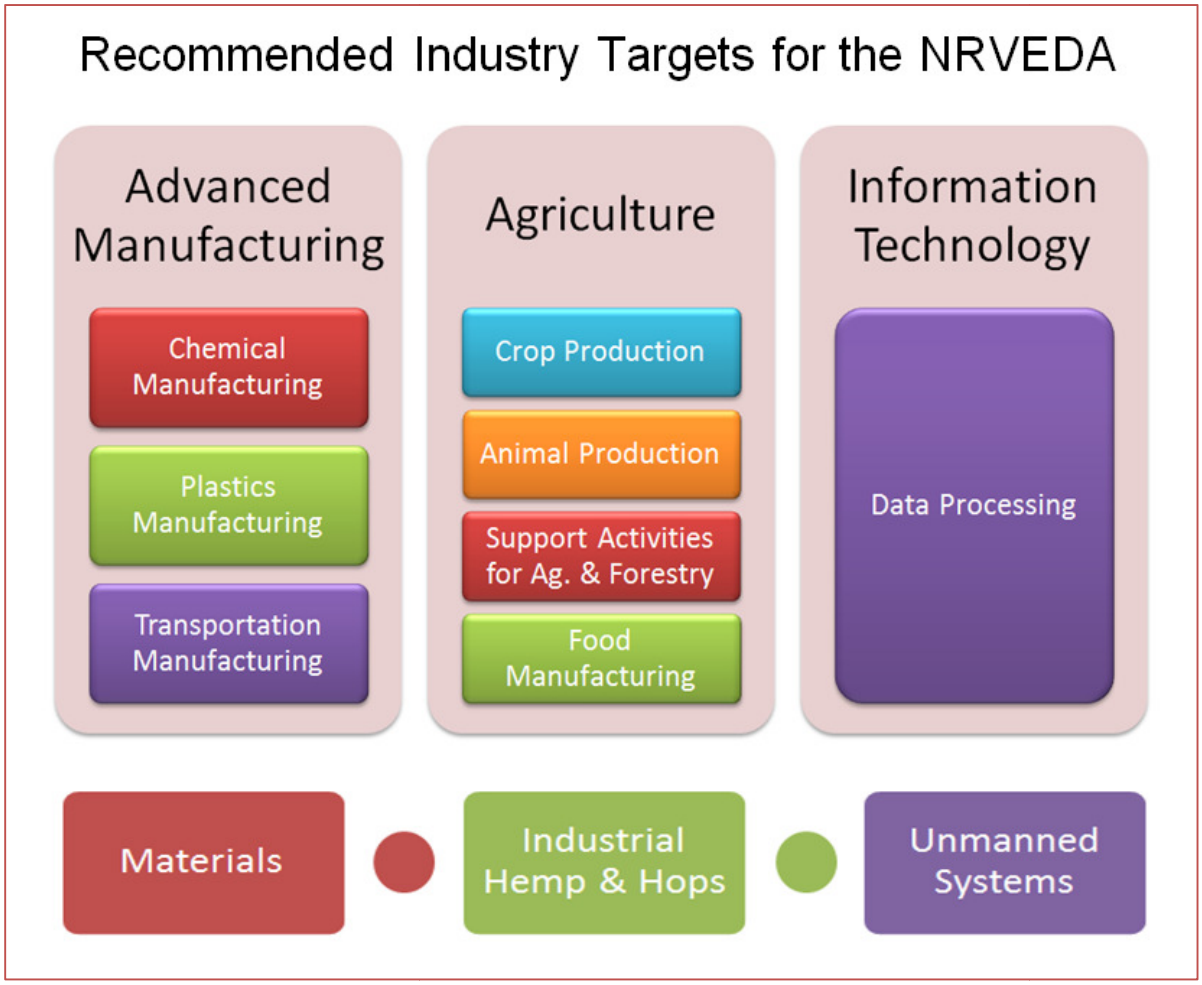
Downtown Blacksburg
Source: Wikipedia.com

New River
Source: Step Into Blacksburg

Sector and Industry Targets and Emerging Opportunities

The Economic Studio analysis finds that the businesses that thrive in the NRV fall under three major sectors: agriculture, manufacturing and information technology. The industries within these sectors that are particularly successful in the NRV include crop production, animal production and aquaculture, support activities for agriculture and forestry, food manufacturing, chemical manufacturing and transportation equipment manufacturing. Areas of new business growth potential include: materials, unmanned vehicles, and hops and hemp growth and production. Although there are many overlapping elements among these areas this report places them in the most obvious sector (see figure 8).

Figure 8.[8]



Advanced Manufacturing

Advanced Manufacturing represents a vital element of the NRV economy. Giles and Pulaski Counties, for example, possess an impressive manufacturing capacity given their limited population. This capacity originated through now defunct industries like textiles, but has since transitioned to include heavy truck, chemical, and metal manufacturing. Multiple employers hope to expand their employee base significantly within a matter of months, while others are purchasing adjacent properties in preparation for future expansion. Occupations require a variety of education levels, ranging from a high school diploma to college degree, and provide

[8] Alex Berryman, *Recommended Industry Targets for the NRVEDA*, Microsoft Office, November 2016.

extensive on-the-job training rather than requiring significant experience. Workforce strongly influences site selection; the NRV contains community colleges and universities that provide important employee training to advanced manufacturers. One of four "shovel-ready" sites in Virginia is located in Pulaski (see figure 6).[9] Additionally, there are numerous smaller sites and spaces available throughout the NRV that are suitable for advanced manufacturing.

Advanced manufacturing employed about 12,000 people across the NRV in 2015, with an increase of 22% from 2010-2015. About 150 establishments operate in the NRV, and wages increased by $4,900 to $55,000 during the same years.[10] The NRV experienced substantially more relative job growth compared to state and national averages. Earnings at the national level exceed the NRV at $64,000, while earnings in the NRV exceed those in the surrounding ELA.[11] Advanced manufacturing positions are more diverse in terms employment numbers and required qualifications than they are in the agriculture and information technology sectors.

Chemical Manufacturing

From 2010-2015 chemical manufacturing jobs in the NRV increased by 40%, to a total of 1,724 people. Chemical Manufacturing firms are substantially more concentrated in the NRV with an LQ that rose to 4.43 from 2010-2015. Workers earned an average $71,000 annually in 2015, a nearly $3,100 5-year increase. However, despite the increase, salaries still fall below state and national averages which grew more than 10%.[12]

Jobs in chemical manufacturing grew in the NRV from 2010-2015, whereas the ELA experienced declines. Stock Clerks and Order Fillers earn a median wage of $10.98, while Chemical Engineers earn at most $45.54 per hour.[13] Production Supervisors can attain their position with a high school diploma; while production staff develop skills through extensive on-the-job-training.

[9] Brian Coy, "Governor McAuliffe Announces First Virginia Business Ready Sites Program Award Recipients.," Economic (Virginia: Office of the Governor, November 1, 2016), https://governor.virginia.gov/newsroom/newsarticle?articleId=18208.
[10] "EMSI."
[11] Ibid.
[12] Ibid.
[13] Ibid.

Chemical manufacturers in the NRV include:

- Celanese Corporation (Narrows) is one of the world's largest producers of cellulose acetate tow, which is used in cigarette filters.[14]
- Pyrotechnique by Grucci Inc. (Radford) holds the Guinness World Record for the "Largest Fireworks Display" and "Largest Pyrotechnic Image". The Radford facility manufactures and distributes explosives.
- Hoover Color Corporation (Hiwassee) extracts iron oxide pigments and manufactures pigments for products like crayons.
- Chemical Lime Company (Ripplemead) mines and distributes lime.
- Revivicor Incorporated (Blacksburg) applies animal biotechnology to human conditions like diabetes by producing genetically engineered pig-based organs suitable for human applications.

Virginia Tech's Packaging Center is creating an emerging opportunity for the NRV. The center partners with the Food Science and Technology program to train future food scientists. This application is important for chemical, plastics and food manufacturing.

Plastics Manufacturing

Employment in plastics manufacturing increased in the NRV 265% to a total of 573 employees from 2010-2015; the LQ rose to 1.73. Local manufacturing companies' salaries rose remarkably by $12,000 to about $48,000 during the same time period.[15] Plastics manufacturers in the NRV operate in a more concentrated fashion than across the Commonwealth, indicating that wages could possibly continue to increase to the state level of $58,000.

All plastics manufacturing positions in the NRV experienced growth since 2010. Although employment numbers remain below the surrounding ELA, molding, core making, and cast machine positions increased to about 100. Median hourly wages in the NRV exceed surrounding communities in multiple instances by more than $10 per hour.[16]

Plastics manufacturers in the NRV include:

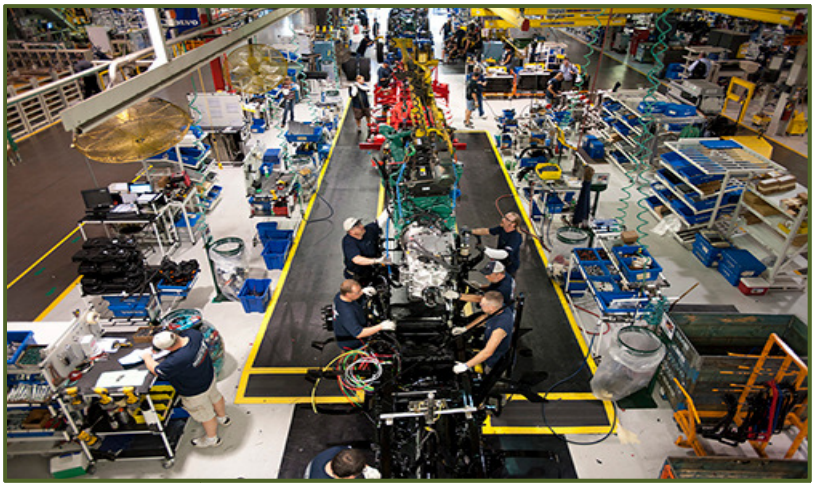
[14] Duncan Adams, "Celanese Plant in Giles County Completes Conversion to Boilers Fueled by Natural Gas," *The Roanoke Times*, April 7, 2015, sec. Business, http://www.roanoke.com/business/news/giles_county/celanese-plant-in-giles-county-completes-conversion-to-boilers-fueled/article_94b6215e-f50b-54d9-88dc-28d8a442f3d3.html.
[15] "EMSI."
[16] Ibid.

- Mar-bal Inc. (Dublin) manufactures the most bulk molding compound (BMC)-molded Standoff Insulators in North America. BMC molded Standoff Insulators prevent electrical current from traveling outside the intended circuit.
- Radva Corporation (Radford) designs and produces insulating containers and packaging constructed from expanded polystyrene (EPS).

Materials as an emerging technological opportunity, discussed below, could potentially transform the scale of plastics manufacturing regionally. The Plastics Industry Trade Association encourages firms to locate where partnerships between universities like Virginia Tech and local business exist.[17]

Transportation Manufacturing

Transportation equipment manufacturing within the NRV experienced a 100% increase in jobs from 2010-2015, employing 4,400 people. Local job growth exceeded the state and nation and LQ increased to 5.63. Simultaneously, wages decreased in the NRV by about $5,000 annually, while increases of $5,000 and $7,000 occurred across the state and nation respectively.[18] A heavy truck-manufacturing cluster could eventually form within the NRV due to the fact that Volvo Trucks USA in Dublin, Virginia only stocks four hours worth of materials on-site at any time. Volvo Trucks encourages suppliers to relocate nearby.



Volvo Trucks USA, Dublin, VA Source: Biomass Magazine, 2014

[17] P. Rasmussen, "The Dynamic Duo: Chemicals and Plastics," *Site Selection Magazine* 59, no. 5 (2014): 16–18.
[18] "EMSI."

Previous work experience within transportation manufacturing is generally not necessary for employment, with the exception of Supervisors and Managers who need up to five years of experience. Eleven occupations ranging from Team Assemblers to Inspectors employ at least 95 people. No single occupation employs more than 100 people in the ELA.[19] Positions such as First-Line Supervisors of production and operating workers require a high school diploma, with median earnings exceeding $30 per hour. Students in programs such as machining face the difficult decision of whether to leave a program without graduating in order to obtain immediately available entry-level jobs, or completing their program with future job uncertainty.

Transportation manufacturers in the NRV include:

- Federal-Mogul Corporation produces aftermarket, replacement automobile parts needed for the repair and servicing of vehicles.
- Imperial Group fabricates and supplies parts for Volvo Trucks USA.
- Patrick Enterprise Corporation fabricates steel products and equipment for heavy truck, construction, mining, rail-car, and coal industries.

Higher education institutions in the NRV partner with manufacturers both in job training and research and development. The Transportation Equipment Manufacturers Competitiveness Initiative (TEMCI) works with a number of automotive supply companies as well as multiple VT faculty. The Global Center for Auto Performance Simulation located in Alton, Virginia, is an affiliate of the Virginia Tech Transportation Institute (VTTI). Automotive manufacturers work with New River Community College (NRCC) on workforce training. NRCC also coordinates an Educational-Industrial Advisory Committee of 125 members who meet annually to foster public-private partnerships. Committee members provide feedback on skills and industry requirements, while maintaining a relationship with the college for hiring new employees that have been prepared to perform as needed. Programs relevant to transportation manufacturing include electrical engineering technology, instrumentation and control automation, electronic technology, and automotive manufacturing.

[19] Ibid.

Manufacturing Site Selection

Industry site selectors review resources at a state level before narrowing their targets to the regional level. Virginia has attractive industry-supportive infrastructure such as the Port of Virginia, ample utilities, agriculture for inputs, and workforce training institutions.[20] For example, both Norfolk Southern and CSX Railways have expanded the height of rail tunnels to enable double-stacked intermodal freight hauling from Hampton Roads to the Midwest.[21] Virginia also tends to avoid political controversy that creates a negative business climate.[22],[23] Statewide business climate affects regional economic development, including foreign direct investment (FDI) like Korona Candles.[24],[25]

Site selection publications consistently declare that a trained workforce is the most important criterion for successful targeting. Doing so requires that community educational institutions from kindergarten to postsecondary possess the ability to immediately prepare and sustain a "pipeline" of employees.[26],[27],[28] Trends and conditions presently limiting workforce capacity include:

- Students prematurely leaving a degree or certificate program to obtain an available full-time position, which holds potential negative long-term ramifications.
- Substance abuse and addiction issues that prevent an otherwise competent individual from returning to work or entering a new job.
- Access to affordable, quality childcare that meets the needs of both "white-collar" professionals and "blue-collar" shift-workers.

Companies prefer "shovel ready" sites to shorten the time needed to construct a manufacturing facility, yet developing a Tier 4 or 5 site may require at least 5 years and millions

[20] P. Rasmussen, "Depth & Diversity," *Site Selection Magazine* 59, no. 5 (2014): 103–13.
[21] M. Arend, "Tunnel Vision," *Site Selection Magazine* 57, no. 4 (2012): 133.
[22] McMeekin, "Site Selectors: 5 Trends Impacting Economic Development."
[23] K. Syers and M. Comerford, "What Advanced Manufacturers Need to Thrive in the U.S.," Industry, *Trade & Industry Development*, (September 26, 2016), https://www.tradeandindustrydev.com/industry/manufacturing/what-advanced- manufacturers-need-thrive-us-12117.
[24] Rasmussen, "Depth & Diversity."
[25] Syers and Comerford, "What Advanced Manufacturers Need to Thrive in the U.S."
[26] McMeekin, "Site Selectors: 5 Trends Impacting Economic Development."
[27] Syers and Comerford, "What Advanced Manufacturers Need to Thrive in the U.S."
[28] M. Williams, "Recruitment of Advanced Manufacturing," *Site Selection Magazine*, 2014, 166–73.

of dollars of investment by localities (see figure 6). Our study combined information from several sources to create the site selection criteria below:[29],[30],[31]

- Abundant, competent workforce
- Proximity to kindergarten-college education institutions to ensure an educated workforce
- Quality of life ranging from healthcare, to cultural assets, to environmental health
- Sources for maintenance and repair services including air service and regional distributors
- Reliable electric and natural gas sources
- Property tax incentives
- Fiscally sound state and local governments to ensure workforce stability
- Proximity to potential clients for growth
- Proximity to supply chain partners

Industrial Sites in the NRV

Prospective advanced manufacturers can currently choose from at least 49 sites and buildings within the NRV. Companies that are currently located here, but wish to expand may have to leave their immediate community to acquire a larger site; it is advantageous to the NRV to relocate these companies within the valley rather than losing them altogether.

- Small Sites are no larger than 100 acres. Publicly owned properties are advantageous because of previous public investment. The Honeywell site in Pulaski County has obtained environmental remediation certification, with 20 acres ready for construction. Site two in Montgomery County's Falling Branch Corporate Park is pad-ready, while 19 acres at the Cascade Park in Giles County is cleared and level.

- Moderate Sites range in size from 100 to 500 acres. The Hardy Farm site in Pulaski County and the High Meadows property in Radford represent the largest and most prepared moderate sites, with 250 and 300 acres suitable for construction respectively.

- Mega Sites exceed a size of 500 acres; the NRV Commerce Park has 498 acres suitable for construction and most closely meets the condition. The property possesses comprehensive utilities on-site and is only 3.5 miles from Interstate 81. This property is one of four sites statewide at the Tier 4 level.

[29] Ibid.
[30] R. Starner, "Home Cooking," *Site Selection Magazine* 53, no. 4 (2008): 579–85.
[31] R. Starner, "An Elastic Climate for Growth," *Site Selection Magazine* 56, no. 5 (2011): 708–9.

- Warehouse/Manufacturing Space ranges in size from 8,500 to over 1 million square feet. All properties are located within 10 miles of Interstate 81, and tall ceilings and loading docks distinguish the properties from more office-oriented buildings. Contiguous open spaces as well as properties that include office space are available.

Virginia Enterprise Zones enable businesses to seek state and local grants that provide incentives to businesses locating in the NRV. "The Virginia Enterprise Zone (VEZ) program is a partnership between state and local government that encourages job creation and private investment. VEZ accomplishes this by designating Enterprise Zones throughout the state and providing two grant-based incentives, the Job Creation Grant (JCG) and the Real Property Investment Grant (RPIG), to qualified investors and job creators within those zones, while the locality provides local incentives."[32] The Pulaski/Radford VEZ 25 includes sites located in the NRV (see Appendix B).

NRV Commerce Park, 2016

Regional economic growth via advanced manufacturing can develop through both supply and demand. Technological advancements and capital investments impact the production of a traded sector. Regional linkages and leakages dictate the sector's economic

[32] Jordan Snelling and Tory McGowan, "Virginia Enterprise Zone (VEZ)," government, *Virginia Department of Housing and Community Development*, (2016), http://www.dhcd.virginia.gov/index.php/community-partnerships-dhcd/downtown-revitalization/enterprise-zone.html.

impact and multiplier effect. Advanced manufacturing strongly meets certain aspects of the initial criteria provided by NRVEDA by achieving the following:

- Creating quality jobs
- Aligning with regional assets
- Complementing the existing regional economy
- Projecting a positive trajectory
- Providing employment across the education spectrum

Agriculture

The New River Valley has a strong history of farming and livestock production, and is home to Virginia's land grant university (VT). Because of the research and presence of VT, the transportation assets, and mild climate the NRV is uniquely suited in many ways for agriculture experimentation and technology development. It does present challenges in regards to terrain, land costs, and unavoidable climate change or disease threats. Because of the research going on at VT some of these threats may be ameliorated not only for the region, but also nationally and globally.

Crop Production

Crop Production in the NRV has remained steady with a 7% job increase from 2010-2015. The NRV has more jobs in crop production as compared to the state, and is keeping pace with job changes at the national level. In terms of the LQ, the density of the sector has remained relatively unchanged with 13 establishments being reported in 2010 as well as 2015. However, both the state and national levels have experienced increases in the number of establishments during the same time period. Wage earnings have increased at every level, although the NRV has experienced a higher change in earnings and is paying higher wages when compared to state and national levels. The respective wage change for each level is as follows: NRV 26% increase, state 20% increase, and national 21% increase.

Animal Production

Animal production and aquaculture in the NRV has declined slightly over the past five years, reporting a 3% job decrease in this industry. The decrease appears to be specific to the region, as the state has experienced a 2% increase in jobs, and national level jobs have increased by 13%. When examining the LQs, both the NRV and the state show a minor decline, whereas the LQ at the national level has remained relatively concentrated with new establishments being added from 2010 to 2015. As for wage changes in this area, both the NRV and the nation reflect a 16% increase, while the state reports a 10% increase in wage payments.

The occupation with the largest number of employees within the animal production industry is crop, nursery and greenhouse, farm workers and laborers. From 2010-2015 the occupation experienced 2% growth in the NRV and 23% growth in the ELA. Median hourly earnings range from $11.03 - $11.49/hour throughout the area. These occupations employ inexperienced workers without formal education; training for the job is considered short. Although First-line Supervisors of farming, fishing, and forestry workers and farm workers, farm, ranch and aquaculture animal occupations employ less than 30 people, both occupations grew by 17% and 24% in the ELA, and had hourly earnings of $12.70 and $21.39 respectively. In contrast, these two occupations employed less than 10 people, and did not grow in the NRV. First-line Supervisors of farming, fishing, and forestry workers require a high school diploma and less than five years experience, with no on-the-job training. Farmworkers, farm, ranch and aquaculture animal occupations do not require formal education or work experience, and receive on-the-job training. There was no employment in the forest and conservation workers occupation in the NRV or ELA 2010-2015.

Support Activities for Agriculture and Forestry

Support activities for agriculture and forestry is an industry that has grown significantly from 2010-2015 with the NRV experiencing a 500% increase in job growth, the state having a 48% increase, and the nation with a 12% increase in jobs. This growth is relative however, keeping in mind that the NRV increased the number of jobs by 50 (from only 10 jobs in 2010 to

60 jobs in 2015). Thus, a better representation of job growth in this area can be observed at the state level, which reported a 48% increase in jobs, adding 657 new jobs from 2010 to 2015. Similar to job change, the LQ for this sector has become more concentrated with the NRV doubling the number of establishments in this area (from 6 to 12); the state added 41 establishments, while at the national level 1,239 establishments were added. Wage changes for this sector are as follows: NRV 22% increase, state 13% increase, nation 22% increase.[33]

The occupation employing the largest number of employees, by far, within the support activities for agriculture and forestry industry is crop, nursery and greenhouse farm workers and laborers. From 2010-2015 the occupation experienced 2% growth in the NRV and 18% growth in the ELA. Median hourly earnings range from $11.03 - $11.49 throughout the area. This occupation employs inexperienced workers without formal education; training for the job is typically short. The farm workers, farm, ranch, and aquaculture animals occupation grew significantly in both the NRV and ELA, but employed fewer than 25 total workers. This occupation pays $12.70-$13.48/hour within the area, and requires no formal education or work experience. A short period of on-the-job training is typical.[34]

Food Manufacturing

Food manufacturing is an emerging opportunity that falls under two of the recommended target sectors, manufacturing and agriculture. Food manufacturing has primary applications for completing the agriculture supply chain. Agriculture and food manufacturing are naturally complementary industries. Food grown in the NRV can be processed or manufactured near the farm where it is grown. Further, the region's proximity to large transportation networks is necessary for this emerging industry. Food manufacturing is already a well-established industry in other places around the country, but it is not yet well-established in the NRV. There are a few small food processing facilities already located in the valley, as described below, but growth potential remains for this industry in the NRV. The food manufacturing and processing industry is one of the largest in the country; accounting for

[33] "EMSI."
[34] Ibid.

37.5% of all sales nationally, equating to $2 trillion.[35] Larger companies control the market while smaller regional branches have some control locally. Holiday sales, especially in the second half of the year, account for the majority of sales in the industry.

In Virginia, food manufacturing is one of the largest manufacturing industries, accounting for 15% of all manufacturing jobs in the state. The 33,900 workers produce $20.5 billion in direct economic output. Since 2003, the Virginia food-processing sector has created over 6,000 new jobs.[36] The size and scale of the businesses range from international companies to small scale, local businesses. Regardless of the size and scale of these businesses, adequate spaces and sites for production are needed.

In the industry of food processing, the rules are changing for site selection. The desire to grow and produce locally in tandem with the locavore movement and rising consumer concerns about environmental and food safety issues are affecting site choices. Challenges for food manufacturing in the NRV include a lack of labor force, cost of production, facility efficiency, and the need for environmentally sound practices. Tax breaks in different localities could be the determinant for sites in the food processing and manufacturing industry.[37]

A number of small food processing and manufacturing firms are currently located in the NRV. These firms provide employment and come in a variety of forms, such as grocery store bakeries, animal feed suppliers, and hubs for food sales and deliveries. Some local businesses include Smith Valley Meats in Rich Creek, Flowers Baking Company in Fairlawn, and Kroger Bakeries throughout the NRV.[38] Food manufacturing in the NRV is more likely to be successful as an agglomeration of small farmers and manufacturers selling to local and niche markets. The sum of many small operations could well be more economically impactful than fewer, larger operations.

[35] Ibid.
[36] "Extension," Education, *Virginia Tech Department of Food Science and Technology*, (2016), http://www.fst.vt.edu/extension/.
[37] Starner, "An Elastic Climate for Growth."
[38] "EMSI."

Agriculture Site Selection

The most important site selection criteria for the agriculture sector is low-priced land, which includes the cost of procuring or leasing farmland, and water supply. The following criteria are crop-specific: 1) soil requirements (soil type, depth, drainage, texture, organic matter content, pH, and fertility with respect to the macronutrient and micronutrient content of the soil; 2) topographic requirements (natural adaptation or tolerance to land features such as elevation, slope, and terrain; 3) climatic factors (temperature, water or rainfall, light, relative humidity, and wind; 4) Biotic factors and the prevalence of pests and diseases as well as bees and other pollinators. These factors may vary with geographical location and, as to microclimate, from farm to farm.[39]

Accessibility is also an important site selection criterion. A farm that is managed as a business must have access to supplies, equipment, and the market. It must be provided with infrastructure (e.g. roads) and, if the product is intended to be marketed elsewhere, shipping facilities or airports. Skilled labor must be available at reasonable cost. Security and political stability are important for a farm to be secure from thieves and stray animals.[40]

University Assets

VT is a catalyst for industries; university research, equipment and expertise are extremely valuable to various industries. Mutually beneficial relationships between the university and private companies are common and encouraged at the state level.[41] VT research related to this report's recommended industries is of particular interest to representatives from existing and emerging industries. The Virginia Agricultural Experiment Stations owned by VT are currently working on developing an industrial hemp program following a 2014 initiative from the Virginia Department of Agriculture and Consumer Services. Industrial hemp has a variety of

[39] Ben. G. Bareja, "What Are the Factors to Consider in Location and Farm Site Selection?," Education, *Crop Farming*, (October 2011), http://www.cropsreview.com/site-selection.html.
[40] Anne Grier, Agriculture Site Selection Interview, telephone, September 22, 2016.
[41] Brian Coy, "Governor McAuliffe Announces $2.43 Billion Bond Package to Fund Key Research and Economic Development Projects," Economic (Virginia: Office of the Governor, December 9, 2015), https://governor.virginia.gov/newsroom/newsarticle?articleId=13672.

uses from fiber creation for clothing and rope to construction, carpeting, and automobile manufacturing; to alternative energy, food production, and pharmacology. A timeline has not yet been set for local growers to obtain hemp seeds and the legal right to farm hemp, but that reality is on the horizon. Further research and collaboration will result in significant gains for the university and local industry partners.[42] The VT's agriculture programs are also currently researching climate change, providing feed for livestock, and education in dairy science, animal and poultry production for local farmers.

The VT (beer) Brewhouse, which is not open to the public and does not market or distribute their creations commercially, does have an impact on local and national brewery science and the beer industry as a whole. The university is currently working with local and national brewers to innovate, educate, and grow their businesses. Their most recent public venture occurred at the Deschutes Street Pub in August in Roanoke. Virginia's beer industry creates more than $8 billion in economic impact and generates $2.9 billion in annual tax revenues; its economic impact is significant to the state and NRV. Hops research is another element of the Brewhouse that can have an impact on major beer manufacturers.

Unmanned aircraft (or drone) research at VT is also related to agriculture production. The drone in development called the "eBee" has been used to measure vegetative vigor in fields of crops by analyzing the chlorophyll content from above. It has also been used to analyze field sites to determine where there are historic or archeological sites beneath the soil that cannot be seen from ground level.

Information Technology

Information technology (IT) is a strong and competitive sector in the NRV. Many stakeholders who were interviewed for this report stated that some of the strengths in the NRV related to IT include that it is affordable to do business here, there is an educated workforce, and Virginia is ranked third for highest concentration of technology jobs. VT, NRCC and Radford

[42] John Reid Blackwell, "Hemp Crop Harvested in Virginia for First Time in Decades," *Roanoke Times*, November 20, 2016, sec. Business, http://www.roanoke.com/business/news/hemp-crop-harvested-in-virginia-for-first-time-in-decades/article_8f5621e7-77e1-541b-9f12-360ed807f966.html.

University (RU) each have degree programs directly related to the IT sector; therefore, the universities in the NRV are producing a well trained workforce that can serve as a direct pipeline for this sector. A CEO of a local IT company cited several strengths in the NRV: the competitiveness of the higher education institutions that generate a talented workforce; the strong economic development efforts; and location assets in the NRV. Another industry representative mentioned that the Corporate Research Center (CRC) is a valuable asset for technology companies. The CRC provides activities and services for the IT workforce and helps companies attract talent from area universities, as well as build a community and retain employees.

The IT sector in the NRV as a whole increased in employment by 16% from 2010 to 2015, and on average annual salaries increased by $3,769, to $51,600 in 2015. The number of establishments in the IT sector in the NRV remained static between 2010 and 2015, with 57 firms related to IT.[43] Based on data analysis data processing, hosting and related services was the primary industry within the IT sector that was selected as high performing in the NRV.

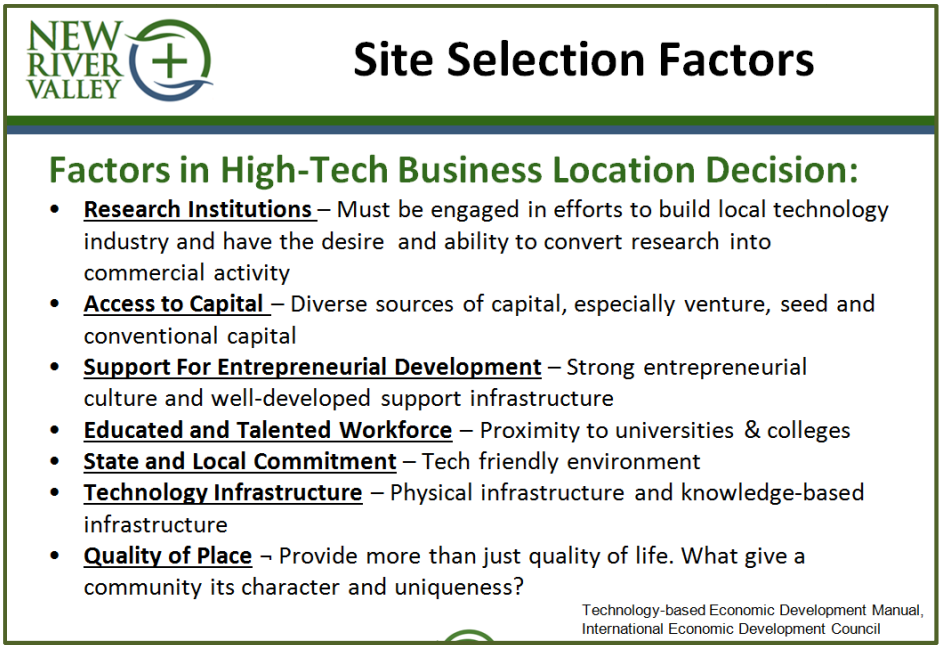
Data Processing

The data processing, hosting and related services industry decreased by 10% from 2010 to 2015 in the NRV, with a total of 104 employees in 2015. The LQ for this industry is 0.73, which is down by just 0.23 compared to the 2010 LQ. The number of data processing, hosting and related services firms in the NRV dropped from eight in 2010 to six in 2015. Despite these small decreases over the short term, wages remain high for this industry, experiencing a $44,739 increase over the five year period to an average annual wage of $105,970 in 2015.[44] These are the highest average salaries of the industries included in this report.

[43] "EMSI."
[44] Ibid.

IT Site Selection

The information technology industry demands a talented, educated workforce. The cost for acquiring such talent is more difficult for some metropolitan areas than it is in the NRV, due to the existence of educational institutions. Quality of life is an important site selection criterion for attracting talent for IT employers. The industry wishes to attract large youth populations, relative affordability, air transportation access, and livability. Business costs and competition are factors for site selection because of the known and unknown costs to consider when relocating, expanding or establishing a business. Research and development tax credits are also attractive to IT businesses.[45]



Source: Jewel, Charlie. "Expanding Virginia's New River Valley." Presentation 9/14/16.

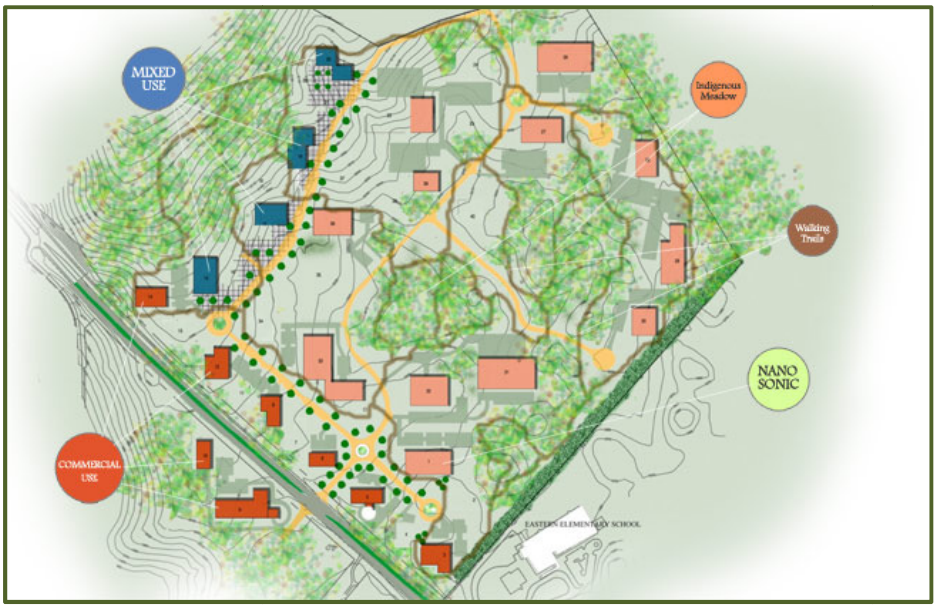
IT Sites in the NRV

There are many existing sites in the NRV that complement the IT sector. The CRC in Blacksburg hosts over 180 research, technology and support companies; at least 40 of these are

[45] "Virginia Economic Development Partnership," economic, *Virginia YesVirginia.org*, (n.d.), http://www.yesvirginia.org/.

IT-related.[46] The CRC has available spaces for companies with services that technology companies need, such as broadband internet. There are also several other available sites in the NRV that are compatible with the IT sector such as the Floyd Regional Commerce Center, the Floyd Innovation Center, the Dish Network Building, and the Wheatland EcoPark.

Based on the sites and buildings inventory received from the NRVEDA, the Floyd Innovation Center is described as suitable for a technology-related company; the center was also built using green building practices, which might appeal to technology companies. At the Wheatland EcoPark in Giles County every building is planned to meet Leadership in Energy and Environmental Design (LEED) green building standards. The forward-thinking, innovation-based building standards that are planned for this EcoPark may also appeal to technology companies. The Dish Network Building in Montgomery County is described in the sites and building inventory from NRVEDA as having data center space, which could be used by a firm in the IT sector. One threat related to the IT sector and site selection in the NRV is the karst topography, which can be a challenge for data centers, but not necessarily for other IT related firms.



Wheatland Eco Park source: www.wheatlandecopark.com/overview.html

[46] "Virginia Tech Corporate Research Center. (2016). Tenant Directory: Materials & Chemistry," Industry, *Virginia Tech Corporate Research Center*, (2016).

Stakeholder Perspectives

Information technology was discussed during several of the stakeholder interviews. In fact, one university representative from the region noted that Google's drone group was in the headlines for food delivery testing in Blacksburg, which is partly run by the group Mid-Atlantic Aviation Partnership (MAAP) and is one of six Federal Aviation Administration (FAA) test sites around the country. MAAP is a collaborative effort between Virginia, Maryland, and New Jersey, led by VT. The focus of this group is overcoming obstacles regarding unmanned aircraft systems so that the industry can evolve. Additionally, VTTI is conducting corporate research for unmanned vehicles. Companies involved in testing unmanned vehicles often have contracts with VTTI.

There has been collaboration by local private partners such as Aeroprobe and MOOG, and a chapter of the Association of Unmanned Vehicle Systems International (AUVSI), an international trade group for all types of drones. The university representative interviewee believes this to be a valuable partnership because of its large collection of assets; it tends to be difficult to find traditional employment data in this area. This idea was echoed by a business representative who expressed a constraint of the NRV is the inability to find local IT experts. However, NRCC has built partnerships with several different industries, including information technology/software development and have incorporated four programs at their STEM Center which include:

- General Information Technology degree
- Game Design/Web Design degree
- IT Network and Technical Support Specialization degree
- Cyber Security degree

These programs were created as a result of local demand in relevant occupations in the service region of NRCC. For instance, the Cyber Security degree was developed due to a local demand in professional IT fields.

University Assets

VT is involved in cybersecurity research and development. State officials are hoping to ensure that Virginia is a national leader and expert on cyber security, and are implementing programs to provide training for high school and college students. VT has contracted with a Virginia based defense company to work on adaptable software to meet security threats and challenges for defense. The state has shown that they support further expansion and development of research in this category by implementing a $75 million plan to emphasize intelligent infrastructure research involving multiple colleges and institutes across the state.

RU and NRCC do not provide the breadth of research opportunity and partnership that VT does, but NRCC does have many training and industry opportunities for individuals interested in IT positions. NRCC offers classes and programs in alternative energy, automotive technology, instrument and control automation, and machine technology. The alternative energy technology program includes training for solar, photovoltaic, and wind energy. Also, NRCC and RU both offer cyber security degree programs. Their IT programs are working with leaders in the field to ensure students are learning the latest technology. In addition, Pulaski County public schools recently announced that they are adding cyber security to their career and technical curriculum at county high schools in 2017.[47] The goal of this initiative is to prepare high school students to enter the workforce in the NRV. All of the assets from the three higher education institutions, combined with the cyber security program in Pulaski County Public Schools, create strong university and educational support for IT in the NRV.

Emerging Opportunities in the NRV

A data-driven approach was used to examine the NRV's suitability for specific emerging and potential industries. The following criteria were used to evaluate industries: fifty or more employees; notable job growth; above-average LQ; robust business activity, preferably more

[47] B. Teague, "Pulaski County Changes Career and Technical Program to Match Job Market," News, *WSLS*, (December 5, 2016), http://wsls.com/2016/12/05/pulaski-county-changes-career-and-technical-program-to-match-job-market/.

than one company in the industry; growing wages that are above the region median of approximately $30,000. Five emerging opportunities were identified that are not yet well-established, but show potential for significant economic opportunities in the NRV. These emerging opportunities include: food manufacturing, unmanned systems, hops production and processing, industrial hemp production, and materials. These industries are new technologies, industries or opportunities that are developing, underdeveloped, or are under-established in the NRV.

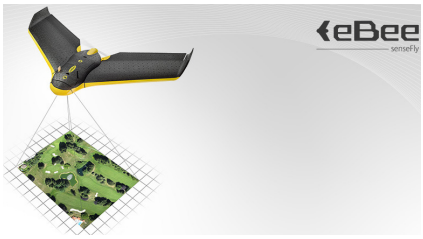
Unmanned Systems

An Unmanned System is a machine or device that is capable of performing missions autonomously without human intervention. Unmanned systems are equipped with data processing units, sensors, automatic control, and communications systems.[48] Unmanned systems include unmanned aircraft, ground robots, underwater explorers, satellites, and other unconventional vehicles.[49] Virginia is a national leader in technology, and therefore is in a unique position to help define this emerging sector. There are several immediate uses of unmanned systems in the state of Virginia that include: wildfire mapping, disaster response, scanning and spraying crops, and monitoring the infrastructure of oil, gas, and electricity.[50] This emerging industry is well suited for the NRV as it supports agricultural uses such as crop production. Currently drones have several capabilities which include: soil and field analysis, planting, crop spraying and irrigation.[51] In addition to aerial applications, there are potential uses of maritime vehicles and unmanned ground vehicles such as self-driving farm equipment or autonomous dump trucks.[52] Unmanned maritime vehicles have the potential to affect cargo

[48] "The Future of Unmanned Vehicle Systems in Virginia," Economic (Virginia: Uncork-It Communications, December 2, 2013), http://www.doav.virginia.gov/Downloads/Studies/UAVs%20in%20Virginia/TheFutureOfUVSInVirginia2014.pdf.
[49] Ulrike Esther Franke, "Civilian Drones: Fixing an Image Problem?," ISN Blog, *International Relations and Security Network*, (January 26, 2015), http://isnblog.ethz.ch/security/civilian-drones-fixing-an-image-problem.
[50] "The Future of Unmanned Vehicle Systems in Virginia."
[51] Michal Mazur, "Six Ways Drones Are Revolutionizing Agriculture," *MIT Technology Review*, July 20, 2016, https://www.technologyreview.com/s/601935/six-ways-drones-are-revolutionizing-agriculture/.
[52] "The Future of Unmanned Vehicle Systems in Virginia."

transport, water safety, and fishery management. This emerging opportunity has potential applications in all three recommended target industries: unmanned systems manufacturing, agricultural sector applications, and software development (IT) related to unmanned systems.

Source: http://dronelife.com



Source: http://dronelife.com

Source: Wikipedia.com

Skills required for operating unmanned systems include engineering expertise with an emphasis on guidance and control, communication, and autonomous behavior; as well as operation skills in both conventional and unmanned systems.[53] University programs housed within the mechanical engineering or robotics departments are apt to offer training and education in this area.[54] One of these is VT's Terrestrial Robotics Engineering and Controls (TREC) Lab. One of TREC's projects is the ESCHER (Electric Series Compliant Humanoid for Emergency Response) is a full sized humanoid design being developed to support disaster-response and search-and-rescue tasks.[55] Additionally, VT's Provost, Thanassis Rikakis, recently announced plans to develop drone cages and testing grounds for autonomous vehicles beginning in January, 2017.[56] Radford University offers a dual degree in Physics and Engineering, in partnership with Virginia Tech.[57]New River Community College offers two degree programs related to unmanned systems that include Engineering Design Technology and Architectural & Engineering Design Specialization. Within these degree programs students

[53] J. Wynbrandt, "Growing Jobs Demand in Unmanned Aerial Systems," *Flying Magazine*, 2015, http://www.flyingmag.com/careers/growing-job-demand-unmanned-aerial-systems?lJvYMb4hvoETxIj0.03.
[54] Ibid.
[55] "Terrestrial Robotics Engineering and Controls Lab at Virginia Tech," Education, *TREC*, (December 10, 2016), http://www.me.vt.edu/trec/.
[56] Robby Korth, "Virginia Tech to Spend $75 Million toward Infrastructure 'Destination Area,' Including Drone Cage," *The Roanoke Times*, August 31, 2016, sec. News, http://www.roanoke.com/news/education/higher_education/virginia_tech/virginia-tech-to-spend-million-toward-infrastructure-destination-area-including/article_39954a78-768e-5809-8116-171f38a9454c.html.
[57] "Department of Physics," Education, *Radford University*, (December 10, 2016), http://www.radford.edu/content/csat/home/physics.html/engineering.html.

work on projects involving Unmanned Aerial Vehicles/Unmanned Ground Vehicles and Drones.[58]

Current jobs in Unmanned Systems include:[59]

- Defense contracting
- Commercial operations

Supporting industries in Unmanned Systems include:[60]

- Agriculture
- Oil and gas
- Movie companies
- Photography

Companies in Virginia that are currently working in Unmanned Systems:

- Aeroprobe Revolutionary Technology – located in Christiansburg, explores air data systems such as UAV performance and data acquisition.[61]
- Moog Components Group – located in Blacksburg provides advance technology in motion control and works closely with industries such as aircraft manufacturing in developing fully integrated flight control systems and advanced controls for unmanned combat air vehicles.[62]

In order for Virginia to take advantage of this emerging industry, Virginia's policymakers must consider the economic potential of these new technologies. Virginia was the first state in the country to codify Unmanned Aerial Systems (UAS) legislation, limiting UAS access to the national airspace for certain law enforcement purposes. Therefore, policies established by Virginia leaders will determine if and how the Commonwealth will leverage its position in this emerging technology.[63]

[58] "EDT Engineering Design Technology," Education, *New River Community College*, (December 10, 2016), http://www.nr.edu/cadd/.
[59] Wynbrandt, "Growing Jobs Demand in Unmanned Aerial Systems."
[60] Ibid.
[61] "Aeroprobe Revolutionary Technology," Industry, *Http://www.aeroprobe.com/*, (2016), http://www.aeroprobe.com/.
[62] "MOOG Components Group Motion Control & Electronics," Industry, *MOOG*, (2016), http://www.moog.com/about-us/components-group.html.
[63] "The Future of Unmanned Vehicle Systems in Virginia."

Hops Production and Processing

Virginia was once considered the "Hop Capital of the New World," and is currently experiencing a resurgence of the craft beer industry. Craft beer in Virginia has grown 159% in the past three years, employs 8,000 Virginians, and provides more than $623 million in revenue to the state.[64] It also supports related businesses in the tourism, agri-tourism and food service industries. Craft brewing promotes the combination of local markets to help develop and utilize ingredients used in brewing, brewing technology, and tap room and tasting room development. Of the recommended target sectors, this emerging opportunity in the NRV has applications primarily for the Agriculture sector.

The NRV is a viable location for hop production from growing potential to marketing to distribution. VT is home to world-renowned plant scientists whose current research initiatives focus on developing the best cultivars of hops for the region. The increased focus on craft brewery attraction in the region will require that the region supply larger quantities of hops, which at present are limited due to the labor-intensive harvesting nature of the plant. The Virginia Agricultural Council is hoping to develop research trials related to hop strain development and growing practices. Production increases as plants mature, a process that takes about three years. Thus, profitability will increase over the course of the plant's life (about 15 - 25 years).

Sites for production are limited due to steep terrain in the NRV and the labor-intensive nature of the crop; therefore, major production is not likely to be viable. However, research suggests that due to the differing desires of niche consumers of hops, smaller operations are likely to be more profitable than attracting a large grower. Hops also need to be processed shortly after harvesting, so there is potential for the hops processing industry to grow in the NRV if hops production grows. The NRV's proximity to large transportation networks make this area a good fit for the timeliness required for hop harvest and processing. Because of increased market demand for local brewing, state support for the industry, and the current hops shortage nationally, hop production will likely become a more viable agriculture product for the NRV.

[64] "EMSI."

Industrial Hemp Production

Hemp history in Virginia dates back to colonial times, when the colony's farmers were mandated to supply hemp to the English Royal Navy for ropes.[65] Hemp has been used for textile, rope, and other fibers for hundreds of years. In 2014, Section 7606 of the Farm Bill allotted research funding and access to seeds and plants for colleges and universities to develop new and innovative products made from hemp fibers, seeds, and oils. Hemp is used in more than 25,000 products spanning nine markets including agriculture, textiles, recycling, automotive, furniture, food and beverages, paper, construction materials, and personal care. Of the recommended target sectors for the NRV this emerging opportunity, like hops, has applications primarily for the agriculture sector. Currently the primary source of industrial hemp is Canada, where the average plot size for commercial hemp operations is 62.4 acres.

Sales of hemp products in the United States are expected to grow to more than $500 million in the coming years, though importing is difficult and restrictions on growing prohibit import and export between states. The United States primarily imports hemp products from Canada, but because of the nature and need of certain elements of the plant at certain points in its life cycle, transportation over significant distances can be difficult.

Virginia is well suited for industrial hemp production, especially in the NRV. Hemp can be used as a rotation crop with corn, soybeans, and wheat in order to replace nutrients in the soil. It can also be used to remove heavy metals from soils, but in this case the product could not be used commercially. The well-drained, fertile soils of the NRV provide a viable opportunity for industrial hemp growing. Because of the presence of VT, one of only five universities allowed to sponsor research funds in the state, the NRV is in a strong position to develop hemp. Also, because this crop is not yet well-established in US markets, the NRV could position itself to be one of the first large-scale producers when it does become more established and sales begin to grow. The extensive transportation networks and access to broader east coast markets also puts the NRV in an excellent position to distribute in time for the plant, seeds, and stalks to be used in multiple markets and industries.

[65] Blackwell, "Hemp Crop Harvested in Virginia for First Time in Decades."

Materials

Materials is an emerging sector related closely to advanced manufacturing. Polymeric materials include synthetic and natural properties, and play an essential role in everyday life. They are created via polymerization of many small molecules, known as monomers. Materials range from familiar synthetic plastics to natural biopolymers, such as DNA and proteins, which are fundamental to biological structure and function. These products have a range of potential uses for all of the recommended sectors in this report. The VT Macromolecules Innovation Institute has faculty and students doing research on such topics as: 3D printing with food, energy and water applications, materials in electronic devices, chemical transport within the environment, food packaging, energy efficient automobiles, harnessing and storing solar energy, and purification of water.[66]

Nine of the companies in Blacksburg's CRC are working in the materials and chemistry technology fields. These companies include Alacran Inc., Emisshield Inc., the Institute for Critical Technology and Applied Science, Mar-Bal Inc., MatWeb LLC, Nalco Company, NanoSafe Inc., Professional Services Industries Inc., and Techulon Inc.[67] Other firms in the region that work with materials science include Polymer Solutions (Blacksburg), Corning (Christiansburg), Wolverine Advanced Materials (Blacksburg), and Phoenix Packaging (Dublin).[68]

In the VT Department of Food Science and Technology faculty and students are conducting research related to food packaging. Research activities focus on the interaction of materials and the food or environment, which is known as the macromolecule-biomolecule interface. The department's interdisciplinary network of scientists and engineers has expanded their research opportunities and access to analytical equipment for materials science and engineering.[69] Packaging research and activities in this department include:

[66] "Faculty and Research Topics," Education, *Virginia Tech Macromolecules Innovation Institute*, (2016), http://www.mii.vt.edu/faculty-and-research-topics/.
[67] "Virginia Tech Corporate Research Center. (2016). Tenant Directory: Materials & Chemistry."
[68] "EMSI."
[69] "Food Processing and Packaging," *Virginia Tech Department of Food Science and Technology*, 2016, http://www.fst.vt.edu/research/packaging_processing/.

- Controlled release of natural antioxidants from polymer food packaging by molecular encapsulation with cyclodextrins
- Materials applications for photo-protection of food quality including milk, functional foods and bioactive ingredients
- Release of antioxidants from biodegradable films into dry milk products and food simulating liquids
- Collagen films with antioxidants for flavor protection in pet foods.

Materials crosses a variety of IT fields and manufacturing sectors. The NRV also has some small to mid-sized materials-based firms, such as Polymer Solutions in Christiansburg, which is involved in characterization testing of novel materials. Some companies in the NRV that typically appear to be categorized under the automotive manufacturing industry are actually in the materials business too. For instance, Corning, Incorporated uses ceramics in converters; Wolverine Advanced Materials makes gaskets using advanced processes; and Nanosonic, Incorporated in Giles County produces metal rubber. The university representative interviewee confirmed our findings that all of these advanced materials-related companies connect very well with the strengths of the universities in the region.

2016 industry forecasts for the materials sector state several timely advantages: low energy prices ; construction activity growth that pushing many industries in this sector forward; and increased consumer spending is expected to benefit many paper and packaging companies. According to Fidelity Investments, lower oil prices benefit chemical companies by lowering input costs. Companies that produce construction materials such as aggregate, cement, wallboard, paint and ceiling supplies are expecting demand to continue into the near future.[70] Growth in consumer spending is also driving packaging volumes, which benefits the materials sector. Low commodity prices are one aspect forecasters mention as a possible challenge for this industry, but overall forecasters predict steady growth in materials. This, combined with the high concentration of firms and research in the NRV, make materials an attractive sector for recruiting new firms to the area.

[70] Tobias Welo, "2016 Outlook: Materials Low Energy Prices Could Set the Stage for Further Bifurcation in This Sector.," *Fidelity Viewpoints*, December 16, 2015, https://www.fidelity.com/viewpoints/investing-ideas/2016-outlook-materials.

NRV SWOT

The chart below briefly displays the strengths, weaknesses, opportunities and threats for economic development in the NRV:

Strengths	Weaknesses
Quality of Life Lower cost of living Good public school system Affordable to do business Easy to get samples in the mail Dublin is a good place for manufacturing Christiansburg is a good place for Technology centrally located close to Roanoke Proximity to I-81 and Railroad Educated workforce Large part-time workforce Strong work ethic within workforce Water supply Proximity to VT and RU, NRCC Industrial parks on I-81	Hard to find IT experts nearby Blacksburg's building inspection department Salaries are lower here - hard to attract qualified employees Lack of child/daycare Hard to find employees experienced with high quality systems Good science practices are not taught at VT-graduates are not workforce ready Entertainment and after-hours activities designed for college students, not much for other demographics
Opportunities	**Threats**
Market to companies and prospective employees As Roanoke rises to a higher level, the NRV will benefit and be more likely to become a manufacturing hub Governor emphasizing medical research NRVEDA provide information about what other places are doing to attract companies, workers, childcare, etc. Partnership with VT for equipment use Passenger rail to Roanoke 2017 Possibility of passenger rail to NRV Brownfield sites in Radford Homegrown talent businesses NRV seems poised to grow	Roanoke Airport: The inconvenience of cancelled flights, no direct flights VT does not adhere to FDA regulations in their laboratory protocols Lack of flat sites - terrain Karst topography Aging public school buildings Drug issues in workforce Young people leave area to find work

Source: Cecile Newcomb

Considerations

Future Considerations

This report seeks to inform NRVEDA's targeting strategies. This section is intended to reveal information beyond our original scope that arose during the process that is of interest to local economic developers. Further investigation and consideration should be given to the following:

- Cybersecurity is increasingly a field that overlaps practically all industries, and the need for cybersecurity services is growing. This field needs more research and understanding, and to be included, as appropriate, in NRVEDA's targeting strategy.
- Childcare, and the lack thereof, surfaced in multiple interviews. Affordable, responsible, and available childcare correlates to the talent recruitment dimension of NRVEDA's mission.
- Internet availability is essential to everyday life at home and at work. Site data provided by NRVEDA did not include this element, yet internet performance impacts attracting many companies.
- Retaining recent college graduates combats aging and brain drain. Job opportunities, continued investment in quality of life elements, and strengthened partnerships with universities are suggested as means to this goal.
- Inter-governmental cooperation is important for infrastructure. For example, cooperation is needed for grading costs to create shovel-ready sites on jointly owned properties.
- Workers commuting into the NRV change the employment dynamic. Our research shows impact on the local economy, but further research on how commuter employment choices, skill sets, and spending habits impact local industries is beyond the scope of our current study.
- Regional economic development planning with nearby communities could potentially increase competitiveness of the NRV. A mutual gains approach can benefit the entire region.
- Local policies to invest in manufacturing infrastructure and/or to pursue millennial-oriented office space as part of downtown revitalization is an area to explore.

Additional suggestions of ways in which NRVEDA can be of value to local economic stakeholders surfaced during interviews, including:

- Understanding the focus and direction of VT and RU such that the alliance can facilitate partnerships and opportunities for business growth.
- Support for start-up and entrepreneurial ventures.

- Reduce confusion about the services offered by each economic development organization in the area.
- Recruit complementary businesses. For example, tool suppliers and machining shops to support local industries.
- Facilitate dynamic relationships between the NRV and the Roanoke Valley
- Encourage a higher service level at the Roanoke-Blacksburg Regional Airport.
- Facilitate more available quality childcare.

Limitations of This Study

Despite the comprehensiveness of this report, the group acknowledges typical limitations of the study. Time constraints limited the possibility of conducting more interviews and deeper research. For example, interviews with agriculture sector stakeholders were not included, but would have been beneficial. The EMSI software program processes and combines information from multiple entities, therefore data quality is dependent upon primary sources. The studio group and staff from the VT Office of Economic Development also sought to interview additional stakeholders ranging from government to business representatives who declined to participate or respond to interview requests. It is possible that interviewees may have withheld information due to a limited comfort with the interviewer, or for other reasons.

Reflections: Lessons That Could Benefit Future Work

Considering lessons learned is an integral part of every project and serves several purposes. The lessons learned from this project are to be used as references for future projects. One of the major lessons learned from this project is to start the Institutional Review Board (IRB) approval process as soon as possible. Three to four weeks are needed to conduct stakeholder interviews. Also, at least a week is needed for scheduling interviews, as reaching stakeholders and scheduling interviews can be challenging. In the end, between the Office of Economic Development (OED) and the studio class, we interviewed 15 business leaders, educational institution representatives and local economic developers, but interviewing or surveying a wider audience would increase perspectives and improve results.

Conclusion

To meet the NRVEDA's goal to develop a more targeted, comprehensive strategy to attract and retain world-class jobs, investment and talent in the NRV, the 2016 Economic Development Studio at VT recommends industries that meet the alliance's targeting criteria. These industries fall within the three sectors of advanced manufacturing, agriculture and information technology.

In the advanced manufacturing sector materials, unmanned systems, and chemical, plastics and transportation manufacturing provide quality jobs, complement existing industries, diversify and expand the economy, show strong growth trajectory and are benefitted by the presences of RU, VT and NRCC. In the agriculture sector crop and animal production, support activities for agriculture and forestry, food manufacturing, and hemp and hops production all align with the NRV's assets, expand the economic base, provide opportunities and have mutually beneficial relationships with VT's agricultural research programs. In the information technology sector data processing provides opportunities, complements existing industries, and takes advantage of an educated workforce while providing quality jobs.

Based on qualitative and quantitative research and analysis, this report recommends sectors and industries that NRVEDA should target for future growth. The recommended targets and sectors should attract additional employers within industries that strengthen the region and capitalize on competitive advantages by the following:

- Expanding the economic base
- Creating quality jobs where the sector average wage is at least the regional average wage
- Creating quality investment that adds to the local government tax base
- Aligning with the assets of the NRV
- Complementing existing industries
- Having a good growth trajectory locally, nationally and internationally
- Providing opportunities for a wide range of employees (from unskilled to college educated)
- Providing opportunities for localities throughout the NRV
- Helping to diversify the regional economy

The students in the fall 2016 Economic Development Studio at VT thank the NRVEDA for the opportunity to provide this report and the accompanying presentation which was held on Thursday, December 8, 2016. We hope that the NRVEDA finds this report to be a valuable resource for planning and executing the new direction and mission of the alliance.

Resources

Adams, Duncan. "Celanese Plant in Giles County Completes Conversion to Boilers Fueled by Natural Gas." *The Roanoke Times*, April 7, 2015, sec. Business. http://www.roanoke.com/business/news/giles_county/celanese-plant-in-giles-county-completes-conversion-to-boilers-fueled/article_94b6215e-f50b-54d9-88dc-28d8a442f3d3.html.

"Aeroprobe Revolutionary Technology." Industry. *Http://www.aeroprobe.com/*, 2016. http://www.aeroprobe.com/.

Arend, M. "Tunnel Vision." *Site Selection Magazine* 57, no. 4 (2012): 133.

Bareja, Ben. G. "What Are the Factors to Consider in Location and Farm Site Selection?" Education. *Crop Farming*, October 2011. http://www.cropsreview.com/site-selection.html.

Berryman, Alex. *Recommended Industry Targets for the NRVEDA*. Microsoft Office, November 2016.

Blackwell, John Reid. "Hemp Crop Harvested in Virginia for First Time in Decades." *Roanoke Times*. November 20, 2016, sec. Business. http://www.roanoke.com/business/news/hemp-crop-harvested-in-virginia-for-first-time-in-decades/article_8f5621e7-77e1-541b-9f12-360ed807f966.html.

Coy, Brian. "Governor McAuliffe Announces $2.43 Billion Bond Package to Fund Key Research and Economic Development Projects." Economic. Virginia: Office of the Governor, December 9, 2015. https://governor.virginia.gov/newsroom/newsarticle?articleId=13672.

———. "Governor McAuliffe Announces First Virginia Business Ready Sites Program Award Recipients." Economic. Virginia: Office of the Governor, November 1, 2016. https://governor.virginia.gov/newsroom/newsarticle?articleId=18208.

"Department of Physics." Education. *Radford University*, December 10, 2016. http://www.radford.edu/content/csat/home/physics.html/engineering.html.

"EDT Engineering Design Technology." Education. *New River Community College*, December 10, 2016. http://www.nr.edu/cadd/.

"EMSI." Labor Market Database, n.d. http://www.economicmodeling.com/.

"Extension." Education. *Virginia Tech Department of Food Science and Technology*, 2016. http://www.fst.vt.edu/extension/.

"Faculty and Research Topics." Education. *Virginia Tech Macromolecules Innovation Institute*, 2016. http://www.mii.vt.edu/faculty-and-research-topics/.

"Food Processing and Packaging." *Virginia Tech Department of Food Science and Technology*, 2016. http://www.fst.vt.edu/research/packaging_processing/.

Franke, Ulrike Esther. "Civilian Drones: Fixing an Image Problem?" ISN Blog. *International Relations and Security Network*, January 26, 2015. http://isnblog.ethz.ch/security/civilian-drones-fixing-an-image-problem.

Grier, Anne. Agriculture Site Selection Interview. Telephone, September 22, 2016.

Hines, Joseph C. "Economic Development 101: Are Your Sites and Community Prospect Ready?" Educational presented at the Economic Development Studio, Virginia Tech, September 27, 2016.

Jewell, Charlie. “Virginia’s New River Valley.” Slide presentation presented at the Economic Development Studio Class, Virginia Tech, September 2016.

Korth, Robby. “Virginia Tech to Spend $75 Million toward Infrastructure ‘Destination Area,’ Including Drone Cage.” *The Roanoke Times*. August 31, 2016, sec. News. http://www.roanoke.com/news/education/higher_education/virginia_tech/virginia-tech-to-spend-million-toward-infrastructure-destination-area-including/article_39954a78-768e-5809-8116-171f38a9454c.html.

Mazur, Michal. “Six Ways Drones Are Revolutionizing Agriculture.” *MIT Technology Review*, July 20, 2016. https://www.technologyreview.com/s/601935/six-ways-drones-are-revolutionizing-agriculture/.

McMeekin, B. “Site Selectors: 5 Trends Impacting Economic Development.” Industry Blog. *Business Climate*, September 29, 2016. http://www.businessclimate.com/site-selectors-5-trends-impacting- economic-development/.

“MOOG Components Group Motion Control & Electronics.” Industry. *MOOG*, 2016. http://www.moog.com/about-us/components-group.html.

Newcomb, Cecile. *Data Funnel*. Microsoft Office, November 2016.

———. *Photos of the NRV*. Photographs, December 13, 2016. https://www.google.com/imghp?hl=en&tab=wi&ei=T1NQWJjcMYTbmQHj3oTACw&ved=0EKouCBgoAQ.

Rasmussen, P. “Depth & Diversity.” *Site Selection Magazine* 59, no. 5 (2014): 103–13.

———. “The Dynamic Duo: Chemicals and Plastics.” *Site Selection Magazine* 59, no. 5 (2014): 16–18.

Snelling, Jordan, and Tory McGowan. “Virginia Enterprise Zone (VEZ).” Government. *Virginia Department of Housing and Community Development*, 2016. http://www.dhcd.virginia.gov/index.php/community-partnerships-dhcd/downtown-revitalization/enterprise-zone.html.

Starner, R. “An Elastic Climate for Growth.” *Site Selection Magazine* 56, no. 5 (2011): 708–9.

———. “Home Cooking.” *Site Selection Magazine* 53, no. 4 (2008): 579–85.

Syers, K., and M. Comerford. “What Advanced Manufacturers Need to Thrive in the U.S.” Industry. *Trade & Industry Development*, September 26, 2016. https://www.tradeandindustrydev.com/industry/manufacturing/what-advanced-manufacturers-need-thrive-us-12117.

Teague, B. “Pulaski County Changes Career and Technical Program to Match Job Market.” News. *WSLS*, December 5, 2016. http://wsls.com/2016/12/05/pulaski-county-changes-career-and-technical-program-to-match-job-market/.

“Terrestrial Robotics Engineering and Controls Lab at Virginia Tech.” Education. *TREC*, December 10, 2016. http://www.me.vt.edu/trec/.

“The Future of Unmanned Vehicle Systems in Virginia.” Economic. Virginia: Uncork-It Communications, December 2, 2013. http://www.doav.virginia.gov/Downloads/Studies/UAVs%20in%20Virginia/TheFutureOfUVSInVirginia2014.pdf.

“Virginia Economic Development Partnership.” Economic. *Virginia YesVirginia.org*, n.d. http://www.yesvirginia.org/.

"Virginia Tech Corporate Research Center. (2016). Tenant Directory: Materials & Chemistry." Industry. *Virginia Tech Corporate Research Center*, 2016.

Welo, Tobias. "2016 Outlook: Materials Low Energy Prices Could Set the Stage for Further Bifurcation in This Sector." *Fidelity Viewpoints*, December 16, 2015. https://www.fidelity.com/viewpoints/investing-ideas/2016-outlook-materials.

Williams, M. "Recruitment of Advanced Manufacturing." *Site Selection Magazine*, 2014, 166–73.

Wynbrandt, J. "Growing Jobs Demand in Unmanned Aerial Systems." *Flying Magazine*, 2015. http://www.flyingmag.com/careers/growing-job-demand-unmanned-aerial-systems?IJvYMb4hvoETxIj0.03.

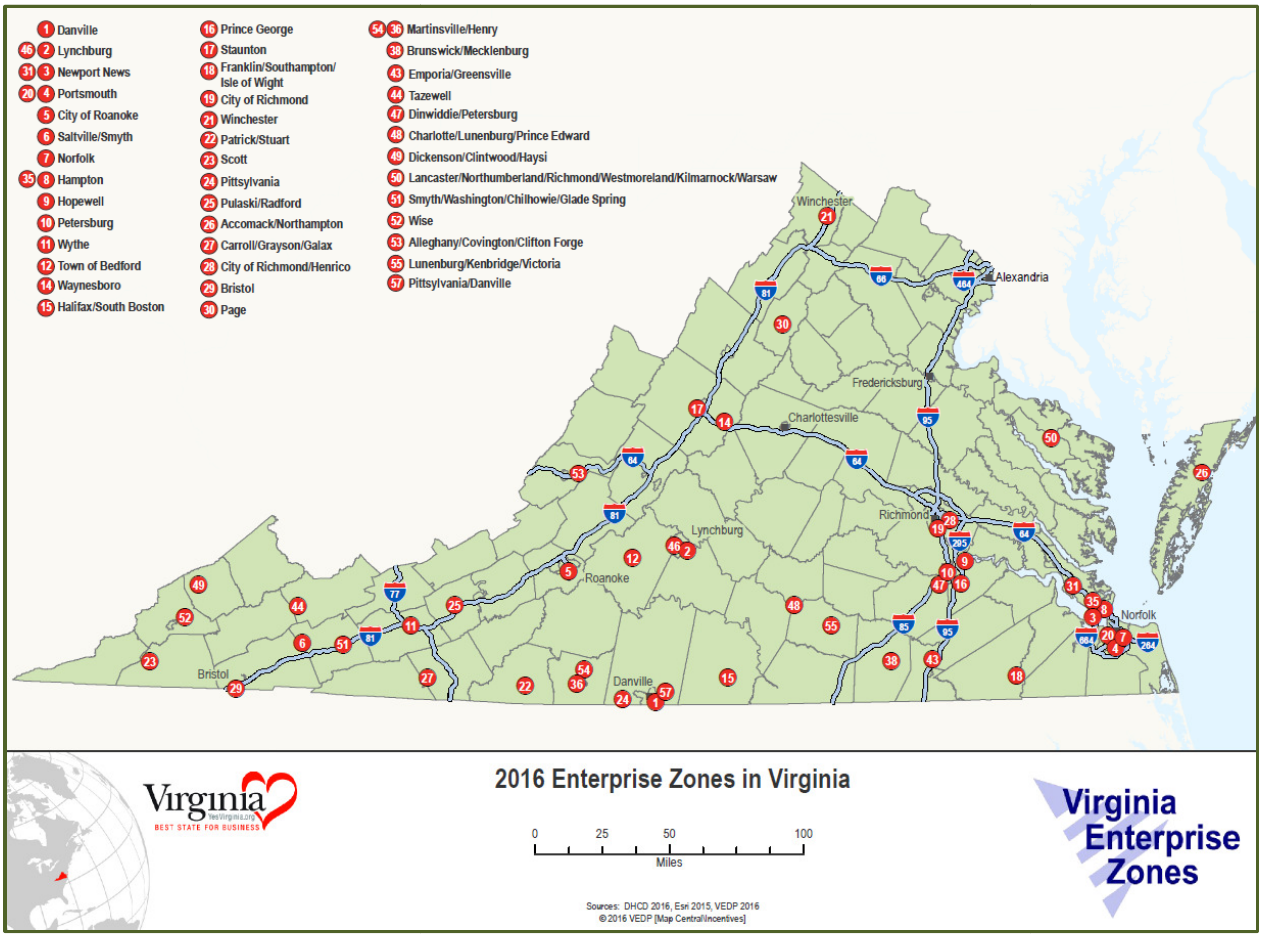
Appendix A

GOAL OF INTERVIEWS

- Capture Insider Knowledge
- Add to SWOT Analysis
- Identify additional qualitative site selection variables or priorities
- Identify potential sectors and industries not already operating within the regional economy

1. Tell me about your organization and the responsibilities of your position
2. Tell me about your experience working with businesses in the region
3. What industries have you worked with lately, and what is their position or interest when engaging you?
4. What are some strengths of the NRV community?
    - Workforce
    - Infrastructure/Site availability
    - Quality of Life/Business Climate
5. What weaknesses hinder attracting and expanding industry in the NRV?
    - Workforce
    - Infrastructure/Site availability
    - Quality of Life/Business Climate
6. What assets do you see in the region, beyond your specific community?
    - Education
    - Trade opportunities
    - Highways/Airport
    - Nearby-located outside region but relevant
7. To your knowledge, how are other regions marketing themselves?
    - What results have they generated?
    - Do you see opportunities for the NRV to follow suit?
    - Sorts of industries targeted
    - Necessary resources
    - Problems resolved
8. How could national, state, or other regional activities negatively affect your business?
    - Ongoing planning/preparation
    - Fears or concerns
9. What are challenges you foresee in the region and the community that impede economic development?
    - Attraction of businesses
    - Attraction of more educated work force
    - Quality of Life
10. What is your vision for economic development in the region?
    - What are some emerging industries that could do well in the region?
11. Is there anything else you would like to add?
    - Any questions, comments or concerns

Appendix B



Source: DHCD 2016, Esri 2015, VEDP 2016