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Introduction

As part of its mission, FloridaMakes is working to provide Florida’s regional manufacturers associations (RMAs) with actionable information that will help them support and increase the economic competitiveness of small- and medium-size manufacturers located in their service areas. Small and medium manufacturers are defined as companies having 500 or fewer workers at a single establishment with small manufacturers defined as those firms that have 50 or fewer employees. FloridaMakes has retained IHS to prepare an economic profile of the Mid-Florida economy, with a focus on the characteristics of the manufacturing sector. IHS defines the manufacturing sector as consisting of establishments assigned to North American Industry Classification System (NAICS) codes 31, 32, and 33.

The Mid-Florida region comprises four Florida counties: Citrus, Levy, Marion, and Sumter. The major city in the Mid-Florida regional economy is Ocala, which is within Marion County, a part of the Ocala metropolitan statistical area (MSA). Citrus County is in the Homosassa Springs MSA, Sumter County is in The Villages MSA, and Levy County is in the Northeast Florida nonmetropolitan area.

In the following sections, findings of potential interest to policymakers are presented in **bold**.

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1 While data for this study are presented for the four-county study area, they are available by county upon client request.
Strategic summary

What is the situation today?

- The 2015 population of the Mid-Florida RMA service area was 646,126 people, or 3.2 percent of the state of Florida.

- Since 2011, the average annual unemployment rate in the Mid-Florida region has been 1.6 percentage points higher than the statewide rate.

- The Mid-Florida regional economy is much less diverse than the Florida economy overall. Private, services-providing (PSP) sectors represent more than two-thirds of regional employment, just below the US share of 68.9 percent. Health care and social assistance, retail trade, local government, and accommodation and food services accounted for just more than half of the region’s total employment in 2015.

- Of 22 major sectors in the Mid-Florida region, two-thirds of the region’s sectors are less concentrated, based on employment, than they are in the United States. The utilities and the agriculture, forestry, and fishing sectors contribute more significantly to employment in the regional economy than they do in the overall US economy.

- The manufacturing sector comprises a little more than 10,000 jobs, 5.7 percent of the region’s total employment. The share of the Mid-Florida region’s total 2015 employment in manufacturing is well below the US figure of 8.5 percent, but above the Florida figure of 4.1 percent.

- The transportation equipment, machinery, and nonmetallic mineral manufacturing sectors each offer more than 1,000 manufacturing jobs in the Mid-Florida region, together representing 44 percent of regional manufacturing employment.
• Of the region’s largest manufacturing employers, the majority are in Marion County and have fewer than 500 employees. Only one, the Lockheed Martin Corporation, employs more than 1,000 workers. However, the vast majority of manufacturers in the region (86.6 percent) employ fewer than 50 workers and more than two-thirds have fewer than 10 employees.

What are our advantages?

• Of the region’s five largest manufacturing sectors, three had positive compound annual growth rates (CAGR) in employment between 2000 and 2015: machinery, nonmetallic mineral, and food manufacturing. Some sectors, although smaller, not only increased employment, but also far exceeded the national growth rates: the beverage and tobacco product manufacturing sector more than quadrupled, and miscellaneous manufacturing employment more than tripled.

• Three midsize sectors (in terms of total 2015 employment) experienced more than ten percent CAGRs in output between 2000 and 2015: beverage and tobacco product, miscellaneous, and primary metal manufacturing.

• Manufacturers of nonmetallic minerals, primary metal, food, machinery, and miscellaneous products all exhibited positive employment, output, and productivity growth from 2000 to 2015, with primary metal and miscellaneous manufacturing witnessing productivity increases of more than three percent annually.

• The share of the region’s workforce in durable\(^2\) manufacturing sectors (76.5 percent) is above Florida’s durable manufacturing jobs share of 67.9 percent. Having a higher-than-average share of the manufacturing workforce in durable manufacturing subsectors is a positive thing since these sectors typically pay higher annual wages, require more highly skilled and educated workers, are slightly more labor intensive (i.e., generate more direct jobs per $1 million in additional output), and have higher levels of productivity (measured in output per worker) than the nondurable sectors.

• Almost two-thirds of the Mid-Florida region’s manufacturing industry is composed of high-performing and emerging sectors\(^3\) (which means state and local economic development organizations such as FloridaMakes have a significant opportunity to support sectors with existing strengths).

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\(^2\) Durables, or hard goods, are defined as those that are not totally consumed during their immediate or first use.

\(^3\) See the “Shift-share analysis” section for definitions used to categorize sectors as high performing or emerging, as well as other sector category classifications.
• Mid-Florida had **13 high-performing four-digit North American Industry Classification System (NAICS) manufacturing sectors** that are highly concentrated in the region and performed better than their peers nationally (in terms of employment growth between 2000 and 2015). Those providing more than 400 local jobs in 2015 include manufacturers of:
  - Plastics products
  - Cement and concrete products
  - Other food
  - Glass and glass products
  - Other general-purpose machinery
  - Steel products from purchased steel
  - Household and institutional furniture and kitchen cabinets

• Also providing more than 400 jobs, the **navigational, measuring, electromedical, and control instruments sector**, while not highly concentrated in the Mid-Florida region, is an emerging sector that performed better than its peers nationally in terms of annual employment growth. This sector **experienced a 27.4 percent CAGR between 2000 and 2015**.

• **The abilities of the Mid-Florida labor force are well-suited to fill jobs in agriculture, extraction, certain commodity-based manufacturing, and construction/repair services.**

• For the major occupational categories required by the manufacturing industry\(^4\), **Mid-Florida has national competitive advantage in terms of labor costs**. Someone in these occupational categories in Mid-Florida typically makes between 6.8 percent and 28.2 percent less than their counterparts nationally.

• **Transportation equipment and machinery manufacturing**, the two largest manufacturing sectors in the Mid-Florida region in 2015, both have **IHS composite sector risk ratings that are lower than that of the overall US manufacturing sector**,\(^5\) and only one of the region’s top-ten manufacturing sectors had an IHS composite risk score above the US manufacturing industry average.

**Where should we be concerned?**

• Most of Mid-Florida’s manufacturing subsectors experienced job reductions in the past 15 years. A few of the most significant include:
  - Transportation equipment, the region’s largest manufacturing sector, more than halved its workforce size to an employment of just under 1,900 in 2015.
  - Plastics and rubber products manufacturing had a decline of more than 480 jobs.
  - Fabricated metal products witnessed a workforce reduction of almost 80 percent, from nearly 3,400 jobs to under 700.
  - Wood product manufacturing decreased almost three-fifths to 584 workers in 2015.
  - Furniture and related products lost more than 200 jobs in the 15-year period.
  - By 2015, chemical manufacturing was left with just under two-thirds of its 2000 employment.
  - Support activities—printing more than halved, losing more than 100 jobs.
  - With just over 80 workers in 2000, paper manufacturing experienced a rate of decline of 3.1 percent annually.
  - Although small to start, electrical equipment and appliance manufacturing declined more than 94 percent, leaving only 3 people in the sector in 2015.

• Given the relatively small size of the Mid-Florida economy, the manufacturing industry’s relatively large role in the regional economy (it is the sixth-largest sector), and the weaker-than-average labor market, additional losses of manufacturing jobs may not only have significant effects on the regional economy but also mean workers who lose their jobs may have a difficult time finding new ones.

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\(^4\) See “Wages in manufacturing occupations” section for more detail.

\(^5\) See definition in “Risk rating by industry sector” section.
• The Mid-Florida region has just **over two-fifths of its manufacturing industry employment in advanced manufacturing** sectors. Below the US and Florida shares of 46.8 percent and 49.7 percent, respectively, this lower-than-average figure indicates **lost opportunities for innovation, productivity, and higher-paid, higher-skilled manufacturing jobs.**

**Where should we focus our efforts?**

• Given the large percentage of high-performing and growth sectors, local economic development programs and policies can be designed to capitalize on these sectors’ existing strengths or minimize growth barriers. **Economic development practitioners might begin by identifying the names of individual firms in the high-performing and emerging sectors to determine why they are high performers,** i.e., the extent to which their recent above-average performance was due to firm-level factors (such as excellent management, efficient operations, competitive prices, superior product quality, etc.) or regional competitive advantages (such as lower costs of doing business; high quality of labor; proximity to markets, suppliers, or both; lower tax rates; excellent transportation networks; favorable regulatory environment; etc.).

• Workforce training organizations and educational institutions can benefit from **identifying the skills required by high-performing and emerging manufacturing sectors and develop programs or talent recruitment strategies to meet the industry’s current and future needs for skilled workers.**

• To increase per capita incomes, Mid-Florida should **encourage growth and worker training in manufacturing subsectors that pay above-average wages such as advanced and durable manufacturing** (i.e., basic chemicals or metalworking machinery). However, if increasing the number of manufacturing jobs in the region, rather than the quality of those jobs is the goal, **attracting manufacturing employers whose national competitive advantage is derived from being a low-cost producer may be an effective strategy.**

• Given the size of the majority of the Mid-Florida region’s manufacturers, sector development strategies should **focus on adopting best practices that are relevant for small or very small manufacturing enterprises.**

• **Explore what is driving the higher-than-average “supply” and “growth” risks respectively threatening the transport equipment and the machinery, equipment, and appliances manufacturing sectors** to determine if there is a role local policymakers or economic development practitioners can play in mitigating these risks, as these sectors alone represent almost one-third of regional manufacturing employment.

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6 See definition in “Advanced manufacturing” section.
Characteristics of the regional economy

Population
IHS estimates the 2015 population in the Mid-Florida region was 646,126 people, or 3.2 percent of the state of Florida. The population density was 146 persons per square mile, two-fifths of the Florida density of 369.5 persons per square mile.

Unemployment rate
In April 2016, the region’s unemployment rate (not seasonally adjusted and based on workers’ place of residence rather than on workplace location), was 5.7 percent, a full percentage point above both the US and Florida rates of 4.7 percent and 4.5 percent, respectively, that month. The April 2016 unemployment rate was 0.8 percentage point lower than in April 2015.

Since 2011, the average annual unemployment rate in the Mid-Florida region has been 1.6 percentage points higher than the statewide rate. The national unemployment rate in 2011, at 8.9 percent, was 3.3 percentage points lower than in the region. In 2012 and 2013, the gap narrowed, but the region’s unemployment rate has stayed 1.4 percentage points above the national level from 2013 to 2015.

Labor force
In April 2016, Mid-Florida’s total labor force was 222,675 people, a 0.6 percent decrease from April 2015. In the Mid-Florida region, 1,832 fewer people were unemployed in April 2016 than the year before, while the employment level increased by more than 500 workers. The combination of unemployed workers leaving the labor force and the modest increase in employment caused the regional unemployment rate to fall. By contrast, the labor forces in Florida and the United States rose during the same period by 0.6 percent and 1.2 percent, respectively.

The key finding from the labor force analysis is that, while unemployment levels are dropping, the Mid-Florida region’s labor market is still weaker than in the state or country overall. The weak labor market means workers who lose their jobs may have a difficult time finding new ones, but it also presents an opportunity for manufacturing companies with workforce shortages to find skilled workers. The soft labor market also suggests little upward pressure on wage levels.

Economic structure
Employment by major economic sector, according to two-digit NAICS codes, is presented in the accompanying table in descending order by number of jobs.

IHS estimates there were 10,007 jobs in 2015 in the Mid-Florida region’s manufacturing sector (NAICS codes 31–33). The share of the Mid-Florida region’s total 2015 employment in manufacturing is 5.7 percent, well below the US figure of 8.5 percent, but above the Florida figure of 4.1 percent.

The below-average share of 2015 manufacturing employment is reflected by the low employment location quotient (LQ) of 0.67.
Of 22 major sectors in the Mid-Florida region, eight had employment location quotients (LQs) greater than or equal to one, and 14 had employment LQs less than one, meaning that almost two-thirds of the region’s sectors are less concentrated than they are in the United States, while just over one-third are more concentrated. With a LQ of 2.42, the agriculture, forestry, and fishing sector (NAICS 11) is especially highly concentrated, followed closely by the utilities (NAICS 22) and construction (NAICS 23) sectors at 2.22 and 1.77, respectively.

Because of its historical role as a center of tourism, transportation, and business and health services, Florida has an above-average concentration of its total employment in the private, services-providing (PSP) sectors. However, while PSP sectors still account for more than two-thirds of jobs in the region, their share (66.5 percent) is much less than in Florida overall (where PSP sectors represent 75.9 percent of employment in 2015) and is lower than the US share of 68.9 percent. Among goods-producing sectors (e.g., agriculture, mining, construction, and manufacturing), the manufacturing sector is second only to construction, in terms of its share of regional employment.

### Structure diversity

To evaluate the diversity of the Mid-Florida region’s industrial structure, IHS calculated the Hachman Index, which compares a regional economy's distribution of economic activity by sector (in this case, employment) to that of the US economy. With the Hachman Index, the maximum value is 1.00, or, in other words, the closer the region’s Hachman Index value is to 1.00, the more similar that region’s economic structure is to the US economy. For the Mid-Florida region, the Hachman Index was 0.834, indicating the region’s economy is much less diverse than the Florida economy overall, which has a Hachman Index of 0.941. Since regional economies, especially smaller ones, are usually less diverse than larger state economies or the United States overall, this disparity is to be expected. Given the small size of the Mid-Florida economy—its total employment in 2015 was eighth-lowest among the nine RMAs—its relatively high level of structure diversity is somewhat surprising.

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7. The private, services-providing (PSP) sector consists of the following major sectors: trade, transportation, and utilities; information; financial activities; professional and business services; education and health care; leisure and hospitality; and other services. The PSP sector excludes employment in the private, goods-producing sectors—agriculture; natural resources and mining; construction; manufacturing; and government.

8. Calculate two-digit LQs by NAICS sector weighted by employment shares, and then invert the result.
To provide a more accurate picture of the Mid-Florida region’s overall manufacturing industry, the following sections provide data on manufacturing subsectors’ growth, structure, diversity, and risk ratings. We conclude with a shift-share analysis to get a more detailed perspective on regional manufacturing sector performance in 2015.

Industry growth

As shown in the table on employment growth rates in the manufacturing sector, between 2000 and 2015 employment declined in 13 of the 20 three-digit manufacturing subsectors, leaving the region with no leather and allied products manufacturing. Approximately 5,500 jobs were lost in the fabricated metals, transportation equipment, and wood product subsectors. In ten of the three-digit subsectors, the annual rate of decline in employment was greater than that for the US manufacturing sector overall of -2.3 percent.

Although most of the Mid-Florida subsectors experienced job reductions in the past 15 years, there were some that not only increased employment, but also far exceeded the national growth rates: the beverage and tobacco product manufacturing sector more than quadrupled and miscellaneous manufacturing employment more than tripled. The largest increases in employment were in the nonmetallic minerals and machinery subsectors.

Mid-Florida’s compound annual growth rate (CAGR) for employment in manufacturing was a decline of 2.4 percent, the same as in Florida and just above the US rate of decline, 2.3 percent. The transportation equipment, machinery, and nonmetallic mineral manufacturing sectors each employ more than 1,000 people and make up 44 percent of manufacturing sector employment in the region.

Durables and nondurables

Additional insight into a region’s manufacturing sector can be obtained by analyzing the durable and nondurable sectors. Durables, or hard goods, are defined as those that are not totally consumed during their immediate or first use (i.e., used over an extended period of time, usually with a useful life of at least three years, and thus do not have to be purchased often). By contrast, nondurables, or soft or consumable goods, are immediately and totally consumed when initially used, have a useful life of less than three years, and need to be purchased frequently. The following charts present the employment trends in the Mid-Florida region for the individual three-digit NAICS code manufacturing subsectors that make up the durable and nondurable sectors. Each chart presents the CAGR in employment between 2000 and 2015 on the x axis, the 2015 employment LQ on the y axis, and the size of each bubble presents that sector’s total employment in 2015. Each chart provides a visual representation of the performance of the individual subsectors and the structure of the manufacturing economy. Approximately 76.5 percent and 23.5 percent of the Mid-Florida region’s manufacturing employment in 2015 was in the durable and nondurable sectors, respectively, with the Mid-
Florida region’s durable manufacturing sector constituting a greater share of manufacturing jobs than in Florida overall, where durable manufacturing accounted for 67.9 percent of manufacturing employment.

Because of differences in the goods made and the production processes used, the durable and nondurable manufacturing sectors also differ from each other in terms of the mix of skilled workers required, level of wages paid, and productivity, all of which will determine appropriate economic and workforce development strategies. IHS analyzed detailed occupational employment and wage data for 2015 by four-digit manufacturing subsector for the United States, identifying the following differences between the durable and nondurable sectors:

• **Durable sectors require higher shares of skilled workers.** About 19.4 percent of the jobs, by detailed occupation, required a Bachelor’s degree or higher to obtain an entry-level position, compared with only 12.4 percent in the nondurable sectors. Similarly, 26.0 percent of durable jobs required some type of postsecondary education, compared with only 18.8 percent for the nondurable sector. By contrast, 58.0 percent of durable sector jobs required a high school diploma or equivalent for an entry-level position, compared with 60.9 percent for the nondurables. Interestingly, 1.1 percent of the nondurable jobs require an advanced degree for an entry-level position, compared with only 0.5 percent in the durable sectors, because of the high share of STEM occupations required by the chemicals sector, especially in pharmaceuticals because of its high level of research and development spending.

• **Durable jobs pay higher annual wages.** The average annual US wage in the durable sectors in 2015, based on a detailed analysis of occupations required, was $49,387 compared with $44,194 in the nondurable sectors.

• **Durable sectors are slightly more labor intensive,** creating 2.7 direct jobs per $1 million in output compared with 1.6 in the nondurable sectors; the latter figure is low because of the high level of output per employee in the petroleum refining and chemical manufacturing subsectors; if they are excluded, the nondurable figure rises to 2.5 jobs per $1 million in output.
• Nondurable sectors have higher shares of their employment in traditional “blue-collar” occupations and lower shares in STEM occupations. The nondurables had 63.3 percent of their total employment in production, transportation, and material handling occupations in 2015 compared with only 57.4 percent for the durables. By contrast, durable sectors had 12.2 percent of their total employment in three high-skill, high-education STEM occupations: architecture and engineering; computer and math; and life, physical, and social sciences—well above the 5.2 percent share for the nondurables.

• The difference between the durable and nondurable sectors indicates that expanding the durable sector will require greater efforts to develop the supply of highly skilled workers in the local labor force. However, the generally lower entry-level education and training requirements for the nondurables, excluding chemicals, indicate these sectors have a greater potential to employ less-skilled workers, thus providing more opportunities for them to begin careers. The first chart, durable manufacturing sector trends, shows the composition and performance of Mid-Florida’s durable sector between 2000 and 2015. Note the large number of jobs, high concentration of employment, and positive employment growth rate of the nonmetallic minerals manufacturing sector as well as the high employment and positive CAGR of the machinery manufacturing sector. The second chart presents the composition and performance of the nondurable sectors. Although it employs just over 250 people and is less concentrated in Mid-Florida than in the country overall, the high annual growth rate of the beverage and tobacco manufacturing sector is notable.

If one of the objectives of a region’s economic development plan is to increase employment in the traditional, “blue-collar” manufacturing occupations, then expansion of the nondurable sectors should be promoted, especially outside petroleum refining, plastics and rubber, and chemicals. By contrast, if the economic development objective is to attract higher-paying jobs in the STEM occupations that are often associated with nonproduction facilities such as research and development (R&D) centers, then policies and programs should be directed at the durable sectors. In adopting the latter strategy, complementary STEM programs to increase skills of the workforce will also have to be implemented.
Output and productivity

In addition to employment, it is helpful to consider output by sector and productivity (output per worker), to get a better sense of an individual manufacturing subsector’s contribution to a regional economy. For example, a capital-intensive (i.e., high levels and values of structures and equipment per worker) sector such as petroleum refining, chemicals, or primary metals may not employ a lot of workers (i.e., have high levels of output per worker), but could generate substantial increases in regional economic activity through either their backward linkages (i.e., they purchase large amounts of inputs from suppliers located in the region) or through their forward linkages (i.e., the products they make are in turn purchased by other firms in the region who use them as inputs in making other types of goods or services). In other words, when evaluating the manufacturing sector’s regional economic health, it is important to note that, based on changes in productivity, employment growth rates may differ significantly from output growth rates. For example, in the Mid-Florida region, 14 sectors had a positive CAGR for output, but only six had a positive CAGR for employment.

Of the 14 manufacturing sectors with positive growth in output during 2000–15, all also demonstrated growth in productivity (inflation-adjusted output per worker), with computer and electronic product and transportation equipment manufacturing leading the pack with productivity growth rates exceeding 4 percent annually. Among those with positive growth across all three areas (employment, output, and productivity) were manufacturers of nonmetallic minerals, primary metal, food, machinery, and miscellaneous products, with primary metal and miscellaneous manufacturing witnessing productivity increases of more than three percent annually.

Interestingly, beverage and tobacco product manufacturing, despite ranking first for output and employment growth, only increased productivity 0.9 percent in the 15-year period, the fifth-lowest CAGR in the Mid-Florida region (excluding textile mills, which have had no presence in the region in the past 15 years, and thus a CAGR of zero percent). Extending this report’s durable and nondurable analysis, output per worker in the durable manufacturing sector in the United States in 2015 was $375,043 compared with $619,325 in the nondurable sector. The nondurable sector’s level is greater because of the high level of productivity in the petroleum refining and chemical sectors. As in the United States, the 3.5 percent growth rate of productivity in Mid-Florida’s manufacturing sector was far greater than the 0.7 percent rate for the entire economy; the downside of this rapid increase is that it constrains employment growth as manufacturing firms can continue to increase output annually even while eliminating jobs.
The output-per-worker figures presented in the table on productivity growth rates in the manufacturing sector also show the direct increases in manufacturing employment that an increase in output would generate. For example, a sector such as petroleum and coal manufacturing with $947,861 of output per worker will produce just over 1 direct job per each additional $1 million in output, while computer and electronics will produce 3.6 direct jobs per $1 million of new output.

If one economic development strategy is to maximize the direct increase in manufacturing employment, organizations should focus on those sectors with the lowest levels of worker productivity. However, there is an important caveat to this strategy: not all manufacturing jobs are equal; they differ widely based on their annual wage levels. Economic development agencies must consider the prevailing annual wage levels in the manufacturing subsectors they want to promote, which are a function of the types of occupations required, which in turn are determined by the types of manufacturing activities performed.

Whereas an additional $1 million in new output in the furniture and related products sector will create substantially more direct jobs than the same increase in primary metal manufacturing, the new jobs in the latter sector are likely to pay substantially more.

Establishment size

In addition to evaluating the Mid-Florida manufacturing sectors’ growth in the last 15 years, IHS assessed regional structure in terms of distribution of manufacturing establishments by employment size. In the Mid-Florida region four-county study area, the vast majority of manufacturers (86.6 percent, or 291 establishments) employ fewer than 50 workers; the other 13.4 percent (45 establishments) engage 50–499 employees, and there are no manufacturing firms with 500 employees or more. Of the 336 manufacturing establishments in the region, more than two-thirds are “very small” employers (having fewer than 10 employees each).

The significance of the distribution of manufacturing establishments by employment size is that different types of strategies and accompanying services are required for small firms than for large ones. Small and medium manufacturing enterprises (SMEs), usually defined as those with fewer than 500 employees, are more vulnerable to changes in the business cycle, fluctuations in interest and currency rates, regulatory changes, may have more difficulty in accessing capital, and be less able to provide worker training. The RMA needs to be able to offer a broader range of services and support to SMEs than to larger manufacturing firms. We note the proportion of total establishments accounted for by SMEs varies widely by subsector based on production processes used, barriers to
entry, need to achieve economies of scale, capital intensity, etc. Some subsectors, such as fabricated metals, machinery, and printing, have traditionally had higher shares of SMEs, whereas others such as petroleum refining and chemicals have low shares.

### Structure diversity

To evaluate the diversity of the region’s manufacturing sector, we again used the Hachman Index\(^9\) based on four-digit NAICS employment, with LQs based on employment in the manufacturing sectors, not total employment. For the four counties included in the Mid-Florida region, the Hachman Index of 0.282 shows the region’s manufacturing sector diversity is significantly lower than the manufacturing diversity of the state of Florida, which has a Hachman Index of 0.701. Mid-Florida had the seventh-lowest Hachman Index among the nine RMAs.

### Advanced manufacturing

With 4,319 people employed in the advanced manufacturing sectors, as defined either by researchers from the US Bureau of Labor Statistics (BLS) or the Brookings Institution\(^10\) think tank, the Mid-Florida region has just over two-

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\(^9\) See Footnote 8 regarding the Hachman Index calculation.

fifths of its manufacturing industry employment in advanced manufacturing. This share is below the US share of 46.8 percent and the statewide share of 49.7 percent. It is in these sectors we should expect the greatest innovation to occur (i.e., have higher patent rates), and they have higher growth rates in productivity, require more highly skilled workers, and pay higher wages than other manufacturing sectors. Almost 70 percent of Mid-Florida’s employment in advanced manufacturing is in five subsectors: motor vehicle bodies (3362); ship and boat (3366); electronic instruments (3345); other machinery (3339); and agricultural machinery (3331).

The criteria applied in the two studies we used to identify advanced manufacturing:

- High levels of spending for R&D, including high intensity (i.e., above-average shares of R&D spending as a percentage of sales) and high levels per worker.

- The share of employment in the STEM occupations.

The BLS study also considered industries that use advanced manufacturing processes and that produced high-technology goods. The Brookings and BLS studies identified advanced and high-tech NAICS sectors at the four-digit level across the entire economy; for the purposes of this profile, we considered only the individual sectors that were part of the manufacturing sector.

Similar to the discussion for the durable and nondurable sectors, there are also differences between the advanced manufacturing subsectors and the entire manufacturing sector. Our analysis of detailed occupational employment and wage data for 2015 by four-digit manufacturing subsector for the United States found the following differences:

- **Advanced sectors require higher shares of skilled workers**: About 24.9 percent of the jobs required a Bachelor’s degree or higher to obtain an entry-level position, compared with only 16.9 percent for the entire manufacturing sector. Similarly, 32.7 percent of advanced manufacturing jobs required some type of post-secondary education, compared with only 23.5 percent for all of manufacturing. In contrast, 53.9 percent of advanced sector jobs required a high school diploma or equivalent for an entry-level position, compared with 59.2 percent for total manufacturing.

- **Advanced manufacturing jobs pay higher annual wages**: The average annual US wage in advanced manufacturing sectors in 2015, based on a detailed analysis of occupations required, was $52,635 compared with $47,505 across the entire manufacturing sector.

- **Advanced manufacturing requires fewer workers in traditional blue-collar occupations and more in STEM occupations**: Advanced manufacturing had 50.8 percent of its total employment in production, transportation, and material handling occupations in 2015 compared with 59.5 percent for the entire manufacturing sector. Similarly, 16.9 percent of advanced manufacturing employment was in three high-skill, high-education occupations: architecture and engineering; computer and math; and life, physical, and social sciences versus 9.7 percent in all of manufacturing.

- **Productivity in advanced manufacturing is high**. In 2015 output per worker in the US advanced manufacturing sector was $422,751 compared with $325,000 for all of manufacturing.
Risk rating by industry sector

IHS World Industry Service Sector Risk Ratings for each manufacturing sector in the United States use a proprietary methodology that calculates 40 individual risk factors for industrial sectors for most major industrialized countries including the United States. We consider the following major types of risk faced by firms in industrial sectors:

- **Composite sector risk:** A weighted average of 40 different risk components distributed among five major risk categories; 1) growth, 2) price and profitability, 3) supply, 4) industry structure, and 5) economic and commerce risk.

- **Growth risk:** Evaluates, for real revenue and nominal sales, the rate and volatility of growth in the sector and detects the presence of turning points and shifts in sales patterns.

- **Profitability and pricing risk:** Evaluates the sector's ability to pass on cost increases, its historical and forecast profits, and cash-flow growth and volatility, as well as operating efficiency.

- **Supply risk:** Evaluates risk accruing to capital usage, depreciation, and changes in productive capacity.

- **Industry-structure risk:** Evaluates the sector's exposure that results from competitive and structural characteristics (These include factors such as barriers to entry and exit.)

- **Economic and commerce risk:** Evaluates the size of the cycle in the sector and sensitivity of output demand to interest rates and incorporates the specific macroeconomic risks related to currency, legal, financial, and tax initiatives.

The IHS risk ratings provide a broad perspective on the current and future risks in the industry sectors that state and local economic development organizations may consider assisting in terms of strategy development, technical assistance, workforce development, or the provision of economic development incentives such as loans, grants, and tax credits or deductions. The risk ratings are presented for International Standard Industrial Classification (ISIC) codes, which correspond closely with three-digit NAICS codes, and risk scores range between one (least risk) and ten (highest risk). In our April 2016 release, the minimum (e.g., low risk) and maximum (e.g., high risk) composite risk scores for the US manufacturing sectors were 5.0 and 8.1, compared with 6.9 for the entire manufacturing sector. The ranges of scores in the five subcategories are wider than for the composite risk, especially for the growth, profitability and pricing, and supply risk categories. The accompanying table presents the IHS industry risk ratings for the US manufacturing sector from April 2016, listed in ascending order of composite risk (i.e., low scores indicate lower levels of risk, and vice versa).

**IHS industry risk scores can assist state and local agencies in devising economic development strategies targeted at individual manufacturing subsectors.** The appropriate way to use the industry risk rating is to first identify a specific subsector of interest in the table, then read across its row to identify the different types and levels of risks the sector is facing. Informed policies can be developed then based on the potential risks. As some of the risks faced by an individual sector, such as pricing and profitability or industry structure, may not be able to be reduced through state or regional policies, economic development practitioners need to consider the risk factors facing an industry and their ability to lessen those risks when developing strategies for, or allocating scarce resources to, individual manufacturing sectors or companies.
The subsectors with the highest 2015 employment in the Mid-Florida region were transportation equipment (NAICS 336, or ISIC code D35 in the accompanying table on industry risk ratings) and machinery manufacturing (NAICS 333 or D29), which had composite risk scores of 6.1 and 6.3, respectively, both below the overall US manufacturing sector’s risk score of 6.9. The most significant source of risk for the transport equipment manufacturing sector is supply risk (in which this sector’s risk score exceeds the average for the manufacturing industry as a whole), and the machinery, equipment, and appliances manufacturing sector’s greatest risk is in the growth category. Also of interest to economic and workforce development practitioners may be that only one of the region’s top-ten manufacturing sectors, computer and electronic product manufacturing (which employs more than 400 people in the Mid-Florida region), had an IHS World Industry Service composite risk score above the US manufacturing industry average: across the United States, this sector has the highest composite risk score for manufacturing subsectors.

The subsectors with the highest 2015 employment in the Mid-Florida region were transportation equipment (NAICS 336, or ISIC code D35 in the accompanying table on industry risk ratings) and machinery manufacturing (NAICS 333 or D29), which had composite risk scores of 6.1 and 6.3, respectively, both below the overall US manufacturing sector’s risk score of 6.9. The most significant source of risk for the transport equipment manufacturing sector is supply risk (in which this sector’s risk score exceeds the average for the manufacturing industry as a whole), and the machinery, equipment, and appliances manufacturing sector’s greatest risk is in the growth category. Also of interest to economic and workforce development practitioners may be that only one of the region’s top-ten manufacturing sectors, computer and electronic product manufacturing (which employs more than 400 people in the Mid-Florida region), had an IHS World Industry Service composite risk score above the US manufacturing industry average: across the United States, this sector has the highest composite risk score for manufacturing subsectors.

<table>
<thead>
<tr>
<th>ISIC code</th>
<th>Composite sector</th>
<th>Growth</th>
<th>Profitability and pricing</th>
<th>Supply</th>
<th>Industry structure</th>
<th>Economic and commerce</th>
</tr>
</thead>
<tbody>
<tr>
<td>(D15) Food and beverages</td>
<td>5.0</td>
<td>6.2</td>
<td>6.4</td>
<td>56</td>
<td>2.7</td>
<td>2.0</td>
</tr>
<tr>
<td>(D19) Leather footwear</td>
<td>5.8</td>
<td>8.0</td>
<td>7.5</td>
<td>71</td>
<td>1.7</td>
<td>2.0</td>
</tr>
<tr>
<td>(D31) Electrical machinery</td>
<td>5.8</td>
<td>8.2</td>
<td>5.8</td>
<td>67</td>
<td>3.3</td>
<td>3.5</td>
</tr>
<tr>
<td>(D20) Wood products (exclude furniture)</td>
<td>6.1</td>
<td>7.5</td>
<td>8.3</td>
<td>58</td>
<td>3.0</td>
<td>3.7</td>
</tr>
<tr>
<td>(D23) Refined petroleum, coke, and nuclear</td>
<td>6.1</td>
<td>8.2</td>
<td>6.8</td>
<td>56</td>
<td>4.7</td>
<td>2.0</td>
</tr>
<tr>
<td>(D34) Motor vehicles, trailers, and parts</td>
<td>6.1</td>
<td>8.0</td>
<td>6.7</td>
<td>66</td>
<td>4.0</td>
<td>3.5</td>
</tr>
<tr>
<td>(D35) Transport equipment (excluding motor vehicles)</td>
<td>6.1</td>
<td>6.8</td>
<td>7.0</td>
<td>74</td>
<td>4.7</td>
<td>3.5</td>
</tr>
<tr>
<td>(D16) Tobacco products</td>
<td>6.2</td>
<td>9.5</td>
<td>7.7</td>
<td>51</td>
<td>2.7</td>
<td>2.0</td>
</tr>
<tr>
<td>(D10) Wearing apparel</td>
<td>6.2</td>
<td>6.5</td>
<td>7.7</td>
<td>66</td>
<td>2.0</td>
<td>4.2</td>
</tr>
<tr>
<td>(D33) Medical, precision, and optical</td>
<td>6.2</td>
<td>5.3</td>
<td>7.7</td>
<td>64</td>
<td>8.0</td>
<td>2.5</td>
</tr>
<tr>
<td>(D29) Machinery, equipment, appliances</td>
<td>6.3</td>
<td>7.6</td>
<td>6.9</td>
<td>67</td>
<td>5.0</td>
<td>3.5</td>
</tr>
<tr>
<td>(D25) Rubber and plastics products</td>
<td>6.5</td>
<td>8.0</td>
<td>8.8</td>
<td>69</td>
<td>3.7</td>
<td>2.5</td>
</tr>
<tr>
<td>(D26) Mineral-based products (nonmetallic)</td>
<td>6.6</td>
<td>7.7</td>
<td>8.3</td>
<td>64</td>
<td>5.0</td>
<td>3.5</td>
</tr>
<tr>
<td>(D27) Basic metals</td>
<td>6.6</td>
<td>8.2</td>
<td>8.1</td>
<td>69</td>
<td>5.0</td>
<td>2.0</td>
</tr>
<tr>
<td>(D28) Fabricated metal products</td>
<td>6.6</td>
<td>8.6</td>
<td>8.9</td>
<td>51</td>
<td>3.7</td>
<td>3.5</td>
</tr>
</tbody>
</table>

Manufacturing 6.9 8.2 7.6 6.7 6.3 3.5

Note: The sectors are ranked from lowest risk to highest based on the composite sector risk rating.

Shift-share analysis

Finally, to examine the performance of the four-digit manufacturing subsectors based on changes in employment between 2000 and 2015 in the Mid-Florida region, IHS conducted a shift-share analysis.\textsuperscript{11}

Shift-share analysis is an analytical technique used to decompose changes in a variable, such as employment or income, which occurred in a regional economy during a historical period. It compares the performance of an individual economic sector over time within the regional economy of interest to that same sector’s performance in a larger reference economy, usually the United States, in the same time period. Shift-share analysis is based on the theory that an individual sector’s performance in a regional economy over time is due to four effects:

- **National**: The share of growth in the larger reference economy that was captured by the region.
- **Industry mix**: The shares of high-growth and low-growth sectors in the region and how they changed over time.
- **Competitive**: The extent to which an individual economic sector in the region outperformed or underperformed the same sector at the level of the reference economy over the analysis period (the United States is the reference economy for the shift-share analysis presented in this profile).
- **Allocation**: The extent to which a region has above-average shares of economic activity in those sectors where it has a competitive advantage.

Stated another way, shift-share analysis enables an analyst to determine how much of the change in a variable, such as employment, in an individual economic sector over time was due to growth in the US economy and how much was attributable to characteristics of the regional economy, such as competitive advantages or disadvantages, and the distribution of economic activity into competitive and noncompetitive sectors.

Employment is the variable most often used in a shift-share analysis because it is the most widely available, the most current, and is published at the detailed NAICS level. For this study, using employment data at the four-digit NAICS code level (86 manufacturing subsectors) from the IHS Business Market Insights database; we classify each sector that has more than 50 employees into one of four types based on its performance.

- **Type A (“High Performing”)**: The sector’s 2015 employment LQ is greater than 1.0, and its employment CAGR during the analysis period was greater than the sector’s employment CAGR for the United States in the same period.
- **Type B (“Emerging”)**: The sector’s 2015 LQ is less than 1.0, but its employment CAGR was greater than the sector’s employment CAGR for the United States during the same period.
- **Type C (“Legacy”)**: The sector’s 2015 LQ is greater than 1.0, but its employment CAGR was less than the sector’s employment CAGR for the United States in the same period.

\textsuperscript{11} See Appendix A for full results of shift-share analysis.
Type D ("Laggard"): The sector’s 2015 LQ is less than 1.0 and its employment CAGR during the analysis period was less than the sector’s employment CAGR for the United States during the same period.

In the Mid-Florida region, there were 13 high-performing manufacturing sectors classified as A that outperformed the United States and represented an above-average share of the region’s economy (i.e., had employment LQs above 1.0). A few of these that also had exceptionally high employment growth rates in the past 15 years include:

- Glass and glass product manufacturing (30.2 percent CAGR)
- Pesticide, fertilizer, and other agricultural chemical manufacturing (12.0 percent CAGR)
- Beverage manufacturing (10.9 percent CAGR)
- Other food manufacturing (5.5 percent CAGR)

The 13 high-performing sectors currently account for 47.6 percent of total manufacturing employment in the Mid-Florida region. Meanwhile, the region has 18 emerging or growth sectors, classified as B sectors, which are doing relatively well in terms of employment growth, but do not yet account for a large share of regional economic activity. Combined, the A and B sectors represent 64.7 percent of regional manufacturing employment, meaning state and local economic development organizations such as FloridaMakes have a significant opportunity to support sectors with existing strengths in the Mid-Florida region by researching these companies’ competitiveness drivers and designing programs or policies that capitalize on existing strengths and minimize growth barriers. A few of the notable B sectors providing more than 100 jobs in the region include:

- Navigational, measuring, electromedical, and control instruments manufacturing
- Medical equipment and supplies manufacturing
- Other miscellaneous manufacturing
- Machine shops; turned product; and screw, nut, and bolt manufacturing
- Engine, turbine, and power transmission equipment manufacturing

For the traditionally important legacy industries in which the region still has above-average shares of economic activity, but, for a variety of reasons, the industries are underperforming their peers at the US level (the C sectors), we note five:

- Motor vehicle body and trailer manufacturing
- Architectural and structural metals manufacturing
- Ship and boat building
- Other wood product manufacturing
- Sawmills and wood preservation

Since these five sectors currently provide 2,778 jobs in manufacturing (27.8 percent of the region’s employment) but had lower-than-average employment growth in recent years, to maintain jobs in the region, FloridaMakes and other agencies should consider ways they can help these sectors improve their performance. Finally, we find 12 D sectors that are the lowest-performing in terms of relative importance to the regional economy (as compared with the nation as a whole) and with slower growth than the sector had at the US level in the analysis period. Given these sectors only
represent just over seven percent of the region’s employment, resources would be better spent supporting the A, B, and C sectors described in this analysis.

The results of the shift-share analysis can be used for developing strategies in the following manner:

- **Analyze the economic sectors classified as either A or B, as they are the highest performers, to identify the competitive advantages in the region that drive their performance. The B sectors should receive special attention because, while they currently account for below-average shares of economic activity, this is where growth opportunities are likely to be found.** The economic development objective is to turn B sectors into A sectors.

- **Identify the names of individual firms in each A and B sector and analyze them to determine why they are high performers.** It is essential to determine the extent to which their high performances are due to:
  1. Firm-level factors such as excellent management, efficient operations, competitive prices, superior product quality, etc.
  2. Regional competitive advantages such as lower cost of doing business; high quality of labor; proximity to markets, suppliers, or both; lower tax rates; excellent transportation networks; favorable regulatory environment; etc.

- **Analyze the C sectors and identify the factors that affect their competitiveness;** they constitute traditional centers of manufacturing activity so helping them remain profitable also maintains manufacturing employment.

- **Identify clusters of subsectors with similar needs** that also interact with each other through buying and selling relationships.

- **Identify those regional competitive advantages** that apply across all the manufacturing subsectors and those that are uniquely important to a few specialized subsectors.

- **Identify those regional competitive advantages where local actions can make a difference** (i.e., increasing the supply of skilled workers needed by the advanced manufacturing sectors).

- **Begin to develop strategies and programs** that maintain and enhance regional competitive advantage in the targeted sectors.

Based on our experience in other studies, it is always valuable to have economic development professionals with detailed knowledge of the regional economy review the list of the subsectors assigned to each of the four shift-share types. Ideally, the distribution of subsectors by type should generally confirm their understanding of the region’s economic composition (i.e., the subsectors they expect to be classified as A or B sectors actually appear there).
Wages in manufacturing occupations

IHS estimated total annual wage payments for an individual company in selected manufacturing sectors using the US distribution of detailed occupational employment by four-digit NAICS code. Our analysis used 2015 annual wage rates, as published by the BLS, for The Villages, Homosassa Springs, and Ocala MSAs and the Northeast Florida nonmetropolitan area, because they are representative of labor market conditions in the Mid-Florida region. The purpose of the analysis was to compare the total annual wage cost for a manufacturing company located in the Mid-Florida region to the cost if it paid average annual US wages for the same occupational mix, keeping total employment the same.

A review of the major occupational categories involved in Florida’s manufacturing sector statewide shows 57.8 percent of all production workers in Florida are employed in the manufacturing sector, followed by 23.3 percent of all architects and engineers. As such, these are two of the most significant categories for evaluating manufacturing occupation wages in the Mid-Florida region. As shown by the table on manufacturing employment and wage levels in 2015, someone in either of these two occupations in the Mid-Florida region makes less than the average person in that occupation statewide or nationally, with architects and engineers earning almost 30 percent less annually than their peers in the same profession across the United States. We also note the Mid-Florida region has a competitive advantage nationally in terms of labor costs in all manufacturing occupations, and Mid-Florida wages are lower than statewide averages for those same occupational categories, other than in transportation and material moving occupations, where wages in the Mid-Florida region are 5.8 percent higher.

Additional analysis showed the total annual wage costs for all manufacturing sectors in the Mid-Florida region range between 15.8 percent and 51.4 percent lower than the annual manufacturing industry wage bill in the United States, with the difference varying by manufacturing subsector, location within the Mid-Florida region, and occupation type. For example, while architects and engineers in the Homosassa Springs manufacturing industry earn only 3.9 percent less than their national counterparts, manufacturing industry production workers in The Villages earn more than 20.0 percent less in wages annually. Meanwhile, the wages in all occupations in the printing and related support activities industry in The Villages are 17.4 percent lower than they are nationally, whereas wages in all occupations in transportation equipment manufacturing in The Villages are 15.6 percent below national wage averages for this sector.

One implication of these findings is the Mid-Florida RMA should encourage growth in manufacturing subsectors that pay above-average wages such as advanced and durable manufacturing or, if the number of jobs, rather than quality of jobs, is the desired goal, attract manufacturing employers whose national competitive advantage is derived from being a low-cost producer.
Transferability of the Mid-Florida labor force’s core competencies

Understanding the core competencies of a region’s labor force, and the transferability of these competencies between industries, is an important aspect of any workforce development policy that aims to fill skill gaps and guide a region to become a high-skill, high-wage economy. Measures of knowledge, skills, and abilities (KSA) as well as educational attainment can be used to estimate the core competencies of a region’s labor force and evaluate the fit of a region’s core competencies in relation to a particular industry’s skill requirements.

For example, the chart on the following page illustrates a relative correlation index between the abilities demanded by a selected set of industries and the abilities supplied by the labor force in the Mid-Florida region (including Citrus, Levy, Marion, and Sumter counties). The comparison is made between the core competencies supplied by the labor force in Mid-Florida and the core competencies supplied by the US labor force more generally. Industries with a positive correlation index represent sectors for which the regional labor force is better suited to meet the industry’s ability requirement relative to the national labor force. Industries with a negative correlation index represent sectors for which the regional labor force is less well-suited to meet the industry’s ability requirements relative to the national labor force. Likewise, industries with a correlation index near zero are sectors for which the regional labor force is equally well-suited to meet the industry’s ability requirement relative to the national labor force.

For the top set of industries given in the chart (sectors with the most positive correlation index), economic development planning may be relatively straightforward because the labor force already has the abilities required to fill jobs in those sectors. On the other hand, for the bottom set of industries in the chart (sectors with the most negative correlation index), workforce training, relocation incentives, or targeted educational programming may be required before the region’s labor force becomes competitive. (See Appendix B for more examples of practical applications of KSA analysis.)

According to the correlation indices in the top half of the chart, the Mid-Florida labor force should be well-suited to fill jobs in agriculture, extraction, certain commodity-based manufacturing, and construction/repair services. Since firms within the Mid-Florida region have tended to concentrate in these industries over time, it is not surprising the region’s labor force has also concentrated around the core competencies required by these industries. On the other hand, the bottom half of this chart shows the Mid-Florida labor force is less well-suited to fill jobs in sectors such as software publishing, finance and investment, engineering, and insurance and other business services. Since the core competencies required by these industries may be underrepresented in the Mid-Florida region, it may require a concerted workforce development effort over a sustained period to equip the labor force with the skills necessary to become competitive within these sectors.

Although not shown in the chart, there may still be other industries (e.g., industrial machinery, metal or plastics manufacturing, food manufacturing, etc.) for which the local labor force is at least as well-equipped, if not better equipped, than the national labor force to fulfill industry job requirements. These may represent feasible opportunities to nudge the region’s development path in a certain direction given an appropriate workforce development response. Thus, the full set of industry-labor force correlation indices (available upon request) can be used as a tool, within the context of a larger industry/workforce development strategy, to better understand the transferability of a region’s core competencies between a variety of prospective industries.

According to our analysis of the core competencies represented in the region, the Mid-Florida labor force should be well-suited to fill jobs in agriculture, extraction, certain commodity-based manufacturing, such as industrial machinery, metal or plastics manufacturing, or food manufacturing, and construction/repair services.
Mid-Florida region ability correlation ratio: 15 top and bottom industries, 2014 (relative labor force-to-industry correlation between the Mid-Florida region and the United States)

Source: Alward Institute for Collaborative Science
## Appendix A: Results of the shift-share analysis

### Appendix A: Shift-share analysis of the Mid-Florida manufacturing sector, 2015

<table>
<thead>
<tr>
<th>NAICS sector</th>
<th>Description</th>
<th>Allocation code</th>
<th>Employment</th>
<th>LQ % of Private Sector Employment</th>
<th>Employment CAGR 2000–15</th>
</tr>
</thead>
<tbody>
<tr>
<td>3261</td>
<td>Plastics product manufacturing</td>
<td>A</td>
<td>755</td>
<td>1.09</td>
<td>0.50%</td>
</tr>
<tr>
<td>3273</td>
<td>Cement and concrete product manufacturing</td>
<td>A</td>
<td>628</td>
<td>2.90</td>
<td>0.42%</td>
</tr>
<tr>
<td>3319</td>
<td>Other food manufacturing</td>
<td>A</td>
<td>516</td>
<td>2.17</td>
<td>0.36%</td>
</tr>
<tr>
<td>3272</td>
<td>Glass and glass product manufacturing</td>
<td>A</td>
<td>473</td>
<td>4.10</td>
<td>0.31%</td>
</tr>
<tr>
<td>3339</td>
<td>Other general purpose machinery manufacturing</td>
<td>A</td>
<td>441</td>
<td>1.32</td>
<td>0.29%</td>
</tr>
<tr>
<td>3312</td>
<td>Steel product manufacturing from purchased steel</td>
<td>A</td>
<td>416</td>
<td>6.82</td>
<td>0.28%</td>
</tr>
<tr>
<td>3371</td>
<td>Household and institutional furniture and kitchen cabinet manufacturing</td>
<td>A</td>
<td>402</td>
<td>1.45</td>
<td>0.27%</td>
</tr>
<tr>
<td>3331</td>
<td>Agricultural, construction, and mining machinery manufacturing</td>
<td>A</td>
<td>364</td>
<td>1.22</td>
<td>0.24%</td>
</tr>
<tr>
<td>3311</td>
<td>Beverage manufacturing</td>
<td>A</td>
<td>263</td>
<td>1.07</td>
<td>0.17%</td>
</tr>
<tr>
<td>3334</td>
<td>Ventilation, heating, air-conditioning, and commercial refrigeration</td>
<td>A</td>
<td>229</td>
<td>1.49</td>
<td>0.15%</td>
</tr>
<tr>
<td>3333</td>
<td>Commercial and service industry machinery manufacturing</td>
<td>A</td>
<td>115</td>
<td>1.07</td>
<td>0.08%</td>
</tr>
<tr>
<td>3149</td>
<td>Other textile product mills</td>
<td>A</td>
<td>112</td>
<td>1.48</td>
<td>0.07%</td>
</tr>
<tr>
<td>3253</td>
<td>Pesticide, fertilizer, and other agricultural chemical manufacturing</td>
<td>A</td>
<td>49</td>
<td>1.17</td>
<td>0.03%</td>
</tr>
<tr>
<td>3345</td>
<td>Navigational, measuring, electromedical, and control instruments manufacturing</td>
<td>B</td>
<td>417</td>
<td>0.89</td>
<td>0.28%</td>
</tr>
<tr>
<td>3391</td>
<td>Medical equipment and supplies manufacturing</td>
<td>B</td>
<td>350</td>
<td>0.91</td>
<td>0.23%</td>
</tr>
<tr>
<td>3399</td>
<td>Other miscellaneous manufacturing</td>
<td>B</td>
<td>252</td>
<td>0.74</td>
<td>0.17%</td>
</tr>
<tr>
<td>3327</td>
<td>Machine shops, turned product, and screw, nut, and bolt manufacturing</td>
<td>B</td>
<td>151</td>
<td>0.31</td>
<td>0.10%</td>
</tr>
<tr>
<td>3336</td>
<td>Engine, turbine, and power transmission equipment manufacturing</td>
<td>B</td>
<td>109</td>
<td>0.84</td>
<td>0.07%</td>
</tr>
<tr>
<td>3311</td>
<td>Iron and steel mills and ferroalloy manufacturing</td>
<td>B</td>
<td>91</td>
<td>0.77</td>
<td>0.06%</td>
</tr>
<tr>
<td>3279</td>
<td>Other nonmetallic mineral product manufacturing</td>
<td>B</td>
<td>80</td>
<td>0.82</td>
<td>0.05%</td>
</tr>
<tr>
<td>3222</td>
<td>Converted paper product manufacturing</td>
<td>B</td>
<td>52</td>
<td>0.16</td>
<td>0.03%</td>
</tr>
<tr>
<td>3255</td>
<td>Paint, coating, and adhesive manufacturing</td>
<td>B</td>
<td>46</td>
<td>0.68</td>
<td>0.03%</td>
</tr>
<tr>
<td>3335</td>
<td>Metalworking machinery manufacturing</td>
<td>B</td>
<td>35</td>
<td>0.16</td>
<td>0.02%</td>
</tr>
<tr>
<td>3332</td>
<td>Industrial machinery manufacturing</td>
<td>B</td>
<td>28</td>
<td>0.21</td>
<td>0.02%</td>
</tr>
<tr>
<td>3314</td>
<td>Nonferrous metal (except aluminum) production and processing</td>
<td>B</td>
<td>19</td>
<td>0.25</td>
<td>0.01%</td>
</tr>
<tr>
<td>3262</td>
<td>Resin, synthetic rubber, and artificial synthetic fibers and filaments</td>
<td>B</td>
<td>17</td>
<td>0.15</td>
<td>0.01%</td>
</tr>
<tr>
<td>3113</td>
<td>Sugar and confectionery product manufacturing</td>
<td>B</td>
<td>16</td>
<td>0.17</td>
<td>0.01%</td>
</tr>
<tr>
<td>3141</td>
<td>Textile furnishings mills</td>
<td>B</td>
<td>13</td>
<td>0.20</td>
<td>0.01%</td>
</tr>
<tr>
<td>3324</td>
<td>Boiler, tank, and shipping container manufacturing</td>
<td>B</td>
<td>12</td>
<td>0.10</td>
<td>0.01%</td>
</tr>
<tr>
<td>3254</td>
<td>Pharmaceutical and medicine manufacturing</td>
<td>B</td>
<td>10</td>
<td>0.03</td>
<td>0.01%</td>
</tr>
<tr>
<td>3322</td>
<td>Cutlery and handtool manufacturing</td>
<td>B</td>
<td>10</td>
<td>0.22</td>
<td>0.01%</td>
</tr>
<tr>
<td>3362</td>
<td>Motor vehicle body and trailer manufacturing</td>
<td>C</td>
<td>1,325</td>
<td>6.49</td>
<td>0.88%</td>
</tr>
<tr>
<td>3323</td>
<td>Architectural and structural metals manufacturing</td>
<td>C</td>
<td>470</td>
<td>1.09</td>
<td>0.31%</td>
</tr>
<tr>
<td>3366</td>
<td>Ship and boat building</td>
<td>C</td>
<td>454</td>
<td>2.59</td>
<td>0.30%</td>
</tr>
<tr>
<td>3219</td>
<td>Other wood product manufacturing</td>
<td>C</td>
<td>419</td>
<td>1.53</td>
<td>0.28%</td>
</tr>
<tr>
<td>3211</td>
<td>Sawmills and wood preservation</td>
<td>C</td>
<td>110</td>
<td>1.07</td>
<td>0.07%</td>
</tr>
<tr>
<td>3116</td>
<td>Animal slaughtering and processing</td>
<td>D</td>
<td>234</td>
<td>0.40</td>
<td>0.16%</td>
</tr>
<tr>
<td>3231</td>
<td>Printing and related support activities</td>
<td>D</td>
<td>103</td>
<td>0.19</td>
<td>0.07%</td>
</tr>
<tr>
<td>3364</td>
<td>Aerospace product and parts manufacturing</td>
<td>D</td>
<td>77</td>
<td>0.12</td>
<td>0.05%</td>
</tr>
<tr>
<td>3262</td>
<td>Rubber product manufacturing</td>
<td>D</td>
<td>75</td>
<td>0.48</td>
<td>0.05%</td>
</tr>
<tr>
<td>3212</td>
<td>Veneer, plywood, and engineered wood product manufacturing</td>
<td>D</td>
<td>55</td>
<td>0.66</td>
<td>0.04%</td>
</tr>
<tr>
<td>3111</td>
<td>Animal food manufacturing</td>
<td>D</td>
<td>39</td>
<td>0.61</td>
<td>0.03%</td>
</tr>
<tr>
<td>3363</td>
<td>Motor vehicle parts manufacturing</td>
<td>D</td>
<td>35</td>
<td>0.05</td>
<td>0.02%</td>
</tr>
<tr>
<td>3329</td>
<td>Other fabricated metal product manufacturing</td>
<td>D</td>
<td>24</td>
<td>0.08</td>
<td>0.02%</td>
</tr>
<tr>
<td>3256</td>
<td>Soap, cleaning compound, and toilet preparation manufacturing</td>
<td>D</td>
<td>21</td>
<td>0.16</td>
<td>0.01%</td>
</tr>
<tr>
<td>3241</td>
<td>Petroleum and coal products manufacturing</td>
<td>D</td>
<td>20</td>
<td>0.15</td>
<td>0.01%</td>
</tr>
<tr>
<td>3325</td>
<td>Hardware manufacturing</td>
<td>D</td>
<td>20</td>
<td>0.62</td>
<td>0.01%</td>
</tr>
<tr>
<td>3372</td>
<td>Office furniture (including fixtures) manufacturing</td>
<td>D</td>
<td>18</td>
<td>0.12</td>
<td>0.01%</td>
</tr>
</tbody>
</table>

Note: Only sectors with employment of 10 or more were considered;
LQ = location quotient and CAGR = compound annual growth rate
CAGR of NA means zero employment in 2000 for that sector.

Source: IHS Business Markets Insights © 2016 IHS
Appendix B: Knowledge, skills, and abilities (KSA) analysis methodology and applications

To facilitate industry-labor force matching, researchers at the Alward Institute for Collaborative Science have mapped occupations from IMPLAN’s industry employment onto BLS occupational categories and O*NET’s determined sets of knowledge, skills, and abilities (KSA). In addition, they have also linked occupations to their necessary formal education and informal on-the-job training and work experience needed to acquire these KSAs. From here, the Alward Institute has developed data models that can:

- Estimate the core competencies for the total array of occupations employed in a region
- Link these core competencies to region-specific levels of employment and wages

For example, if there are 1,000 jobs in a region, then there will be 1,000 occupational equivalents each for KSA with associated average wage and employment levels. The weighted average of the KSA occupational equivalents make up a region’s core competencies. These occupational equivalents and associated core competencies vary based on the region’s history and industrial mix.

An example of how KSA analysis can be applied: if a county government is looking to attract a new wind turbine manufacturing plant to the area, it might be beneficial not only to estimate the impact of that plant on the local economy, but also to understand the types of jobs and competencies that will be required to run the plant. This type of analysis can be accomplished by bridging between a sector’s occupational staffing pattern and regional measures of knowledge, skills, and abilities to illuminate the set of core competencies likely to be required by a given industry.

Alternatively, a correlation analysis can be used to identify which industries best fit the existing core competencies within a regional labor market. If significant skill gaps are identified, the local government can then be proactive in establishing workforce training and education. This type of analysis is crucial not only in helping economic developers target a range of industries, but also in helping workforce developers identify training and educational programming that can help fill skill gaps in the labor force. Such informed public policy can help guide an economy from a low-skill, low-wage commodity-based economy to a high-skill, high-wage niche-based economy.