



THE BOSTON CONSULTING GROUP

# Developing an Advanced Manufacturing Workforce for Virginia's Tobacco Region

*Key Findings and Recommendations*

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## **Executive Summary**

In August of 2012, the Commonwealth Center for Advanced Manufacturing (CCAM) and the Tobacco Indemnification and Community Revitalization Commission (TICRC) engaged The Boston Consulting Group (BCG) to support them in developing a workforce plan to enhance the capabilities for Virginia's former Tobacco Region to produce a ready workforce in Advanced Manufacturing. Specifically, the focus of this engagement was fourfold:

- Define the region's vision for creating a cluster for Advanced Manufacturing in the Southwest and Southside regions
- Understand the potential skill gaps that could impair the growth of this cluster
- Identify the required curricula and equipment needs to close those gaps
- Create an implementation plan to guide CCAM's efforts

The analysis and recommendations in this report were heavily informed by interviews with a broad set of stakeholders, including employers, educators, and economic developers throughout the Tobacco Region and outside the region.

Industry in the Tobacco Region of Virginia has historically focused on tobacco farming as well as textile and furniture manufacturing. The last several decades have seen a sharp decline in these industries, resulting in job loss and higher unemployment in these regions than in the Commonwealth of Virginia overall. Given this situation, CCAM hopes to develop an Advanced Manufacturing cluster focused on Aerospace, Automotive, and Heavy Machinery in the region to help restore the economic vibrancy of this historic engine of the Commonwealth's economy. There is a great opportunity to attract companies that are beginning to reshore their operations to the United States by enabling a competitive cost structure and leveraging the region's ecosystem of industry, education, government, and workforce. The jobs created by this cluster would have a meaningful impact on the region, with potential to employ 50,000 people or more at maturity. Without this influx of new employers, manufacturing employment in the Tobacco Region could see declines of approximately 0.4 percent per year<sup>1</sup> or worse – the current trend suggest a 4 percent annual decline. The Commonwealth, TICRC, and CCAM have begun to develop many of the necessary foundational elements to ensure successful creation of this cluster; however, there is significant need to increase the pool of skilled labor to support these industries.

Building an economic cluster is an undertaking that unfolds over the course of decades. Successful clusters, such as the Automotive initiative in South Carolina, truly transform the economic landscape by bringing together primary manufacturing and their suppliers to the region. Success breeds success, attracting other primary manufacturers who see tangible evidence that the labor, land, logistics, public services, and business climate are favorable. This is CCAM's vision for the Tobacco Region.

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<sup>1</sup> Virginia Employment Commission

For planning purposes, we have examined the crucial first five years of that vision. We have modeled the requirements for employees based on the needs of manufacturers in the region today as well as the potential for attracting additional companies. Our analysis indicates that the demand for additional manufacturing workers will reach 6,840 by 2017. Of these, 1,055 will be in high-skilled occupations (e.g., engineers), 1,895 in medium-skilled occupations (e.g., machinists), and 3,890 in low-skilled professions (e.g., assemblers). Our projections indicate that the greatest supply gap arises among medium-skilled workers, specifically machinists (both traditional machinists as well as CNC machinists), welders, and industrial maintenance mechanics. Given current supply coming from the community colleges within the Tobacco footprint, there will be a gap of 1,045 jobs left unfilled by 2017. It is important to note that this gap is a point-in-time estimate in the near-term—of course, the potential employment from the cluster will be substantial in the long-term.

### Quick Facts

- Opportunity for Tobacco Region to build a top ten Advanced Manufacturing hub focused on Aerospace, Automotive, and Heavy Machinery
- Along with the region's current employers, it is estimated that there will be 6,840 new job openings in manufacturing by 2017
- Critical gap of approximately 1,045 medium-skilled workers in that time period
- Jobs in greatest demand: machinists, welders, industrial maintenance mechanics
- To close gap, recommend industry-focused strategy to increase capacity, with three regional "Centers of Excellence" to deliver hands-on training programs, and increase awareness and attractiveness of Advanced Manufacturing jobs

There are two primary challenges in closing this gap: (1) increasing the capacity and capabilities of the community colleges in the footprint and other workforce training programs to develop the skills that employers require, and (2) attracting individuals to pursue careers in Advanced Manufacturing professions.

The community college system is currently the primary means of providing technical education for medium-skilled occupations in Virginia. Indeed, a number of these institutions have invested in strong manufacturing programs, especially in regions where there has been high demand for trained workers. Most have not,

however, given low historical employer demand and, consequently, low student interest. Expanding existing programs or creating new ones requires significant investment in equipment, curricula, and faculty to provide quality training. We recommend that TICRC focus on funding training programs that address the critical skills for machining, welding, and industrial maintenance mechanics. The effectiveness of these programs will be critical to the overall success of the cluster.

Expanding the capacity of the region to produce trained workers is only one part of the equation. CCAM and other stakeholders must also address the image of and appetite for careers in Advanced Manufacturing. Many people in the region and across the country perceive manufacturing jobs as they often were in the early 1900s: "dirty," "manual," "low-paying," and "dangerous." Such descriptions are well off the mark when discussing Advanced Manufacturing jobs, which can only be described as "clean" and "high-paying," with an emphasis on 21st century skills such as teamwork and critical thinking. In fact, these very job attributes would likely appeal to a significant portion of

high school students currently steered toward a four-year degree by parents, peers, and high school counselors, who cling to an outdated view of manufacturing careers. Moreover, students with the aptitude and desire to pursue a four-year degree might be in a better position to achieve their goal while employed as a skilled laborer, using company benefits to reduce or eliminate the often staggering debt load that today's college students can accumulate.

To meet these challenges, we recommend a multi-pronged approach targeted at addressing both the capacity and capability of the education system to produce skilled workers as well as changing the perceptions of individuals in the region and attracting them to manufacturing careers. To address the capacity challenge, we recommend investing in three regional training centers with the required equipment to provide the hands-on training necessary to prepare trainees for Advanced Manufacturing careers. Doing this effectively will require significant engagement between educators and employers to ensure that the curricula address the specific skills the employers will require. Supporting these centers would be an increased investment in distance education to increase the availability of quality manufacturing education in the region to provide access to students in areas where there is not significant manufacturing training today.

Additionally, to increase interest in manufacturing occupations and programs, we recommend initiatives targeted at two groups: K-12 students and career-changers. For K-12 students, this involves educating career coaches on Advanced Manufacturing careers so that they can better guide students; broadening current marketing efforts to increase awareness of these careers, such as the Dream It, Do It Virginia program;<sup>2</sup> enhancing dual-enrollment programs to allow high school students to get a head start on their vocational education; and increasing apprenticeship and internship opportunities in Advanced Manufacturing to provide additional exposure to these industries. For career-changers, this entails enhancing adult career coaching at workforce development centers, creating additional education paths to train students with previous experience, and providing apprenticeship opportunities for those individuals with some previous manufacturing experience.

Implementing these recommendations will require involvement from multiple stakeholders, including employers, educators, and economic and workforce developers from the region and the Commonwealth. Together, these groups should collectively define a set of standardized curricula requirements that meet the needs of employers, coordinate the resources to execute the new program (including facilities and equipment), and work with other entities to expand marketing efforts targeted at increasing the awareness and attractiveness of manufacturing careers.

The workforce development strategy defined here is the beginning of a long-term effort to transform the economic landscape of the Tobacco Region. Executing this workforce development plan demonstrates a strong commitment to this vision, but is not a silver bullet—if there are no available jobs for people leaving these training programs, then

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<sup>2</sup> Virginia Manufacturers Association

the workforce development efforts will be for naught. It is critical that the economic development efforts to attract Advanced Manufacturing employers continue to receive focused attention in parallel. This workforce development approach can be used as a marketing tool to demonstrate the future capabilities of the Tobacco Region. It is clear the foundations for success exist, and by continuing the efforts underway today, we believe in the ability of the Tobacco Region to realize this vision.

## Introduction and Context

In August of 2012, the Commonwealth Center for Advanced Manufacturing (CCAM) and the Tobacco Indemnification and Community Revitalization Commission (TICRC) engaged The Boston Consulting Group (BCG) to support them in developing a workforce plan for an Advanced Manufacturing cluster in Virginia's former Tobacco Region. This effort focused on several elements:

- Defining the region's vision for creating a cluster for Advanced Manufacturing in the Southwest and Southside regions
- Identifying the critical skills needed to support this Advanced Manufacturing cluster
- Surveying the current technical education system in the Tobacco Region and evaluating its potential to supply the needed skills
- Forecasting the likely skilled labor shortages given the current supply of individuals trained for Advanced Manufacturing occupations
- Developing recommendations on how to increase the number of workforce-ready individuals coming out of the technical education system
- Creating an implementation plan and governance structure to ensure that CCAM and TICRC have a clear roadmap to institute these recommendations

The analysis and recommendations in this report were heavily informed by interviews with a broad set of stakeholders, including employers, educators, and economic developers throughout the Tobacco Region and outside the region. For a full list of the stakeholders interviewed, please see the appendix to this document.

The Southwest and Southside regions of Virginia have historically focused on tobacco farming as well as furniture and textile manufacturing. These industries were drawn to the area by its inexpensive labor and employed many in the region. However, as many of these industries have moved production outside of the U.S., the region has seen significant job loss, particularly in the manufacturing sector, which has declined approximately 4 percent annually in the last ten years.

Much has been made of the hollowing out of the U.S. manufacturing base in the past several decades. In our increasingly global economy, highly paid manufacturing jobs tend to migrate to low-cost locations, as China's economic ascendancy can attest. However, this globalization has a flip side, one that is causing more companies to reconsider the United States as a place to locate manufacturing operations. As discussed in the BCG report *Made in America, Again* (see *Made in America, Again: Why Manufacturing Will Return to the U.S.*, BCG Report, August 2011), Chinese wage inflation is outpacing the country's productivity gains. As a result, the labor cost savings associated with producing in China will fall from 65 percent in 2000 to 39 percent in 2015. Since labor accounts for only a portion of total costs, China's net advantage will fall to 10 percent before transportation and duties on a broad variety of industries and sectors. For many companies considering investments in plant and equipment, a 10 percent advantage is simply not enough to offset the downside of long supply lines, high fuel and transportation costs, and an unpredictable rule of law. As a result, many

companies that seek to serve the U.S. market will move “re-shore” operations to the U.S., with the potential to create 2.2 million to 3.1 million new jobs in the coming decade. As the U.S. stands to benefit from this natural economic shift, the Tobacco Region should position itself to take advantage of this historic opportunity.

The economic challenges in the Southwest and Southside regions are not unique to Virginia or the United States. One successful response is to develop “clusters” that support and encourage investments in targeted manufacturing industries. For example, Alabama launched an effort to attract a major Automotive manufacturer starting in the 1980s; by 1994, they found their first success with Mercedes-Benz. The company made an initial \$300 million investment and created 1,500 new jobs in the area, which has increased to a total investment of \$1 billion and creation of 3,000 direct jobs.<sup>3</sup> This has had a meaningful impact on the region: between 1999 and 2011, manufacturing employment in the Decatur and Tuscaloosa metropolitan areas has increased from approximately 8,900 to 16,600, an 87 percent increase; average wages for medium- and high-skilled jobs increased 53 percent in the same time period, from approximately \$37,000 to approximately \$57,000. In this same time period, the rest of Alabama lost nearly 20,000 manufacturing jobs (down 9 percent from 1999 employment levels), including more than 1,000 medium-skilled jobs<sup>4</sup>.

Working with the TICRC, CCAM leadership, and a broad range of stakeholders including Virginia’s four-year and community colleges, major employers, and current and prospective students, The Boston Consulting Group has articulated a vision for a globally competitive Advanced Manufacturing cluster in the Tobacco Region. This economic hub would attract employers with its proximity to customers, strong infrastructure, favorable business climate, and competitive cost structure. However, to bolster its position, the Tobacco Region will need to address foreseeable shortages in its skilled labor force. This will not be simple or inexpensive, but the potential payoff is significant—a successful Advanced Manufacturing cluster would transform the economic base of Southwest and Southside Virginia by creating up to 15,000 new jobs in the next 20 years.

To set the target for this cluster, BCG explored four Advanced Manufacturing industries: Transportation (which includes Automotive, Aerospace, Railroad, and Shipbuilding), Machinery, Computer & Electronic Parts, and Electrical Equipment & Appliances. Using attractiveness and feasibility screens developed in conjunction with CCAM and TICRC, the BCG team narrowed the focus for the region’s Advanced Manufacturing on Aerospace, Automotive, and Heavy Machinery (See Figure 1).

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<sup>3</sup> Ellene Kebede & Mudiayi Sylvain Ngandu, "The Economic Impact of the Mercedes Benz Investment On the State of Alabama," *Journal of Agricultural and Applied Economics* 31.2, August 1999

<sup>4</sup> Bureau of Labor Statistics

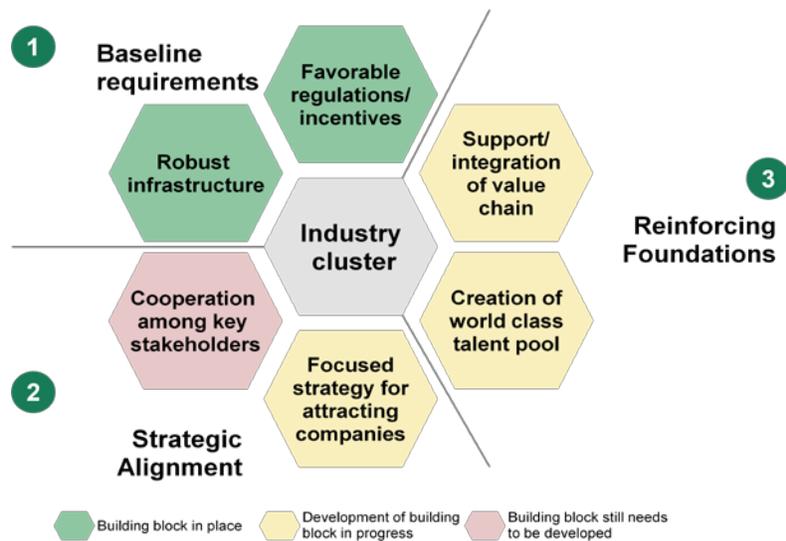
Figure 1: Industry Attractiveness

	 <b>Aerospace</b>	 <b>Automotive</b>	 <b>Heavy machinery</b>
2010–2020 Annual growth potential <sup>1</sup>	2.7%	3.5%	3.5%
Potential to reshore <sup>2</sup>	60–80%	60–80%	5–30%
Match with Virginia capabilities <sup>3</sup>	High	Low	Medium

1. Bureau of Labor Statistics 2. Based on Made in America, BCG analysis 3. Based on Strategic Roadmap: if index of (location quotient, employment growth, relative wages and wage growth, federal R&D grants, number of patents issued, industry output multipliers) is greater than 50%, potential was high  
 Source: BCG "Made in America", Commonwealth Research and Technology Strategic Roadmap, Bureau of Labor Statistics, Virginia Employment Commission, BCG analysis

As previously mentioned, developing this cluster will require focused effort and investment to ensure its success. There are six factors that determine cluster success,<sup>5</sup> as seen in Figure 2.

Figure 2: Cluster Success Factors



<sup>5</sup> A.T. Kearney, "Next Generation Economic Clusters," October 2011; BCG Analysis

**Baseline Requirements:** These are non-negotiable for attracting and developing a cluster – there is little opportunity for differentiation with these traits, but without them, companies are less likely to locate in the cluster. These include:

- *Favorable regulations and incentives*, such as tax breaks for companies and “Right to Work” policies
- *Robust infrastructure*, including access to transportation, telecommunications, and social infrastructure

**Strategic Alignment:** Aligning key stakeholders and developing a strategic plan ensures that the cluster approach is focused. There is opportunity for regions to differentiate themselves across these dimensions. These include:

- *Cooperation among key stakeholders*, such as educators, workforce agencies, research centers, government, and industry, to help deliver the value proposition. In 2012, Caterpillar chose Georgia from over 100 options for a \$200 million manufacturing site because of quick response from broad group of stakeholders – including multiple state and local government entities and Georgia QuickStart, the Technical College System of Georgia – to provide the company the needed incentives, infrastructure, and training support that Caterpillar required.<sup>6</sup>
- *Focused strategy for attracting companies* by identifying value chain focus and creating targeted development plan. Lyonbiopôle established a cluster focused on infectious diseases, and from the onset, developed five-year plans to attract and build new life sciences companies, creating 52 new companies from 2001-07.<sup>7</sup>

**Reinforcing Foundations:** Finally, if regions successfully implement the baseline requirements and have firm strategic alignment, there is opportunity to further differentiate the region by focusing on two elements:

- *Creating a world-class talent pool*, focused on supporting the cluster’s needs with technical skills and scientific research. The Massachusetts Life Sciences Center spends significant amounts investing in training programs, internships, and K-12 science programs.<sup>8</sup>
- *Supporting and integrating value chain companies*, including a focus on small and medium sized companies. The free zone in Ras Al-Khaimah Emirate has attracted 7,000 small and medium companies since 2000 to support its manufacturing and tourism clusters by creating licensing, real estate packages, and business services specifically targeted at smaller companies.<sup>9</sup>

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<sup>6</sup> "All in Good Time," *Site Selection*, March 2012.

<sup>7</sup> 2010 Lyonbiopôle Annual Report

<sup>8</sup> Massachusetts Life Sciences Center

<sup>9</sup> A.T. Kearney, “Next Generation Economic Clusters,” October 2011

Evaluating the Tobacco Region against these success factors, there are strong foundations in baseline requirements, but still some gaps in strategic alignment and reinforcing foundations. CCAM and TICRC can learn from other cluster

**Baseline Requirements:** Virginia is a right to work state and has favorable tax incentives for manufacturers that locate in the state. Additionally, the region has made significant commitment to 21st Century infrastructure, such as the recent broadband investments, and has two interstate highways providing quick access to major manufacturing locations in the Southeastern United States.

**Strategic Alignment:** To make this cluster initiative successful, CCAM and TICRC will need to address challenges in the following elements:

- **Cooperation among key stakeholders:** There are many entities within the Commonwealth of Virginia engaged in economic and workforce development, including the Virginia Economic Development Partnership (VEDP), the Virginia Community College System (VCCS), TICRC, and CCAM, in addition to the many regional entities such as the Virginia Coalfield Economic Development Authority. It is critical that these entities are engaged and aligned on the vision for the region and are working together to see its success. This will require clear roles and responsibilities for each organization to ensure a consistent message and approach.
- **Focused strategy for attracting companies:** It is critical that there is a clear strategy for how the various economic development entities identify potential target companies, create the right incentives to bring those businesses to Virginia, and develop the necessary programs to attract those companies.

**Reinforcing Foundations:** The Tobacco Region has already begun efforts to create a talent pool, and is beginning to focus on the needs of value chain players to support the recent Rolls-Royce investments in Crosspointe.

- **Creation of a world-class talent pool:** Many people across the region are involved in developing workforce programs for the needs of the local employers and several programs, such as the Southern Virginia Higher Education Center (SVHEC) and Danville Community College, are aggressively pursuing programs to address talent development for the region's future needs. It will be important to ensure that these efforts are coordinated across the region, address the full value chain of the education system from K-12 through to universities, and are targeted to support the industries within this burgeoning cluster. This is a key focus of the recommendations of this report.
- **Support and integration of the value chain:** Continued support for attracting not just "prime" manufacturers but also ensuring targeted efforts to attract all entities within the value chain will be critical to long-term cluster success. Research shows that these support components can comprise 50 percent or more of the jobs created by these clusters.

This report lays out BCG's workforce development recommendations to support an Advanced Manufacturing cluster in Virginia's Tobacco Region. Our document is divided into six sections:

- **Analytical Methods and Approach:** Provides an overview of the overall approach to the project
- **Priority Skill Areas and Curriculum Requirements:** Describes the demand for manufacturing employees, the gap in supply, and the curriculum requirements in three priority skill areas with critical shortages
- **The Technical Education Landscape in the Tobacco Region:** Describes the current landscape of technical education providers with specific focus on the community colleges serving the Tobacco Region
- **Recommended Program and Investments:** Describes the program enhancements that will help the Tobacco Region close its skills gap
- **Program Structure Overview and Requirements:** Describes the recommended governance structure and organization to help drive the implementation of these recommendations
- **Proposed Implementation Plan:** Describes the timeline, milestones, and owners to implement the recommendations

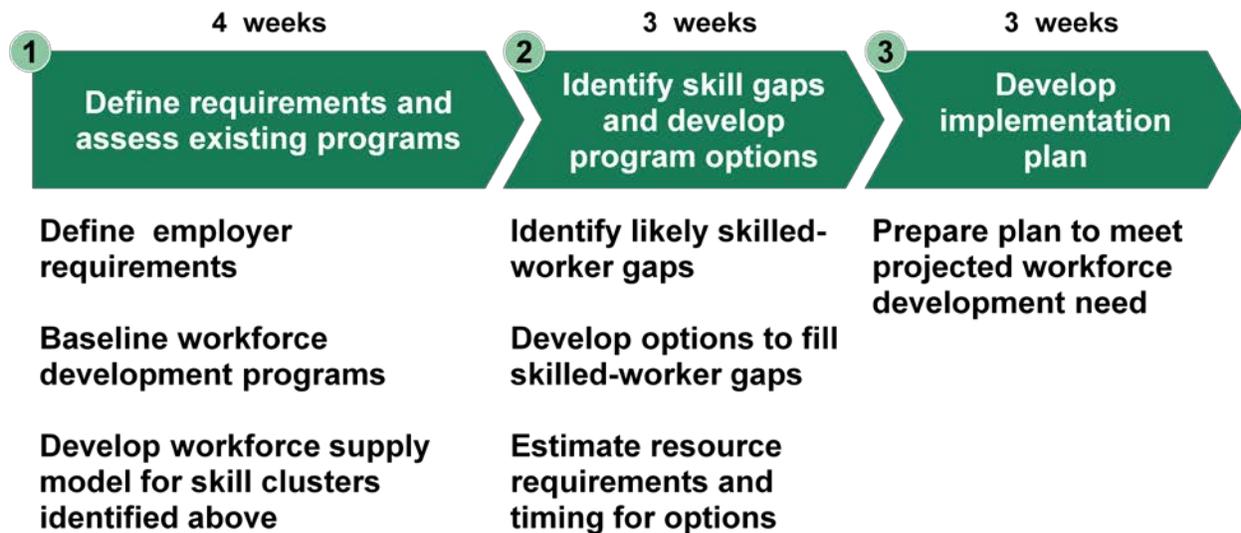
## Analytical Methods and Approach

This report is the result of a ten-week effort from August to October 2012. The effort was completed in three phases:

- 1) Define requirements and assess existing programs
- 2) Identify skill gaps and develop program options
- 3) Develop implementation plan

The overview of this process is show below (seeError! Reference source not found.):

Figure 3: Project Timeline



The recommendations in this report are a result of detailed quantitative analysis of baseline manufacturing job demand from existing employers, as well as the potential demand from a successful Advanced Manufacturing cluster. Our demand projections were matched with an analysis of the various workforce supply lines, including high schools, community colleges, four-year colleges and universities, and career-changers. In addition, we conducted more than forty interviews with key stakeholders in the Commonwealth, including employers, educators, and economic and workforce developers (see the appendix for a full list of interview subjects).

**Phase 1—Define Requirements and Assess Existing Programs:** The goal of the first phase was to establish a clear fact base around the Tobacco Region’s workforce requirements, understanding demand and supply and the current training and education programs in the region.

**Job demand:** To project the region’s workforce requirements, we incorporated data from the Bureau of Labor Statistics and the Virginia Employment Commission to estimate baseline demand and retirements in manufacturing in the Tobacco Region. In addition, we projected cluster demand by reviewing the growth trajectory of the Aerospace cluster in Sonora, Mexico, the Automotive cluster in South Carolina (focusing on BMW), and

the Automotive cluster in Georgia. Finally, with input from CCAM leadership and TICRC, we defined the target industries for cluster development, which we used to estimate the breakdown of different job classes.

**Current supply:** We then estimated the current supply using data from the Integrated Postsecondary Education Data System (IPEDS) on the number of graduates in the Commonwealth and the Tobacco Region for our priority skill areas.

**Gap:** We determined the gaps by quantifying the difference between demand and supply by job type.

In addition, during this phase we met with a number of economic developers, educators, and workforce developers in the region to understand:

- Consideration factors for companies contemplating the Tobacco Region in terms of workforce and perceptions of the greatest challenges of the current training system
- The current state of education and training programs in the region
- Barriers and obstacles in increasing the supply of trained workers in the region, focused both on hard skills as well as the attractiveness of manufacturing careers

Our interviews with training providers focused on curriculum and content of manufacturing programs, student capacity and interest in these programs, current interactions with industry, and the challenges of expanding these programs. In addition to speaking with the eight community colleges in the Tobacco Region, we also included other training providers such as the New College Institute and Southern Virginia Higher Education Center in our analysis. The majority of these interviews occurred in person, with visits to the community colleges and other training facilities coupled with lab tours and faculty interviews.

**Phase 2—Identify skill gaps and develop program options:** With a firm fact base, BCG then identified and prioritized the critical skills gaps and developed potential solutions to address the gaps in these occupations. With input from CCAM leadership and TICRC, we evaluated these options against agreed-upon criteria to identify the most effective solution.

This work was informed by interviews with local employers to understand their needs and with other training providers outside of the region to understand alternative approaches in delivering technical education.

Our interviews with local industry focused on understanding what challenges they have in meeting their workforce needs, what specific skills they look for in applicants, and their experience with current training providers. We used these interviews to build our hypotheses on where the greatest gaps were in the current technical training system and identify effective approaches to meeting employer needs.

To ensure we were incorporating practices from outside the Tobacco Region, we also interviewed leading national educators and training providers to understand alternative approaches for delivering technical education focused on medium-skilled manufacturing jobs. Our interviews with these organizations and leaders focused heavily on the process for developing their training centers, innovative uses of technology in training, and processes used to ensure input from industry.

**Phase 3—Develop Implementation Plan:** Finally, once aligned on the recommended program, we developed a high-level implementation program encompassing a governance model, implementation details, and metrics to track program success, with input from CCAM leadership and TICRC.

## **Priority Skill Areas and Curriculum Requirements**

To create an effective workforce development plan, BCG began with the baseline projection of employment by skill clusters within the region. This analysis involved a number of factors, including the trend line employment by sector and skill cluster as well as the general economic outlook under alternative assumptions. Critically, this projection was organized as a model based on demand for various job skills, as well as supply of qualified job candidates coming from the region and within the broader area of the Commonwealth.

With the baseline and scenarios in hand, the BCG team then added the likely employment demand created by a successful Advanced Manufacturing cluster. The evolution of a cluster can often unfold over decades, which was considered too long for planning purposes. Thus, BCG's analysis centers on a five-year time horizon, evaluating how demand will evolve for critical skill clusters due to the addition of an Advanced Manufacturing hub.

The output of BCG's supply and demand model therefore reflects both the total projected manufacturing employment in the Tobacco Region (broken out by skill cluster), as well as the predicted labor supply shortages by skill cluster. It is these predicted Advanced Manufacturing skilled labor shortages that BCG's workforce development plan seeks to address. Our recommendations encompass actions to be taken by employers, Virginia's four-year universities and community college system, high schools, and state and local government agencies, to ensure that the Tobacco Region stands ready to provide a world-class labor force serving the Advanced Manufacturing cluster.

### **Aggregate Demand**

This report focuses on the region's potential needs within the next five years. Aggregate demand for Advanced Manufacturing employees in the Tobacco Region is composed of two factors:

1. Baseline demand driven by general growth and employee flux in existing companies
2. Incremental demand due to cluster growth

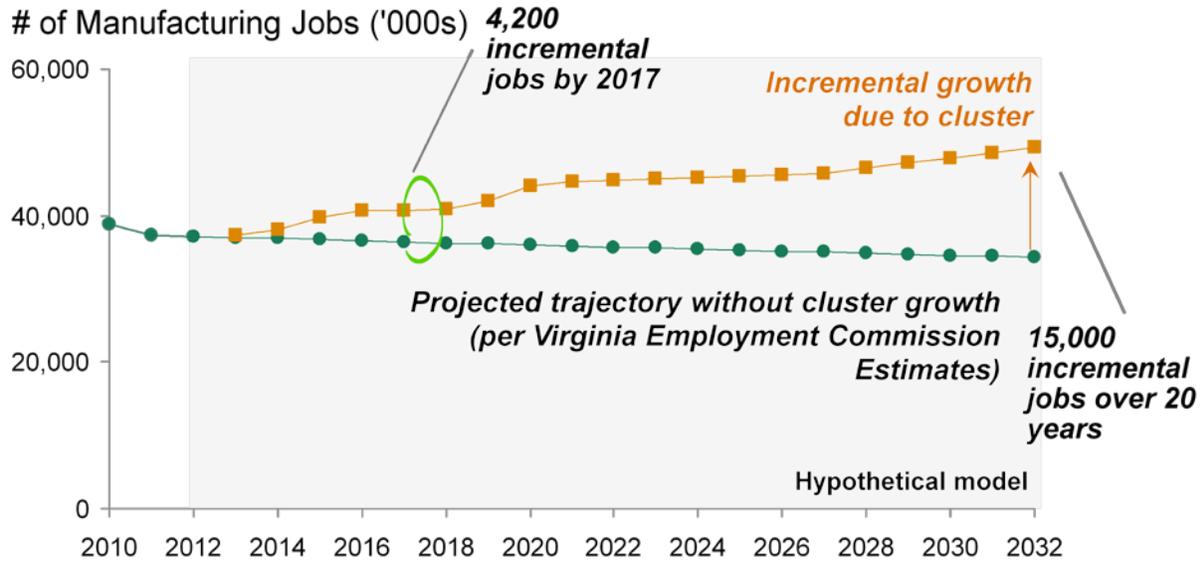
Baseline demand defines the demand from companies already in the region, and is driven by the trend line employment growth (or loss) as well as the retirement rate by occupation.<sup>10</sup> Overall, cumulative baseline demand for the region by 2017 totals 2,640 jobs. When we overlay the impact of an Advanced Manufacturing cluster, the trend line shifts from job loss to job creation, totaling 15,000 net new jobs by 2032. Studying the

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<sup>10</sup>Both retirement rate and projected employment by occupation were for 2008 to 2018 and projected by the Virginia Economic Commission.

trajectory of other clusters, we estimate that by 2017, this cluster will create 4,200 additional jobs (see Figure 4).<sup>11</sup>

Figure 4: Projected Manufacturing Employment in Tobacco Region



The baseline assumption is taken from projections by the Virginia Employment Commission and shows manufacturing jobs in the region declining at a rate of 0.4 percent, or approximately 150 jobs per year<sup>12</sup>. While that may not seem particularly positive, it is a substantial improvement over the current trend line 4 percent annual decline. Thus, building this cluster is not only important for growth, but to avoid further job loss in the region.

Our estimate of 4,200 new jobs from a cluster is based on an assumed growth plan in which the region recruits one to two major manufacturers within the next two years,<sup>13</sup> and that these manufacturers attract 15 to 20 suppliers to the region within five years. This is consistent with BCG research that shows major manufacturers bring in 500 to 1,500 jobs in the first five years of production and attract approximately 20 suppliers, each supplying another 150 jobs on average.

Combining both the baseline and cluster demand, the total estimated aggregate demand is 6,840 jobs by 2017. We estimate that the breakdown of these jobs will be:

- High-skilled: 1,055
- Medium-skilled: 1,895
- Low-skilled: 3,890

<sup>11</sup>BCG analysis

<sup>12</sup> Virginia Employment Commission

<sup>13</sup>Resulting in a total of 1,700 jobs by 2017

Projected labor demand with the addition of an Advanced Manufacturing hub results in an 18 percent increase in the Tobacco Region’s manufacturing employment base. Given this dramatic increase, it is critical to understand the current supply in each skill area to assess whether and how the local labor supply will keep pace with demand.

### Definition of high-, medium-, and low-skilled jobs

This report references jobs in three categories: high-skilled, medium-skilled, and low-skilled. These jobs were classified based on the level of education and level of experience required of the job applicant using information from the Bureau of Labor Statistics on education and experience requirements by occupation.

	High-Skilled	Medium-Skilled	Low-Skilled
<b>Definition</b>	<ul style="list-style-type: none"> <li>• Job requires at least some college/non-secondary award</li> <li>• Job might also require experience or on-the-job training</li> </ul>	<ul style="list-style-type: none"> <li>• Job requires a high school degree</li> <li>• Job requires either significant experience or significant on-the-job training (including apprenticeships)</li> </ul>	<ul style="list-style-type: none"> <li>• Job might require a high school degree</li> <li>• Job might require some experience or some on-the-job training</li> </ul>
<b>Examples</b>	<p><b>8 occupations according to Standard Occupation Code classification, including:</b></p> <ul style="list-style-type: none"> <li>• Industrial engineers</li> <li>• Materials engineers</li> <li>• Industrial production managers</li> </ul>	<p><b>14 occupations according to Standard Occupation Code classification, including:</b></p> <ul style="list-style-type: none"> <li>• Machinists</li> <li>• Welders</li> <li>• Industrial machinery mechanics</li> </ul>	<p><b>76 occupations according to Standard Occupation Code classification, including:</b></p> <ul style="list-style-type: none"> <li>• Team Assemblers</li> <li>• Fiberglass laminators and fabricators</li> <li>• Lathe and turning machine tool setters</li> </ul>

### Current supply and resulting gap of trained workers

The potential pipeline to meet demand in each of the job categories (high-, medium-, and low-skilled workers) differs somewhat based on the educational and experience requirements to enter those occupations. The primary source for high-skilled workers is four-year institutions, given the advanced nature of these positions. Medium-skilled jobs are filled by individuals with significant job experience or some post-secondary education. Low-skilled jobs are filled by high school graduates or workers with some previous manufacturing experience.

Currently, Virginia produces approximately 2,200 graduates annually in engineering programs, more than enough to satisfy the region’s cluster and baseline demand for 1,055 high-skilled workers. Additionally, given the nature of these jobs, the supply pipeline for talent extends beyond Virginia. Nonetheless, while Virginia’s colleges produce a sufficient number of engineers, there is an opportunity to orient existing engineering programs toward the most relevant, real-world skills in Advanced

Manufacturing to complement their theoretical foundations. CCAM is currently addressing this challenge by providing internships for engineering students in Virginia, including those in the "PRODUCED in Virginia" program, in partnership with the University of Virginia (UVA). This is only a start; there is still opportunity to embed manufacturing experience directly into the engineering curriculum at UVA and other four-year universities.

Virginia's community colleges and other workforce training centers within the Tobacco footprint currently produce only 140 individuals annually for medium-skilled jobs. Across the Commonwealth, there are approximately an additional 260 individuals earning degrees or certificates in relevant manufacturing disciplines. Assuming the primary labor pool will come from within the Tobacco Region, the 5-year supply of skilled labor will total only 850, leaving a critical gap of 1,045 medium-skilled workers by 2017.<sup>14</sup>

Finally, for low-skilled occupations, we estimate the region graduates approximately 1,100 high school students per year (5,500 by 2017) with enough proficiency in math and science to qualify for low-skilled jobs. This is well above the forecast requirement of 3,890. However, high school programs could do much more to enhance the workforce readiness of these individuals by increasing the connection between high school programs and Advanced Manufacturing needs through dual enrollment and providing additional career readiness programs to prepare students for the "soft skills" and WorkKeys certifications. Additionally, this labor pool represents a potential source of medium-skilled workers in the future as they gain foundational skills and exposure to manufacturing processes.

Given the likelihood of a critical shortage in the Tobacco Region for medium-skilled workers, the remainder of this report and our recommendations focus on solutions to address the skills gap in medium-skilled jobs.

### **Priority Occupations & Skill Requirements**

Out of the 1,895 medium-skilled workers required, approximately 98 percent of the demand will be for three occupations: machinists (both traditional and CNC machinists, as well as tool and die makers), welders, and industrial maintenance mechanics, and the current supply into these occupations will provide 850 individuals by 2017, leaving a gap of 990 (see Figure 5). Although these numbers seem small compared to the current manufacturing employment in the Tobacco Region of around 33,000, there are two important considerations: first, this gap relates only to medium-skilled workers; and second, it is a point-in-time estimate for the last year of a 5-year planning period. Total manufacturing employment in the region during this period is expected to decline by 500 or more jobs. By addressing the expected shortage of these middle-skilled workers, the Tobacco Region will be able attract manufacturers to the cluster. If these shortages are not addressed, interested companies would be less likely to locate in the Tobacco Region.

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<sup>14</sup> Bureau of Labor Statistics, Occupational Supply Demand System

Figure 5: Estimated Gaps for Priority Medium-Skilled Jobs

Occupation	Cumulative demand by 2017	Supply at current rates	Gap
Machinists	925	496	429
Welders	520	192	328
Industrial Machinery Mechanics	395	162	233
<b>Subtotal for priority skills</b>	<b>1,840</b>	<b>850</b>	<b>990</b>
Other	55	0	55
<b>Total</b>	<b>1,895</b>	<b>850</b>	<b>1,045</b>

To address the skills gaps in these priority occupations, it is important to identify what skill sets are required to produce a work-ready employee for current and future manufacturers in the region. Our interviews with employers, educators, and other workforce developers identified three broad groups of requirements for these occupations:

- Core skills
- Manufacturing knowledge
- Hands-on experience

**Core skills** Today's manufacturers require workers who can not only operate their equipment but also collaborate and solve problems, a dramatic shift from the rote manufacturing jobs of 40 years ago. As such, employers require a set of core skills focused on both practical manufacturing knowledge and soft skills. Specifically, they are looking for individuals with a strong grasp of high school level science, technology, engineering, and mathematics (STEM) foundations, including measurement and calibration abilities, core math knowledge, and computer literacy. Soft skill requirements include strong communication abilities (including technical writing), teamwork, and workplace professionalism.

**Manufacturing Knowledge** In the past, a worker could simply perform the same task repeatedly without understanding the driving forces behind it. Advanced Manufacturing employees work across multiple systems and apply scientific and mathematical principles to new situations, all of which requires foundational understanding of manufacturing and engineering processes. These priority skill areas cluster around a common set of manufacturing capabilities that workers must possess, including blueprint reading, mechanics, technical math, CNC control, and safety measures.

Additionally, each occupation requires a unique set of skills. For instance, machinists must possess knowledge of computer-aided design (CAD) and the principles of machining. Welders need a theoretical knowledge of the weld, which includes an understanding of metallurgy, how the weld joins, how to read a welding symbol, and how to apply non-destructive testing techniques on a weld. Industrial Machinery Mechanics should have a good grasp on a variety of different systems including pneumatics, hydraulics, robotics, and programmable logic controls (PLC).

**Hands-on Experience** As manufacturing jobs become more automated, the equipment that medium-skilled workers interact with on a daily basis is becoming more advanced and employees are expected to run multiple machines and processes at the same time. Employers are increasingly demanding some prior experience, which can only be addressed with hands-on practice. Some of these job-specific experiences are listed in the table below:

<b>Machining</b>	<b>Welding</b>	<b>Industrial Machinery Mechanics</b>
<ul style="list-style-type: none"> <li>• Operating a 3+ axis CNC machine</li> <li>• Operating a coordinate measurement machine</li> <li>• Conducting non-destructive testing</li> </ul>	<ul style="list-style-type: none"> <li>• Shielded metal arc welding (SMAW)</li> <li>• Gas metal arc welding (GMAW)</li> <li>• Flux-cored arc welding (FCAW)</li> <li>• Gas tungsten arc welding (GTAW)</li> <li>• Machinery set-up</li> <li>• Thermal cutting</li> <li>• Wire selection</li> </ul>	<ul style="list-style-type: none"> <li>• Machinery installation</li> <li>• Troubleshooting machinery with faults</li> <li>• Machinery maintenance practices</li> </ul>

Beyond on-the-job training, the primary vehicle for delivering this training consists of technical education programs delivered by community colleges or other training programs. To understand how the Tobacco Region is positioned to meet potential workforce requirements, we need to understand the technical education landscape.

## The Technical Education Landscape in the Tobacco Region

Our evaluation of the technical education landscape in Southside and Southwest Virginia provides a baseline of the current training resources and identifies critical gaps to address. To begin our analysis, BCG evaluated how this region compared to identified best practices (see *Vocational Education: The Missing Link in Economic Development*, BCG Perspectives, October 2012). We then studied each entity within the technical education system (K-12 system, community colleges, four-year universities, higher education centers, and other training providers), focusing a significant portion of our effort on the community college system due to its pivotal role in training medium-skilled workers. Once we had assembled a baseline understanding of the current system, we identified specific challenges in closing the skills gaps identified in the prior section.

### Landscape in technical education and role in supplying workforce needs

The entities comprising the vocational training landscape in the Tobacco Region fall into five broad groups: K-12 education system, community college system, four-year universities, higher education centers, and other education providers such as for-profit or workforce training centers. Each of these entities plays a unique role in delivering technical education:

**K-12 Education system** The K-12 system is the start of the workforce pipeline, funneling individuals to both two- and four-year colleges and directly into the workforce. In the K-12 system, students build their foundational math and English skills. In Career and Technical Education (CTE), high school students also have access to technical training. The K-12 system often engages with local community colleges to offer dual enrollment courses to high school juniors and seniors. In addition, K-12 education plays an important role in the system by offering education and counseling about career options. The community college system has placed career coaches in Commonwealth middle schools and high schools to provide one-on-one career counseling and guidance to students.

**Community college system** There are 23 community colleges serving the Commonwealth of Virginia, which provide credit training for students pursuing technical careers and customized non-credit and pre-employment training for employers with specific training needs. As noted, the community college system also coordinates with the K-12 system to provide dual enrollment courses. Lastly, for students looking to transfer to four-year universities, the community college provides general education and foundational courses. The community colleges in the Tobacco Region are organized under Virginia's Community College System (VCCS), but operate as independent entities as opposed to satellite campuses of one central college. There is no standardized program offering or curriculum across the system and these decisions are made by the individual community colleges.

**Four-year universities** There are eighty-five <sup>15</sup> four-year universities in the Commonwealth, including Virginia Tech, University of Virginia, Virginia State University, Old Dominion, and others. While these schools are a critical source for high-skilled professions such as engineers or materials scientists, they are not a significant source for the middle-skilled workforce. However, the four-year universities do play a role in allowing associate degree holders to continue their education and move from medium-skilled to high-skilled positions. Still in its early phases, the "PRODUCED in Virginia" program offers the final two years of a four-year UVA engineering degree via distance learning to students who have completed their first two years in one of the Commonwealth's community colleges. This allows students to work towards their degree while seeking employment and without the challenge of commuting to Charlottesville. In addition, the four-year universities are important contributors to the research and development initiatives that increase productivity in the region.

**Higher Education Centers** There are two higher education centers in the Tobacco Region that contribute to developing the manufacturing workforce: New College Institute and the Southern Virginia Higher Education Center (SVHEC). These higher education centers serve as "clearinghouses" in which four-year universities and community colleges can offer courses in a setting more accessible to local students. The SVHEC has invested in the R&D Center for Advanced Manufacturing and Energy Efficiency (R&D CAMEE) facility, which has manufacturing equipment for research and development to support local employers, in addition to training and education programs. The New College Institute is in the process of building a facility that will include multiple manufacturing bays used for training and is currently rolling out its first dual-enrollment programs in conjunction with Virginia State University.

**Other educational centers** In addition to the groups listed above, there are a multitude of other workforce training centers and for-profit education providers. While not a complete list, there are several that have a more prominent role in delivering technical education in the region:

- Virginia Technical Institute – Located in Altavista, VA. Provides hands-on training in a number of construction related fields such as pipefitting, welding, and carpentry.
- ECPI University/Virginia Council on Advanced Technology Skills (VCATS) – Curriculum was developed by the Virginia Manufacturer's Association with ECPI as the exclusive training and assessment provider for the VCATS Manufacturing Specialist and Manufacturing Technician certifications. The current program covers many of the foundational skills needed in manufacturing but does not yet include hands-on training, which limits its ability to train employees for the priority, medium-skilled jobs.
- Washington County Skills Center – Located in Abingdon, VA. Provides training in CNC machining and welding. The skills center coordinates with Virginia Highlands Community College for its CNC machining program.

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<sup>15</sup> IPEDS Data Center

## Critical components of an effective technical education system

Prior in-depth research on technical and vocational education in markets around the world completed by BCG (see *Vocational Education: The Missing Link in Economic Development*, BCG Perspectives, October 2012) revealed four factors that are critical to the success of vocational education programs:

**Industry participation** Industry provides input on what skills are required, the number of employees needed, and often provides funding. Technical education systems should not operate in a vacuum and should ensure program offerings and curriculum are aligned with the needs of local employers. Industry leaders should also be involved with the technical education system by serving on advisory committees and as adjunct professors, piloting new courses, and even providing equipment or materials donations. Crucially, industry must support the technical education system by hiring graduates for full-time roles, apprenticeships, and internship programs.

**Coordinated School System** A coordinated school system brings together the interests of all stakeholders, ensuring that education providers are aligned on the needs of the community, and sharing resources to reduce duplicate investments. In addition to community colleges coordinating among themselves, there should also be links between the K-12 education system, four-year universities, and other workforce training centers.

**Student Interest** Too often, vocational education is offered on a separate track as a clearly substandard option versus general education. Vocational career options should be appealing to both students and parents, rather than a last resort for low-performing students. In countries such as Germany, vocational education and apprenticeship are part of the dual education system and viewed as a popular path to a career. In 2001, 51 percent of Germans under 22 had completed an apprenticeship.<sup>16</sup> Without student interest, vocational education systems will not be able to generate the demand they need to be successful.

**Accreditation and funding tied to key performance indicators (KPIs)** Funding and accreditation in successful vocational education systems should be tied to measures of performance such as graduation and/or job placement rates instead of just student enrollment – in Virginia, a significant portion of VCCS funding is tied to the number of students enrolled. Increasingly, there is some funding held for innovation programs that each community college must apply for. However, by more directly linking funding to measures of student success and the economy's needs, the interests of the education system are aligned with those of the student.

In assessing the relative strengths and weaknesses of the Tobacco Region's vocational education system, there are several gaps to address:

- Greater and more focused participation and input from industry on a broader basis

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<sup>16</sup> International Center for Technical and Vocational Education and Training

- Improved coordination between schools to share strengths and resources across the footprint with a more standardized curriculum approach
- Increased acceptance and image of technical education
- Tying funding to student outcomes and needs of employers

Success Factor	Strengths	Weaknesses
<b>Industry Participation</b>	<ul style="list-style-type: none"> <li>• Community colleges have individual industry advisory boards, many of which are specific to manufacturing</li> </ul>	<ul style="list-style-type: none"> <li>• Coordination with industry is not centralized; no one point of contact</li> <li>• No standardized system for alignment on curriculum or program offerings with colleges and local employers—varies widely across schools</li> </ul>
<b>Coordinated School System</b>	<ul style="list-style-type: none"> <li>• Community colleges are beginning to work together to achieve scale; one example of this is the nursing program shared by the four schools in the Southwest region</li> <li>• Community colleges are increasing their dual enrollment programs with local high schools as a way to increase their reach and utilize excess resource capacity during the day</li> </ul>	<ul style="list-style-type: none"> <li>• Curriculum is not standardized across the system, which leads to varying levels of student preparedness</li> <li>• Currently the system does not fully leverage scale to share resources and achieve efficiencies with curriculum development, faculty, and facilities</li> </ul>
<b>Student Interest</b>	<ul style="list-style-type: none"> <li>• In some areas there is a strong history of manufacturing, which leads to higher-than-average interest in this field</li> <li>• Career coaches in schools are a resource students can leverage to explore career options</li> <li>• “Dream it, Do it” campaign is increasingly attacking this issue with marketing and information campaigns</li> </ul>	<ul style="list-style-type: none"> <li>• Most students do not view manufacturing as an attractive career option in large part due to watching manufacturing jobs in their regions outsourced</li> <li>• Many students and parents also have an outdated view of the technology used in manufacturing and the level of skill needed to operate it</li> </ul>
<b>Accreditation and Funding Tied to KPIs</b>	<ul style="list-style-type: none"> <li>• VCCS is starting to allocate some funds that require petitioning for innovation grants</li> </ul>	<ul style="list-style-type: none"> <li>• There is a lack of coordination on credentials and standards the programs are driving toward; for example John Tyler is aligned with the NIMS and Mountain Empire uses SME</li> <li>• Funding tied mostly to fulltime equivalent students, not graduation or job placement performance</li> </ul>

## Challenges in K-12 and four-year universities

While not the focus of this effort, our research noted several opportunities to ensure the K-12 and university systems become better positioned to address the needs of Advanced Manufacturing employers.

### K-12 Challenges

- **Improve performance in STEM subjects** Currently only 62 percent of students in the Tobacco Region passed the Algebra II SOL against an average of 69 percent in the Commonwealth<sup>17</sup>; in particular, students need to improve their applied math skills and continue to engage in math courses through graduation so the information is not forgotten by the time they reach college
- **Increase enrollment in dual enrollment programs for high school juniors and seniors** This offers students the opportunity to earn college credit and experience the rigor of college-level coursework while still in high school
- **Improve availability of information about opportunities in manufacturing careers** There is a pervasive mindset that a four-year degree is the only path to success and as a result technical education is viewed as substandard

### Four-year University Challenges

- Encourage more students to pursue engineering degrees with a focus on manufacturing
- Ensure engineering students gain hands-on experience with the equipment used in production

## Community College System

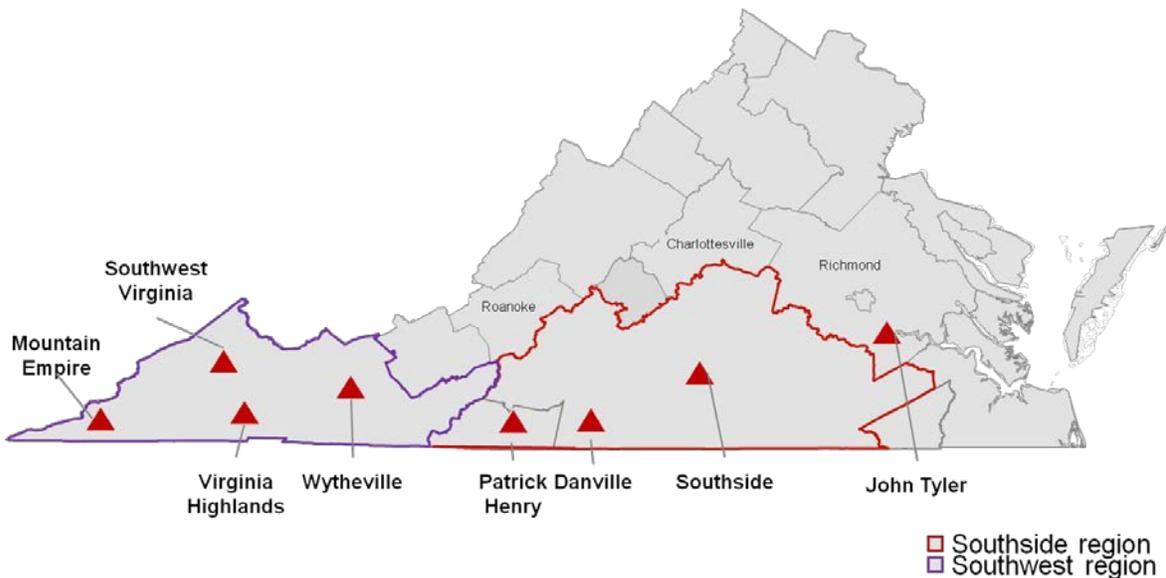
Eight community colleges service the Tobacco Region. The community colleges operate as relatively autonomous entities within Virginia's Community College System. Below is an overview of the community colleges in the Tobacco Region (see Figure 6).

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<sup>17</sup> 2011-2012 school year, Virginia Department of Education

Figure 6: Community College Overview

Name	City	Annual Full Time Student Equivalents 2010-11	Annual Students 2010-2011
Danville Community College	Danville	2,910	6,741
John Tyler Community College	Chester	6,289	14,522
Mountain Empire Community College	Big Stone Gap	2,252	4,442
Patrick Henry Community College	Martinsville	2,479	4,744
Southside Virginia Community College	Keysville	3,927	9,439
Southwest Virginia Community College	Richlands	2,353	5,352
Virginia Highlands Community College	Abingdon	1,880	3,863
Wytheville Community College	Wytheville	2,489	5,397



**Regional background and overview**

To put the current community colleges in context, it is helpful to have an understanding of the background and history of each area, as we have found this tends to influence the level and quality of manufacturing education. Not surprisingly, in areas with a longer history and density of manufacturing, there tends to be a greater focus on Advanced Manufacturing training in the local community college.

In the Southside region, there is a high concentration of manufacturing in the Danville area, where large employers include Goodyear and Nestle USA. Also in the Southside region, there is a large cluster in Campbell County including Babcock & Wilcox, BGF Industries, and Georgia Pacific Wood Products. In addition, Rolls-Royce has constructed a new plant outside of Richmond. Danville and John Tyler have two of the strongest programs in the region, and this is in no small part due to their partnerships with Goodyear and Rolls-Royce, respectively. Additionally, Southside Virginia Community

College has made considerable investments, including recently in a training site in Greenville, that includes space for an Advanced Manufacturing training lab.

In the Southwest region, there is a large concentration of manufacturing along the I-81 corridor including Utility Trailer, Bristol Compressors, Universal Fiber Systems, and Joy Technologies. West of the I-81 corridor, there is a very low concentration of manufacturing. Wytheville Community College is located along the I-81 corridor, and, not coincidentally, has one of the strongest programs in the Southwest region for precision machining and welding due to its proximity and connection to local employers.

### **Strengths and weaknesses of the overall community college system**

Our evaluation of the community college clearly reveals a large degree of variation in Advanced Manufacturing training capabilities between the individual community colleges. What is a strength in one community college is often a weakness in another. The strategy to address the skills gap needs to accentuate and leverage the strengths of the system as a whole, while developing initiatives to address the weaknesses.

#### **Strengths:**

The community college system includes a number of strong programs that serve as a foundation for workforce development. Along with these programs also comes the faculty and administration with the expertise to develop and manage these high-caliber programs. This group will provide important input into curriculum changes and lab facilities in any proposed solution. Interviews with these individuals revealed a level of excitement and responsiveness that will be critical in implementing a solution.

Another strength of the community college system is the presence of career coaches in 168 Virginia high schools and some of the middle schools. Collectively, these programs reach over 38,000 students across the Commonwealth, and serve as a resource to supplement the often-overburdened school guidance counselors. Career coaches provide students with information about career options and the education needed to enter those careers, including Advanced Manufacturing. Recent studies have shown a 47 percent increase in the number of students choosing to pursue post-secondary education based on their meeting with a career coach.<sup>18</sup>

A final strength of the community college system is the coordination between local employers and local colleges. While there is room to improve this relationship, there are many examples of successful partnerships between industry and the colleges to provide equipment, adjunct faculty, and internships/apprenticeships to students; two examples of this are Danville Community College's long-standing partnership with Goodyear and John Tyler's partnership with Rolls-Royce. However, there is always opportunity for the community colleges to ensure they are more deeply connected with employer needs and customizing solutions for them, not just rearranging existing classes.

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<sup>18</sup> VCCS Workforce Services

**Weaknesses:**

Three major weaknesses prevent the entire system from delivering technical education more effectively in the Tobacco Region. First, while there is a strong degree of collegiality among the schools, there is a lack of coordination among the individual colleges, which results in missed opportunities to leverage shared resources. For example, in the Southside region, Danville, Southside, and Patrick Henry community colleges are within relatively close proximity, creating an opportunity to leverage equipment, faculty, and curriculum to increase effectiveness and reduce cost. Yet, there is not currently significant coordination between these programs. However, there has been some recent movement toward increased collaboration and during our interviews, many of the colleges' representatives expressed a desire and need to coordinate more.

Second, there is a lack of common standards against which the curriculums are designed. Some programs align their curriculum against the National Institute for Metalworking Skills (NIMS) standards, while others use Society for Manufacturing Engineers (SME) standards. This leads to differences in the skills of graduates, and may lead to confusion among employers about what skills an applicant has based on the title of their degree.

As discussed before, hands-on training is a key component to a comprehensive manufacturing training program; unfortunately, there is a lack of state-of-the-art equipment in many of the training programs in the region. In some programs, the equipment used is 25 years old and obsolete relative to the tools used in industry, which severely affects the students' preparedness to work in an Advanced Manufacturing facility. For machining, the state-of-the-art equipment needed is a four- or five-axis CNC machine. Currently only half of the machining programs in the region have access to these machines, which creates a significant challenge for students not at those schools trying to train for a career in precision machining.

There are additional gaps in the curriculum offered by many of the community colleges which need to be addressed. These cover core skills, manufacturing knowledge and hands-on experience.

**Challenges for the community college pipeline to close skills gap**

There are specific challenges the community college system will need to address for each of the categories of skills gaps identified previously through interviews with employers:

**Core skills:** To address the skills gaps with workplace professionalism, the community college system will need to figure out how to manage courses with the same expectations as employers. For example, there will need to be a balance between disciplining students who are late to class without detracting unnecessarily from their educational experience. Additionally, the lack of STEM skills is inherited from the K-12 system. If high school graduates do not have the foundational math and science skills necessary to be successful in college level courses, this then becomes the problem of

the community college system. To address this, the community college system will need to develop methods to identify and remediate these skill gaps before students begin college level courses.

**Manufacturing knowledge:** The challenge for the community college system in addressing manufacturing knowledge is to increase access to all students and across programs. For example, as many of the community colleges may not currently offer associates degrees or diplomas in industrial maintenance, students in these colleges do not have access to those foundational courses, such as robotics or hydraulics. To increase student access to these courses, the community colleges will either need to offer these courses on-site at all schools or leverage distance learning to provide remote access to students.

**Hands-on experience:** The greatest challenge in the hands-on experience gap is in providing access to state-of-the-art equipment and faculty trained on it. State-of-the-art equipment is expensive and requires a large amount of lab space and potential facility structural modifications needed to house it (e.g., power and cooling needs, reinforcing floors). Additionally, there are a limited number of individuals with deep experience in this equipment available to deliver instruction, and those who do often have full-time roles in industry. To overcome this challenge, some employers have begun to encourage their employees to serve as adjunct faculty at the local community college, but this is far from standard practice.

## Recommended Program and Investments

Meeting the expected demand in the Tobacco Region for skilled workers will require initiatives targeted at (1) increasing the capacity and capabilities of the community colleges and other workforce training programs in the footprint to develop the skills that employers require, and (2) attracting individuals to pursue careers in Advanced Manufacturing professions. Without addressing both of these critical issues, the Tobacco Region will not be effective at creating an Advanced Manufacturing hub, and is potentially at risk of not producing enough skilled workers to meet the needs of current employers in the region.

This section describes our recommendations to address each of these issues in turn.

### Increasing Capacity and Capabilities of Community Colleges and Workforce Training Programs

As described above, employers are looking for their employees to be trained on a set of core skills (both STEM and soft skills), manufacturing knowledge, and hands-on experience. However, there are gaps today in delivering these skills:

- **Core skills:** Students need to improve their workplace professionalism, teamwork, and communication skills; solutions will need to continue to incorporate elements into the curricula to ensure that these skills are developed
- **Manufacturing knowledge:** Not all programs offer programs in welding, machining, and industrial machinery mechanics; the recommended program will need to increase access to these courses
- **Hands-on experience:** Given the significant expense required in providing advanced technical training and current lack of student interest, not all schools have made investments in the state-of-the-art equipment needed to train individuals in these programs; the recommended program needs to increase access to this equipment

The community colleges can address the core skills by making small enhancements to their policies and curricula, such as enforcing punctuality more rigorously, infusing teamwork and communication throughout their courses, and instituting “career basics” as part of their technical programs. One of the employers we spoke to said, “We need people who can work well in teams, can follow directions, and show up on time,” but they have not found these skills universally available today’s workforce. For instance, one employer complained that some of the younger employees assumed they could use their cell phones to text friends while working on the factory floor. Several of the community colleges have already started incorporating some of these changes into their programs. We encourage the community colleges to undertake this change directly, as it does not require significant changes or investment.

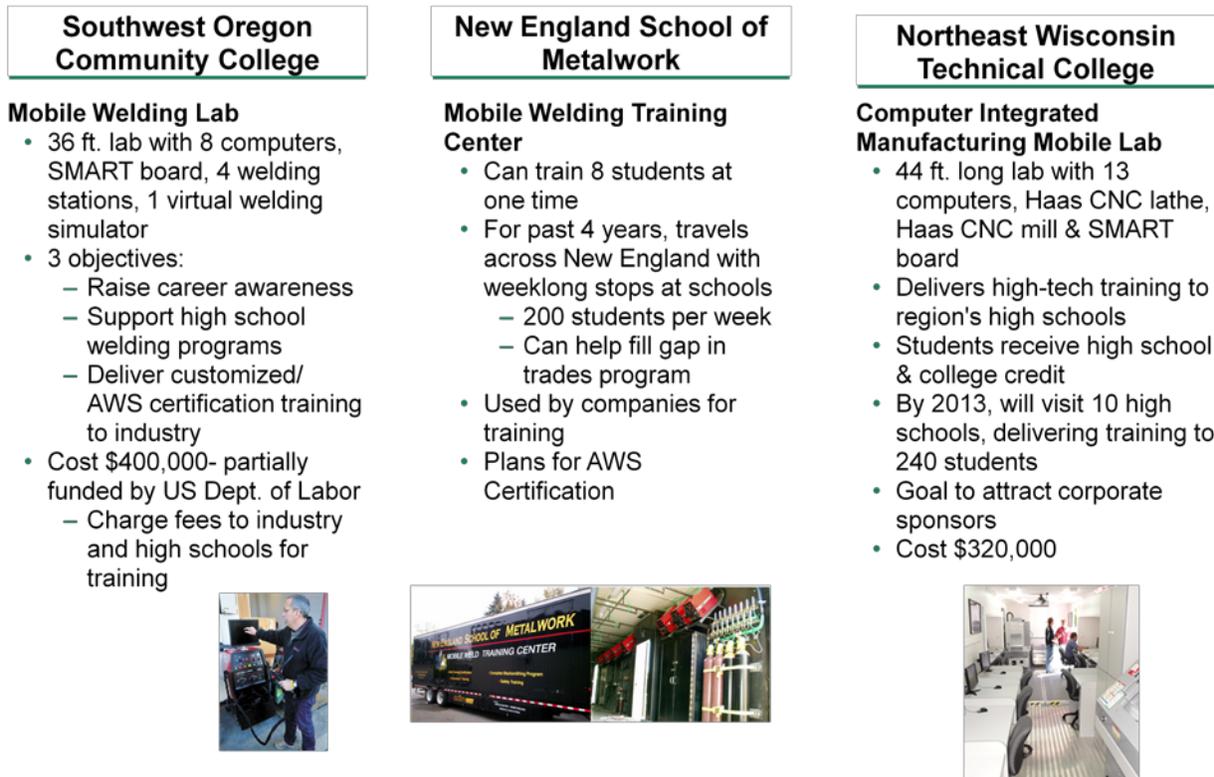
Addressing the gaps in manufacturing knowledge and hands-on experience will require investment in the form of faculty, curriculum, and equipment. For each of these dimensions, the option is whether to invest locally in each school or to share the

investment across schools; for example, through increased distance learning in the case of manufacturing knowledge and regionally shared training centers in the case of hands-on experience.

The potential for distance learning has increased dramatically over the past several years and there are many platforms that can help integrate technology more smoothly, such as Blackboard Collaborate. While still in its early phases, the “PRODUCED in Virginia” program has shown the potential to deliver bachelor’s level engineering courses via distance learning, while students are often employed in industry part-time.

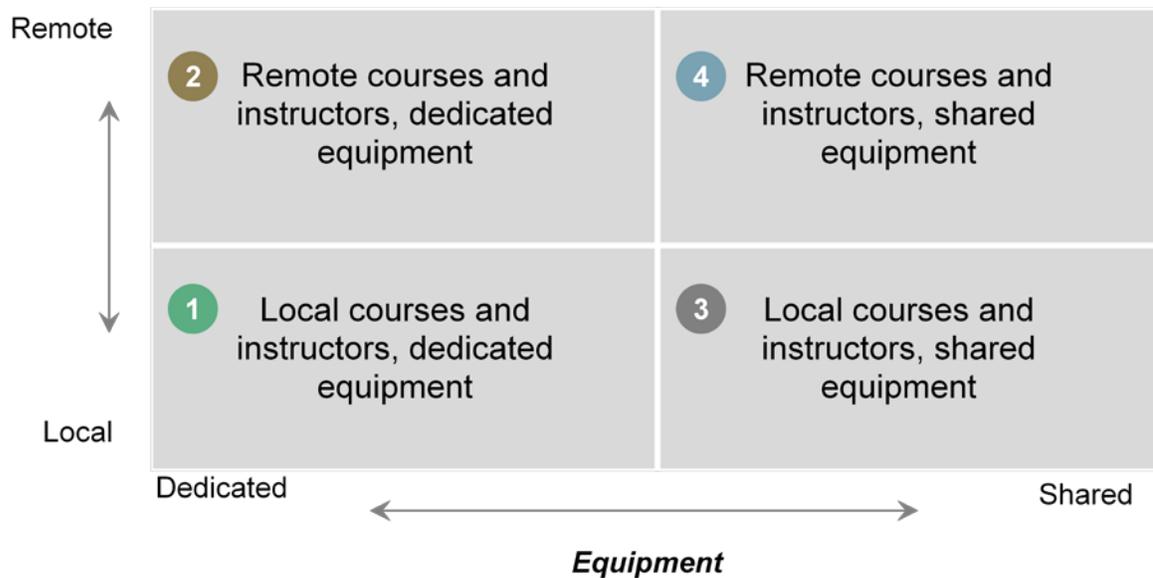
Mobile labs and increased numbers of apprenticeships could also help to address the capacity challenge; however, these options may have limited application in the Tobacco Region. Mobile labs could be quite effective for welding, but given the weight and range of equipment required in machining and industrial maintenance mechanics programs, utilizing a mobile lab for these programs is not feasible (see Figure 7 for examples of mobile facilities). Apprenticeships are an excellent means for established companies to develop a workforce, but they are not feasible in the first five years of cluster development, as it will require an existing workforce, not currently present in the region, to train new employees. Over the long-term, we recommend that employers extend the availability of apprenticeships to address skill gap, and improving the availability of distance learning will enhance the attractiveness of apprenticeships. While these options may not be viable as a systematic solution to address training needs in the priority skill areas, they should be considered as part of the comprehensive solution.

Figure 7: Mobile Lab Examples



Combining the range of solutions for each gap, there are four potential ways to address the skills gap (see Figure 8: Option sets to address skills gap Figure 8).

Figure 8: Option sets to address skills gap

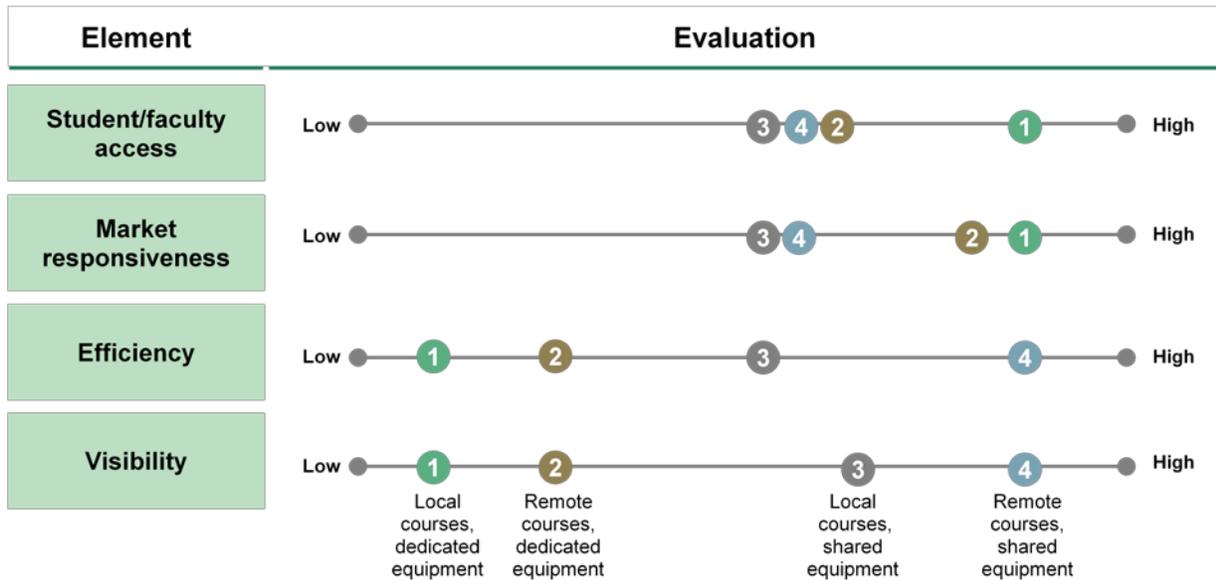


Identifying the most effective option of these four requires balancing for multiple elements and objectives critical to the success of this workforce program:

- **Student/faculty access:** Allow reasonable physical access to classes and equipment throughout the Tobacco Region
- **Market responsiveness:** Adapt offerings to the needs to local employers, such as specific processes and equipment where possible
- **Efficiency:** Maximize the return on investment through increased utilization of both equipment and quality faculty
- **Visibility:** Utilize investments in workforce programs as a marketing tool to potential employers to demonstrate the region's capabilities and attract students who may be considering manufacturing careers

Against these four criteria, option 4—Remote courses and instructors, shared equipment—provides the best balance across all elements (see Figure 9).

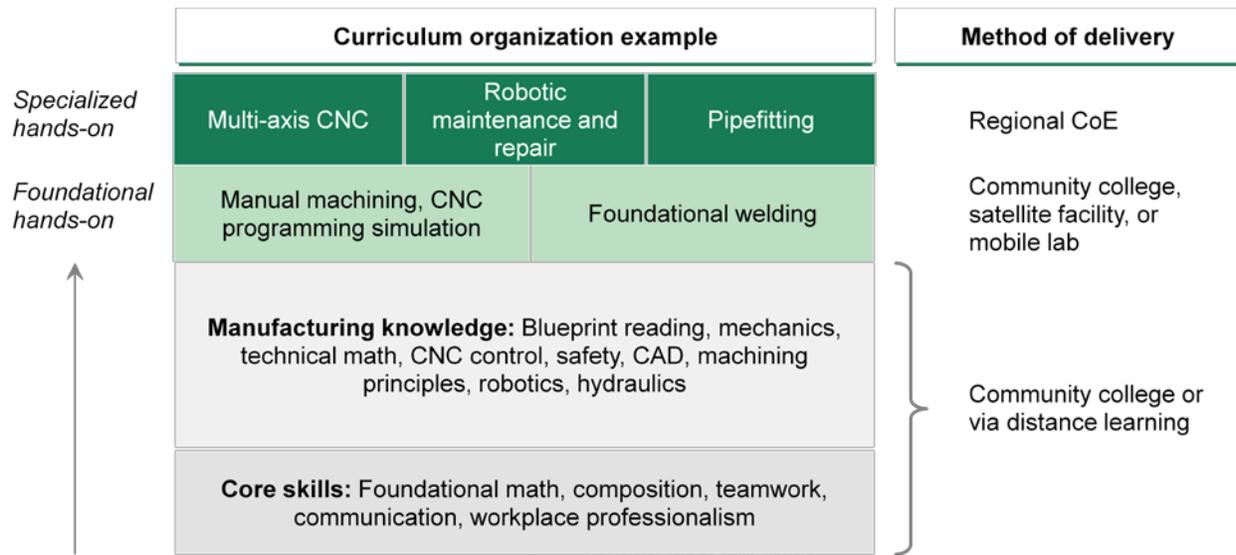
Figure 9: Option Evaluation



As such, we recommend that CCAM and TICRC invest in Regional “Centers of Excellence” (CoE) to provide hands-on training in the priority skill areas and increase funding available to develop distance learning programs that can be used across schools and programs. Combined, this will enhance the ability of the community colleges and other training providers to provide access to needed manufacturing instruction. Each center should offer training on all of the priority skill areas needed, which would allow for cooperation and integration across the programs, potentially culminating in cross-discipline projects.

These regional CoEs would complement the existing community college system by providing access to state-of-the-art equipment, but the community colleges would still play a critical role in delivering core skills and manufacturing knowledge, as described in Figure 10 below. For welding, mobile labs can be utilized to increase capacity at individual schools on a temporary basis to help provide foundational hands-on training.

Figure 10: Delivery Methods



To ensure that each student leaving the program has the necessary skill set, we recommend developing standardized curricula requirements during the implementation phase, with sign-off by employers. As part of this work, it will also be important for employers in this region to align on the applicability of credentials (e.g., the National Institute for Metalworking Skills Certification), and align the curriculum against those credential requirements. These curricula would define the prerequisites for a student to enter and utilize a regional CoE, and will require modifications from the current curricula provided by the community colleges in the Tobacco Region today. We recommend providing funding to help create new curricula offerings, provided they can be delivered via distance learning methods.

The model for the overall student experience would vary based on the starting point of the individual community college (see Figure 11). For example, a student at Patrick Henry Community College, which does not have a significant manufacturing curriculum, could participate in distance learning provided by other schools, and lab courses provided at the regional CoE. At others, such as Danville Community College which has much of the existing equipment, students would have a more traditional experience, receiving most of their curriculum at their local community college and utilizing the regional CoE for some advanced training or for added capacity.

Figure 11: Likely instruction delivery by skill area and college

Community College	Machining		Industrial Maintenance		Welding	
	Manufacturing Knowledge	Hands-on	Manufacturing Knowledge	Hands-on	Manufacturing Knowledge	Hands-on
Danville	On-Campus	On-Campus + CoE	On-Campus	On-Campus + CoE	On-Campus	On-Campus + CoE
John Tyler	On-Campus	On-Campus + CoE	On-Campus	On-Campus + CoE	On-Campus	On-Campus + CoE
Southside	On-Campus	On-Campus + CoE	Distance	CoE	Distance	CoE
Patrick Henry	Distance	CoE	Distance	CoE	On-Campus	On-Campus + CoE
Southwest	Distance	CoE	On-Campus	On-Campus + CoE	On-Campus	On-Campus + CoE
Wytheville	On-Campus	On-Campus + CoE	Distance	CoE	Distance	CoE
Mountain Empire	On-Campus	CoE	On-Campus	On-Campus + CoE	On-Campus	On-Campus + CoE
Virginia Highlands	On-Campus	CoE	Distance	CoE	Distance	CoE

To ensure equitable access and optimize student to faculty ratios, we recommend developing three regional CoEs, each with the capacity to train at least 70 to 75 students per year, with a target to graduate 65 to 70 students per year. Given the proportion of training age population<sup>19</sup> between both the Southwest (approximately 40 percent) and Southside (approximately 60 percent) regions, likely student interest, and the current supply of trained workers in each region, we recommend one facility in the Southwest and two facilities in the Southside.

We estimate that the upfront investment in creating these centers will range from \$17 million to \$20 million, while the annual operating costs will range from \$2 million to \$3 million (see Figure 12). There are opportunities to reduce this upfront investment, such as adaptively reusing vacant manufacturing or other industrial grade facilities; additionally, there is potential to work with machining companies to get some of the equipment donated, which would significantly reduce the overall costs. While TICRC has historically provided significant funding to support Advanced Manufacturing workforce initiatives, it is important that they not be viewed as the sole source of funding for this workforce program. We recommend that TICRC target 30 percent co-funding for this initiative, with the remainder coming from a combination of industry partners (through either direct funding or in-kind equipment donations), educators, and the Commonwealth, to ensure that each of these parties has a financial stake in the program's success. As the implementation teams refine their curricula requirements with employers, the total investment may change based on finalized equipment needs to support each skill area. Each team is responsible for identifying other potential funding sources prior to submitting requests to TICRC.

<sup>19</sup> Ages 15-29

Figure 12: Estimated Investment and Operating Costs

Fixed Costs		Operating Costs	
Item	Cost	Item	Cost
3 facilities	\$3M– \$4.5M	Instructors & technicians	\$1.0M– \$1.3M
Equipment	\$12.3M– \$13.2M	Administrative support & marketing	\$0.6M– \$0.8M
Software	\$0.3M–\$0.6M	Facilities & materials	\$0.6M–\$1.2M
3 Mobile units	\$1.4M–\$1.6M		
<b>TOTAL</b>	<b>\$17M–\$20M</b>	<b>TOTAL</b>	<b>\$2.2M–\$3.3M</b>

The CCAM facility that opened in September 2012 is an excellent model for a regional COE. It has capacity to serve 70 students and could be used as part of training programs throughout the year. While the regional CoEs are being implemented, we recommend exploring potential to pilot programs in CCAM.

### Awareness

While the Tobacco Region may be able to increase capacity through investments in regional CoEs and distance learning, these investments will go to waste without concerted effort increase the both the attractiveness of manufacturing professions and the ease of entering these programs.

Employers and educators consistently cited the poor image of manufacturing careers and technical education as key barriers in building a quality Advanced Manufacturing workforce. There are many reasons given for this, including:

- Individuals have an outdated view of manufacturing as a dirty, labor-intensive profession that requires only a high school degree
- The history of manufacturing in the region gives the perception that it is a risky career that is highly susceptible to off-shoring
- There is a premium placed on four-year degrees at the expense of technical degrees

This view is not unique to the Tobacco Region or to Virginia. According to a national survey completed by the Manufacturing Institute, only 50 percent of people believe that jobs in manufacturing are clean and safe. Furthermore, only 19 percent of those ages 18 to 24 said that their schools encourage students to pursue manufacturing career while only 17 percent said that their parents encouraged them. Finally, only 37 percent of

those surveyed believed that manufacturing jobs were stable when compared to jobs in other industries.<sup>20</sup>

As a result, parents are encouraging their children to pursue other careers and guidance counselors are pushing students to four-year degree programs. This leaves students who may have a greater interest in a technical career and program with heavy debt and a degree that does not support their interests. While regional campaigns to improve the perception of manufacturing careers have seen success, such as Dream It, Do It Virginia’s (DIDIVA) technology camps, there is still a significant perception gap between the realities of manufacturing careers and commonly held views.

To help address these concerns, we recommend a multi-pronged approach targeted at two audiences: students (and their parents) in the K-12 system and career-changers (see Figure 13 below).

Figure 13: Recommended Options to Address Attractiveness and Ease of Entry

		K-12 Students & Parents	Career Changers
<b>Attractiveness of profession</b>	<b>Career coaches</b>	<ul style="list-style-type: none"> <li>• Make these full-time roles</li> <li>• Ensure these coaches are aware of opportunities in Advanced Manufacturing (plant tours) and target students with ideal interests and backgrounds</li> </ul>	<ul style="list-style-type: none"> <li>• Ensure adult career coaches are available at workforce development centers</li> <li>• Link career coaches to Virginia Employment Commission</li> </ul>
	<b>Marketing campaign</b>	<ul style="list-style-type: none"> <li>• Simplify "Made in America, Again" to target parents with concise talking points</li> <li>• Broaden reach of Dream it, Do it</li> </ul>	<ul style="list-style-type: none"> <li>• Advanced Manufacturing job fairs with specific job opportunities and salary information and training required</li> <li>• Target recently unemployed in broadly relevant career fields</li> </ul>
<b>Ease of entry</b>	<b>Access to education</b>	<ul style="list-style-type: none"> <li>• Make dual enrollment Career &amp; Technical Education (CTE) more standardized</li> <li>• Provide CTE dual enrollment students access to state of the art equipment</li> </ul>	<ul style="list-style-type: none"> <li>• Establish assessment process and competency-based credentials to speed up training times for individuals with some relevant experience</li> <li>• Ensure flexible course and lab scheduling to accommodate working students</li> <li>• Increase access to funding for displaced worker training</li> </ul>
	<b>Access to experience</b>	<ul style="list-style-type: none"> <li>• Expand apprenticeship opportunities in Tobacco Region (especially for Small and Medium Enterprises)</li> <li>• Offer internships in R&amp;D centers to promising students</li> </ul>	<ul style="list-style-type: none"> <li>• Increase apprenticeship options for individuals with some experience to allow them to continue working while studying</li> </ul>

Efforts already underway can be leveraged in this effort. For example, the community colleges have invested heavily in career coaches, who can play a critical role in helping guide students towards community college programs. We recommend extending this program, and training these coaches on the opportunities in Advanced Manufacturing so that they feel more comfortable recommending these to their students. Additionally, the Virginia Manufacturers Association (VMA) has invested in DIDIVA campaign focused on increasing awareness and exposure to manufacturing careers, and we recommend

<sup>20</sup> Deloitte & The Manufacturing Institute, Unwavering Commitment: The Public's View of the Manufacturing Industry Today, September 2011

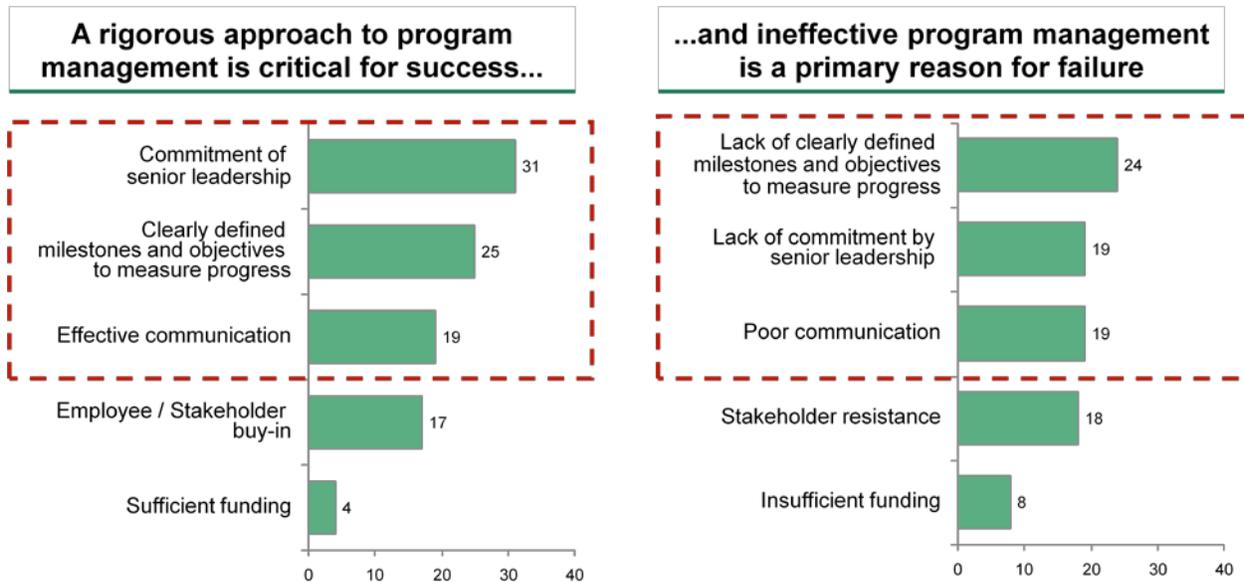
coordinating with and expanding this program. Beyond extending those marketing initiatives already in place, there are likely additional steps that will need to be taken to convey the attractiveness of Advanced Manufacturing careers, and we recommend that additional funding be provided by TICRC and industry partners to support these efforts once a more detailed marketing plan is developed during the implementation phase.

Combined, initiatives addressing the capacity and awareness challenges will position the Tobacco Region well in its efforts to develop a skilled workforce capable of meeting the demands of Advanced Manufacturing employers, and these efforts will be critical enablers to drive cluster success in the coming years. Ensuring the success of these efforts will require rigorous implementation and governance.

## Proposed Implementation Program

Driving successful change programs is challenging for any organization, and approximately 50 to 70 percent of initiatives fail to meet their objectives.<sup>21</sup> There are common elements for what drives success: commitment from senior leadership, clearly defined milestones, and effective communication (see Figure 14); similarly, programs fail for lack of those same things.<sup>22</sup>

Figure 14: Drivers of Change Program Success and Failure



Critical to ensuring this program’s success will be gaining the buy-in of senior leadership of the Commonwealth of Virginia and aligning with the various economic and workforce development entities serving the region to ensure a coordinated effort to support Advanced Manufacturing workforce development.

To implement this program successfully, CCAM and TICRC need a holistic approach that goes beyond a simple timeline. It must also have an organization and governance model that aligns stakeholders around the vision and objectives for this initiative, as well as agreed-upon success metrics that will allow teams to track progress as the program unfolds.

This section outlines our recommendations in three areas:

- **Organization and Governance:** The organizational structure responsible for driving the program’s success

<sup>21</sup> The following studies quote failure rates of change programs between 50 and 70 percent. The Economist (2000) “Change Management: An Inside Job;” J. Kotter & D. Cohen (2002) “The Heart of Change;” EUI (2011) “Leaders of change: Companies prepare for a stronger future;” BCG (2012) “Organization of the Future—Designed to win: Flipping the odds for successful reorganization.”

<sup>22</sup> Economist Intelligence Unit Survey, “A change for the better,” March 2008.

- **Detailed planning:** Defined deliverables, timelines, and milestones
- **Measurable success metrics:** Transparent and easily measurable metrics that capture key success measures of the initiative will be critical to ensuring the project is on track to deliver results

We should note that the recommendations here are a starting point only—it will be critical that each of the implementation teams take a detailed review of their objectives and deliverables to ensure that all critical milestones are defined and agreed to.

**Organization and Governance**

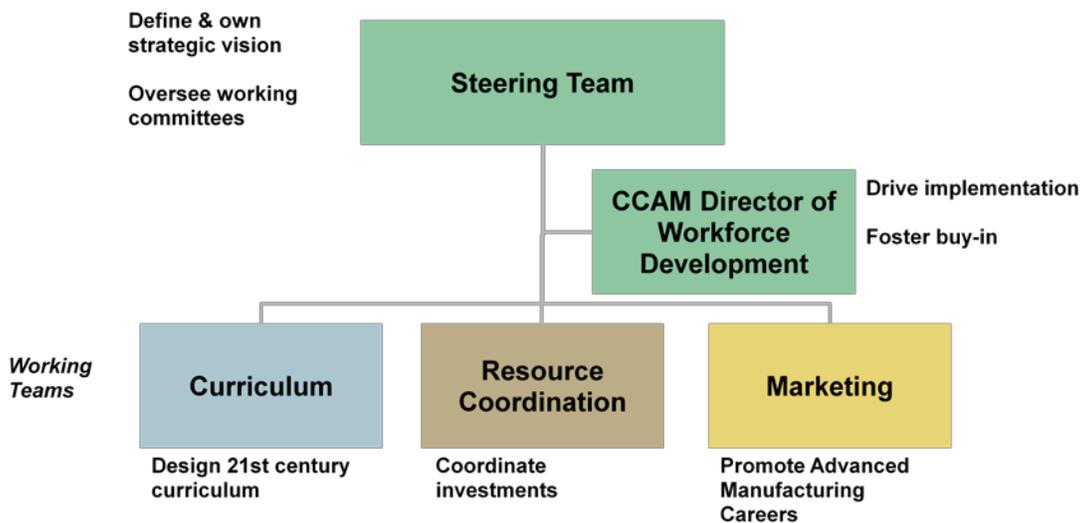
An important first step in ensuring a successful change program is to identify the right oversight and governance model, as well as the teams that will help drive the key implementation workstreams. We recommend that this initiative be created under CCAM's purview, with heavy involvement from the Commonwealth and TICRC. Establishing a strong governance model will:

- Create ownership and accountability for realizing the vision, focused on results and impact
- Delineate responsibilities across groups , involving multiple stakeholders
- Incorporate deep expertise and knowledge of industry, education, and workforce development
- Coordinate workforce development efforts across the region

Additionally, CCAM will support the training centers with ongoing guidance and expertise to ensure the training and equipment are relevant to the needs of Advanced Manufacturing companies in the Tobacco Region.

To drive this initiative, we recommend the governance model depicted in Figure 15.

Figure 15: Recommended Organization and Governance Model



The Steering Team is accountable for defining the strategic vision for the program and driving its success, and will provide the final sign-off on all working team recommendations. This group should have a mix of employers, educators, and economic and workforce developers to ensure that industry needs are met in the most effective way possible.

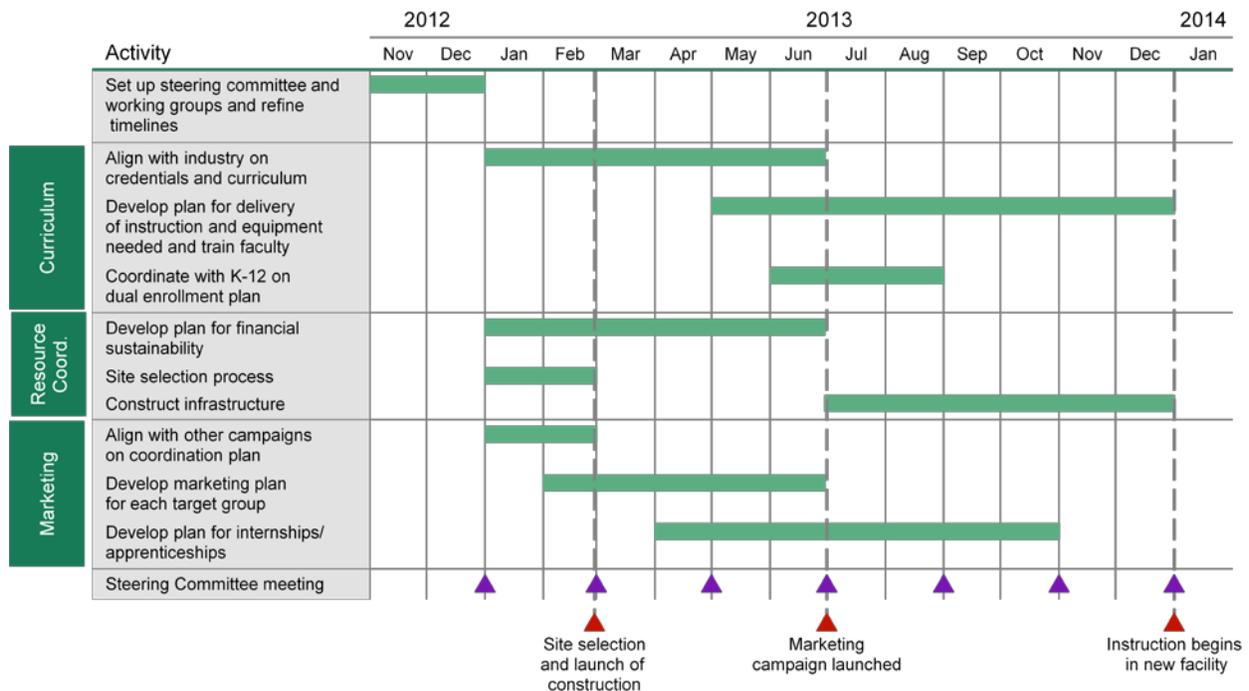
The Director of Workforce Development will be the day-to-day lead for project success, helping to coordinate efforts across each of the working teams as well as identifying and raising issues in program execution to the Steering Team. Additionally, this role will help engage external stakeholders to ensure buy-in.

Each of the working teams (Curriculum, Resource Coordination, and Marketing) is accountable for driving the recommendations within their respective focus areas in conjunction with overall program objectives and should have an appropriate mix of employers and educators to design practical solutions.

### Detailed planning and timeline

To reach an aggressive goal of a January 2014 launch, we worked backwards from the final deadline and created a number of interim milestones. Once the steering committee and subcommittees are set up, they will want to revisit and refine the timelines and milestones. As such, the timings proposed below (see Figure 16) should be viewed as guidelines that will need to be refined and expanded upon as part of detailed implementation planning.

Figure 16: Proposed High-Level Implementation Timeline



The first step in implementation is to launch the Steering Team and each of the working teams. Once the teams are in place, they should refine the objectives, timelines, and milestones to align with the Steering Team. Each team will be responsible for a set of initiatives based on their area of focus.

### **Curriculum committee**

***Align with industry on credentials and curriculum*** The objective is to deliver recommendations on standardized curricula requirements for each of the priority skill areas, with deep input from employers and educators. As part of this step, the team should align on and recommend the relevant credentials and certifications that employers demand for their workforce (e.g., National Institute for Metalworking Skills, or American Welding Society certifications). Once finalized, these curricula requirements will be the standard against which training providers in the region should be measured to assess the quality and applicability of their training, and would be a prerequisite for individuals using the regional CoEs.

***Develop instruction delivery plan*** Once the curriculum is developed, the curriculum committee should work with the education providers to determine which courses will be offered on-campus, through distance learning, or at the regional Center of Excellence, and consider external providers to help support curriculum needs. Additionally, the committee should develop a list of the equipment and mobile labs needed to support instruction and work with the Resources Coordination committee to acquire this equipment.

***Coordinate with K-12 on dual enrollment*** The committee should work to modify the curriculum so that it can be delivered in a high school setting, and coordinate with the local high schools to determine delivery logistics.

### **Resources Coordination committee**

***Develop plan for financial sustainability*** Once the facilities are up and running, they will need a financial plan for ongoing operations. The committee should develop a financial operating model for each of the regional centers, including assessing additional funding options, through either public grants or industry funding. Additionally, the committee should address how revenues will be shared among the facilities and the member community colleges.

***Manage site selection*** The committee should first determine the requirements for size and location of the facilities, then identify and assess available industrial sites in desired locations. This group should help oversee negotiations as part of the selection process.

***Construct infrastructure*** During this phase, the committee will oversee construction of the facility and equipment installation and coordinate the acquisition and installation of any hardware or software needed to support distance learning.

## **Marketing committee**

***Align with other campaigns on coordination plan*** There are currently many programs and initiatives in the region. The first step will be to align with Dream It, Do It Virginia and other campaigns to coordinate responsibilities. The committee should also work with VCCS to develop a plan to target the career coaches with relevant information on Advanced Manufacturing careers.

***Develop a marketing plan for each target group*** In conjunction with external groups, the committee should first identify the target groups and the specific hurdles that are preventing these groups from entering manufacturing careers. With these target groups in mind, the committee should then create a marketing campaign addressing these specific hurdles and leverage third-party agencies to develop marketing materials as needed.

***Develop plan for internships/apprenticeships*** The committee should meet with employers to assess capacity and interest in internships and apprenticeships. Next, the committee should coordinate with the curriculum committee to develop the classroom portion of instruction and develop a plan for student placement into the internships and apprenticeships. Students should begin to be matched in internships and apprenticeships by the end of 2013.

## **Measurable success metrics**

The final component of the implementation program is a set of metrics to help the Steering Team track and measure progress against project timelines as well as the program objectives. The purpose of measuring these components is to help raise early warning on potential implementation or execution issues. Each team should be regularly reporting on initiative progress and proactively identifying initiatives that may be “off-track” to get Steering Team guidance on resolution and additional resources and support as necessary.

Post-implementation, the Director of Workforce Development should be actively tracking program success to ensure that program objectives are being met and identify any potential issues with execution. A starter list of metrics is below (see Figure 17). We recommend that each of the working teams aid in setting targets and that the initiative leadership design a scorecard for easy communication of program status.

Figure 17: Recommended Success Metrics

Category	Objective	Metric	Target
<b>Awareness/ Program Attraction</b>	Increase enrollment in manufacturing training	<ul style="list-style-type: none"> <li>• CTE dual-enrollment enrollment</li> <li>• Perception survey with high school students and parents</li> <li>• Career coach inquiries in manufacturing careers and associated study plans</li> <li>• Unduplicated enrollment in post-HS manufacturing training relative to demand</li> </ul>	<p><i>Appropriate targets and benchmarks will need to be defined as part of detailed implementation planning</i></p>
<b>Program Delivery</b>	Increase quantity of instruction provided	<ul style="list-style-type: none"> <li>• Total hours of credit instruction provided</li> </ul>	
	Improve and maintain high quality of instruction	<ul style="list-style-type: none"> <li>• Number of credentials acquired</li> <li>• Pass rate on credentials for exiting students</li> <li>• Student satisfaction survey</li> <li>• Employer satisfaction survey</li> </ul>	
	Expand system of apprenticeships/ internships	<ul style="list-style-type: none"> <li>• Number of students in apprenticeships</li> <li>• Number of students in internships</li> <li>• Conversion rate of students in apprenticeship/internships to full time roles with same company</li> </ul>	
<b>Student Success</b>	Improve student outcomes	<ul style="list-style-type: none"> <li>• Graduation and retention rate</li> <li>• Student job placement rate</li> </ul>	
<b>Financial Sustainability</b>	Maintain financial sustainability	<ul style="list-style-type: none"> <li>• Operating income</li> </ul>	Break even on operating margin

## **Conclusion**

The opportunity exists for the Tobacco Region to dramatically transform the economy of the region and build an Advanced Manufacturing hub, and executing this program will be a critical component in building the workforce to support that hub. However, this effort does not end with this report. There is still much work to be done to realize the vision for Advanced Manufacturing.

CCAM and TICRC need to engage stakeholders at all levels to get buy-in for this vision and approach, starting with the Commonwealth and with the VCCS. CCAM can be a champion for this effort, but cannot do it alone—it will need the support and input of many stakeholders. Additionally, while this effort focuses on the needs of the Tobacco Region, attracting companies and building the workforce capabilities is a challenge at the Commonwealth level as well, and ensuring a coordinated effort across the many economic and workforce development groups will be critical to this program's success.

Additionally, while building the training capabilities in the region is a critical step in attracting companies and readying the region for success, if there are no new employers or jobs, these efforts will have been for naught. Workforce development and economic development must go hand-in-hand, and continuing the efforts underway to market the region to employers will ensure that students exiting these training programs will have ample job opportunities ahead of them. CCAM has hired a director of economic development to complement its workforce development efforts.

We believe the foundations for successfully realizing the vision for an Advanced Manufacturing hub in the Tobacco Region are strong. With a more coordinated strategy for workforce development in place, concerted effort focused on economic development, and engagement from a broad set of committed stakeholders, the future for the Tobacco Region looks bright.

## APPENDIX

### Interviewees

#### *Employers*

- Brian Warner, Tom Loehr; Rolls-Royce
- Scott Millar, Rhonda Bunn; Canon Virginia
- Mike Beffel, Peter Howard; Chromalloy
- Meg Meyer; Sulzer Metco
- John Israelsson, Sandvik
- Wanda Blythe, ABB
- Warren Thacker, Goodyear
- Jerry Shiffner, Volvo
- Dave Goadby, co-founder, TMI AutoTech, Inc.

#### *Educators in the Tobacco Region*

- Glenn DuBois, VCCS Chancellor
- Craig Herndon, Vice Chancellor, Workforce Development
- Mark Estep and Staff, Southwest Community College
- Charlie White and Staff, Wytheville Community College
- Angeline Godwin, Patrick Henry Community College
- Scott Hamilton and Staff, Mountain Empire Community College
- Carlyle Ramsey and Staff, Danville Community College
- Ray Drinkwater, Melinda Miller, Melody Moore; John Tyler Community College
- Ron Proffitt and Staff, Virginia Highlands Community College
- William Wampler, Liana Blevins; New College Institute
- Doug Corrigan, Director, Riverstone Energy Center
- Betty Adams, David Knealey, and Staff; Southern Virginia Higher Education Center
- Kevin Farinholt, Project Leader – Manufacturing Systems, CCAM
- Shannon Blevins, Becki Joyce; UVA-Wise
- Dale Moore, Founder, Virginia Technical Institute

#### *Training providers outside the Tobacco Region*

- Joe Reid, VP of Sales and Marketing, Amatrol
- Susan Brackett, TechReady SC
- Carl Peters, Director of Training, Lincoln Electric
- Scott Sheely, Industrial Maintenance Training Center of Pennsylvania
- Jack Lewis and Mark Rowh, New River Community College
- Ruth Hendrick, Central Virginia Community College
- James Groves, PRODUCED in Virginia, University of Virginia

#### *Economic and workforce development officials*

- Barry Johnson, UVA
- Pace Lochte, UVA
- John Provo, Virginia Tech
- Katherine DeRosear, Virginia Manufacturer’s Association
- Hugh Keogh, Virginia Chamber of Commerce
- Rob McClintock, Alan Finch, Liz Povar; Virginia Economic Development Partnership
- Elizabeth Creamer, Department of Education
- Carrie Roth, Department of Commerce and Trade
- Mark Heath, Martinsville and Henry County Economic Development Corporation
- Susan Copeland, Virginia Coalfield Development Authority
- Matt Leonard, Executive Director, Halifax Country Industrial Development Authority

**Community College Details**

**Southwest**

The four colleges that comprise the Southwest region are Mountain Empire Community College, Southwest Virginia Community College, Virginia Highlands Community College, and Wytheville Community College.

**Advanced Manufacturing Program Offerings at Southwest Community Colleges**

Community College	Welding			Industrial Maintenance			Precision Metalworking		
	A.A.S/Diploma	Certificate	CSC	A.A.S/Diploma	Certificate	CSC	A.A.S/Diploma	Certificate	CSC
Mountain Empire Community College		Welding	Welding operator	Computerized manufacturing and electromechanical technology (A.A.S.)	Industrial Maintenance	Machinery Maintenance	Computer manufacturing technology		
Southwest Virginia Community College	Welding (Diploma)	Welding	Welding; Welding pipefitter's assistant	Industrial Maintenance (A.A.S)(Electrical focus)		Industrial Maintenance			Manufacturing Technician
Virginia Highlands Community College			Welding (Washington County Skills Center)			Industrial Maintenance	Machinist (Diploma)	CNC Operations	Machine operator; CNC
Wytheville Community College							Machine Technology		Machine Operator

**Advanced Machining Training Capabilites at Southwest Virginia Community Colleges**

Program	Curriculum		Equipment			Enrollment/ Capacity <sup>1</sup>	Graduation rate
	Number of Manufacturing Degree Options	Number of Machining Courses	CNC 2 axis	3 axis	4/5 axis		
Wytheville	2	17	✓	✓	✓	17/20	>75%
Virginia Highlands	4	22	✓	✓		7/15	50-75%
Mountain Empire	1	7	✓	✓		24/24	50-75%
Southwest Virginia	1	4		✓		20/25	50-75%

Best practice
  Average
  Key gap

In the Southwest region, Wytheville Community College emerges as a best practices example for precision machining. Both Wytheville and Virginia Highlands have a wide breadth of machining courses. For industrial maintenance and welding, both Mountain Empire and Southwest Community Colleges offer the widest range of degree and certificate options in the region. An advantage in the Southwest region, which became clear through our interviews with community colleges administrations, is a high degree of willingness to work together. The administrators in these colleges are aware that given current lower levels of interest in these programs and the high cost of equipment needed to support them, it will not be possible for each college to support a “Best in Class” program independently. This mindset of coordination and collaboration will be valuable in solution implementation.

The greatest challenge currently facing the Southwest region is a lack of access to state-of-the-art equipment. A related challenge of the Southwest region is the lack of large employers compared to Southside Virginia. While Southside has Goodyear and Rolls-Royce, which provide input and resources to the local schools, this is not the case in Southwest. Part of the absence of large manufacturers to the degree seen in Southside can be explained by the geography of Southwest, both in terms of proximity to waterways and the mountainous terrain.

**Southside**

The four community colleges that comprise the Southside region are: John Tyler Community College, Danville Community College, Patrick Henry Community College, and Southside Community College.

**Advanced Manufacturing Program Offerings at Southside Community Colleges**

Community College	Welding			Industrial Maintenance			Precision Metalworking		
	A.A.S/Diploma	Certificate	CSC	A.A.S/Diploma	Certificate	CSC	A.A.S/Diploma	Certificate	CSC
Danville Community College		Welding Technology	Welding	Industrial Maintenance (A.A.S. and Diploma)	Maintenance Mechanics	Factory automation and robotics	Advanced manufacturing Engineering Tech, Polymer Manufacturing Tech, Precision Machining		Advanced manufacturing concepts
John Tyler Community College	Welding (A.A.S)	Welding	Welding	Mechatronic Technician (A.A.S.)		Mechanical Maintenance	Technical studies (precision machining or CNC concentration)	Precision machining technology	Basic Precision Machining, CNC
Patrick Henry Community College		Industrial Welding	Welding			Industrial controls; Industrial Maintenance Electronics			Manufacturing Technician
Southside Virginia Community College			Welding				High Performance Technologies		

**Advanced Machining Training Capabilities at Southwest Virginia Community Colleges**

Program	Curriculum		Equipment			Enrollment/Capacity <sup>1</sup>	Graduation rate
	Number of Manufacturing Degree Options	Number of Machining Courses	CNC 2 axis	3 axis	4/5 axis		
John Tyler	5	12	✓	✓	✓	16/16	>75%
Danville	4	17	✓	✓	✓	49/26 <sup>2</sup>	>75%
Southside Virginia	1	3	✓	✓	✓	22/25	>75%
Patrick Henry	1	0				0	N/A

Best practice
  Average
  Key gap

The Southside region as a whole has more resources and programs committed to Advanced Manufacturing than Southwest by a considerable degree. This higher level of investment is due to a number of factors. The first factor is a greater number of large employers in the region, such as Goodyear and Rolls-Royce, which have been instrumental in supplying the local community colleges with equipment, materials, adjunct faculty, and access to apprenticeships and full-time roles for students. The second factor is the presence of higher education centers in Southside that have or plan to provide access to labs and equipment to community college students. One example is the New College Institute in Martinsville, which is currently working with Patrick Henry Community College to create a partnership to allow Patrick Henry

students to access the manufacturing equipment that will be installed at the New College Institute.

Southside has a number of regional best practice programs in Danville and John Tyler, with a third strong program in Southside Virginia Community College. The challenge for Southside is increasing capacity of these programs to meet the greater workforce needs. One necessity for doing this will be to incorporate Patrick Henry into the network to allow its students access to a state-of-the-art machining program.