

2016



Smart Manufacturing:

The 2016 Georgia Manufacturing Survey





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Innovation, advanced technology, and balancing competition and collaboration play crucial roles in helping manufacturers thrive today and prepare for the future. Manufacturers increasingly must not only use efficient and productive technologies but also continuously adapt and innovate in the context of finite resources and greater awareness of environmental impacts.

The 2016 Georgia Manufacturing Survey looks at how Georgia manufacturers deploy information, quality management and production technologies. This includes smart manufacturing methods that use data to drive manufacturing performance improvement. It also examines the benefits of competing on innovation rather than on low price and indicates the extent of engagement of manufacturers in innovation. The use of outsourcing and in-sourcing is depicted, and workforce and training practices are presented. The 2016 Survey also highlights the top concerns of Georgia manufacturers.

About the Survey

The Georgia Manufacturing Survey, begun in 1994 and conducted every two to three years, benchmarks the use of modern manufacturing technology, practices and techniques by industry statewide.

Information gleaned from the survey is used to improve manufacturing assistance programs and regional innovation initiatives that, in turn, help Georgia companies compete, improve their profitability and create jobs for Georgians.

The survey was undertaken from January to May 2016; 526 Georgia manufacturers with 10 or more employees participated in the survey. Results were weighted by industry and employment size to represent the population of manufacturers.

Industry groups were as follows:

- **Food/Textiles** (also shown as “Food-text”) includes food and beverage production, animal feed, apparel and leather.
- **Material** encompasses industries in wood, pulp and paper, plastics and non-metallic minerals.
- **Machinery** (also shown as “Mach”) also includes fabricated metals.
- **Electronics/Transportation** (also shown as “Elec-Trans”) includes electrical appliances and vehicles.
- **Science** includes petro-chemicals, pharmaceuticals and medical supplies.

Summary of Findings

Strategies – 18% of Georgia manufacturers chose low price to compete in the marketplace, compared to 8% that compete through innovation or new technology.

Profitability – Profits of Georgia manufacturers increased between 2014 and 2016 by 13% on average.

Outsourcing – In 2016, 12% of manufacturers were affected by outsourcing, that is, work transferred from a Georgia facility, and 13% gained from in-sourcing, or work transferred to a Georgia facility. The percentage of firms involved in outsourcing is about the same as those reported in the 2014 survey, while the percentage benefitting from in-sourcing is lower than in the 2014 survey.

Exporting – Nearly half of Georgia manufacturers had export sales, with 16% of manufacturers increasing their export sales in 2015 over 2013 levels. This percentage is below that reported in the 2014 survey.

Research and development – Georgia manufacturers who conducted R&D compared well with manufacturers across the country. Thirty-seven percent of Georgia manufacturers conducted R&D in-house. Only 2% used public loans or grants to pay for R&D, and only 16% used R&D tax credits.

Manufacturing concerns – 35% of the respondents identified marketing and sales as their top concern. However, concerns about basic and technical workforce skills showed the most growth over 2014 levels.

Sustainability – Only 12% of Georgia manufacturers produced an emissions inventory or carbon footprint of their facility; 57% of large manufacturers produced an emissions inventory.

Training – Nearly 35% of respondents said technical skills were a top concern. Yet, 25% reported not spending any funds on employee training, whether it involved routine tasks or new capabilities.

Investing in technology – More than half of manufacturers reported using enterprise resource planning, computer aided design and preventive/predictive maintenance. Plans for investing in new technologies were most common for bar code readers (21%). Plans to invest in new technologies were higher than 2014 levels.

Smart manufacturing – Nearly half of manufacturers collected and analyzed data for improvement. Only 5% of manufacturers considered cybersecurity a problem, even though most had some production workers who use mobile devices and the Internet on a daily basis as part of their job.

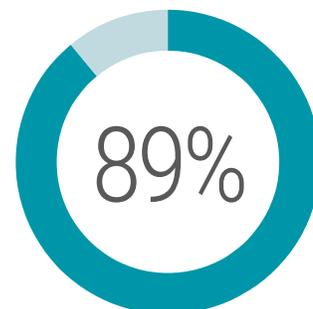
Overall, the survey indicates that as the economy has improved, Georgia manufacturers are reaping current benefits in higher profitability levels and paying greater attention to quality and workforce issues, but continue to underinvest in innovation and training.

Manufacturers Prioritize Strategies

As part of the 2016 Georgia Manufacturing Survey, manufacturers were asked to rank six strategies based on their importance in competing for sales. The strategies were low price, high quality, innovation/new technology, quick delivery, adapting to customer needs and sustainable manufacturing strategies.

Strategy Preferences of Georgia Manufacturers

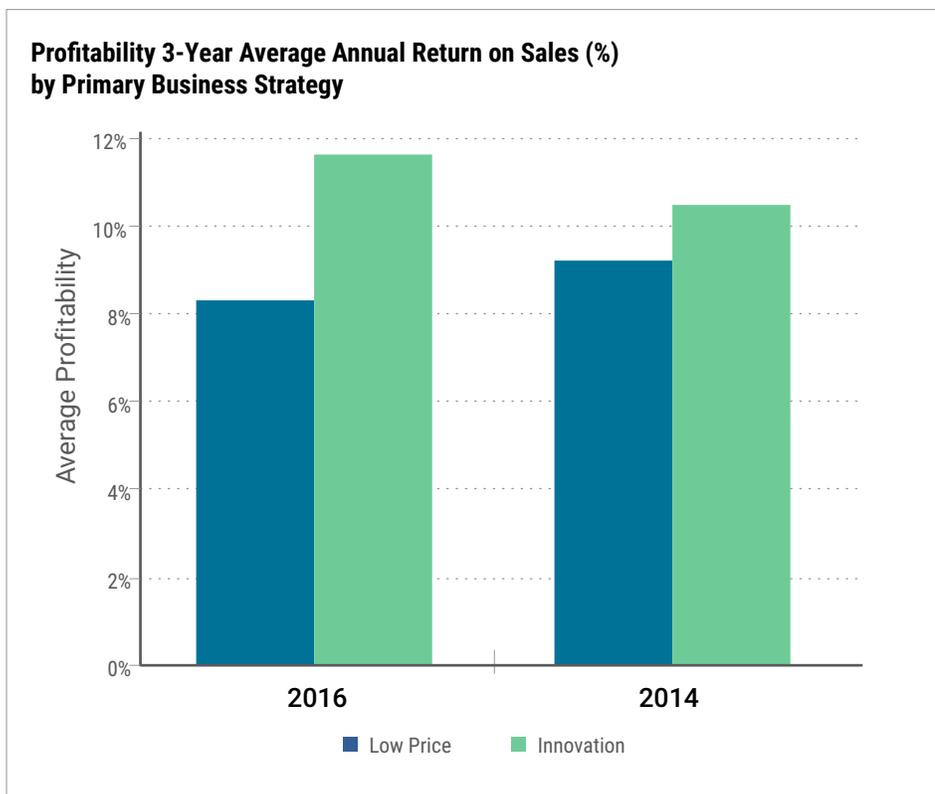
| | |
|------------------------------------|-------------------------------------|
| Quality of service:..... 64% | Quick delivery: 12% |
| Low price: 18% | Sustainable manufacturing: 2% |
| Adapting to customer needs:... 10% | Innovation/new technology:..... 8% |



Across all six strategies, results revealed that innovation strategies were associated with the highest mean return on sales—nearly 12%. Low-price strategies were linked to the lowest mean return on sales of 8%. High quality and quick delivery strategies brought margins of over 11%, while adapting to customer needs was associated with margins just below 11%.

Profits Increase for Firms Competing on Innovation

Average Return on Sales for Manufacturers Competing Primarily through Price vs. Innovation



Source: Georgia Manufacturing Survey 2016, weighted responses of 526 surveys; Georgia Manufacturing Survey 2014, weighted responses of 504 surveys.

Eighty-nine percent of Georgia manufacturers experienced positive profitability (average annual return on sales) from 2013 to 2015. The median manufacturer’s profitability was 9%, while the top 10% of manufacturers had profitability levels of 25% or more and the bottom 10% had 0%. These returns were higher than the 2014 survey, with more manufacturers with 9% or more profitability and fewer with negative profitability.





Many Georgia manufacturers used strategies associated with lower wages. Average wages for manufacturers that prioritize innovation/technology strategies were \$16,000 higher than those for manufacturers that prioritize low price and \$21,000 higher than those that prioritize customization strategies.

Higher Returns to the Community are Linked to Innovation and Customization

Average Manufacturing Wages by Strategies of Georgia Manufacturers



Source: Georgia Manufacturing Survey 2016, weighted responses of 526 manufacturers.

Electronics and transportation industries had a higher percentage of manufacturers primarily competing on innovation. All industries favored high quality as a primary sales strategy, especially those in the machinery group. Science-based manufacturers were least likely to compete using low price as their primary strategy.

Most Manufacturers Focus on Quality and Price

Most Important Manufacturing Strategies by Industry Group
(Percentage of firms indicating strategy is of highest importance)

| Strategy | Food-Textiles | Material | Machinery | Electronics Transportation | Science |
|------------------------------------|---------------|----------|-----------|-------------------------------|---------|
| High quality | 65.0% | 64.3% | 69.0% | 53.1% | 62.5% |
| Low price | 20.7% | 17.2% | 15.8% | 22.5% | 14.6% |
| Quick delivery | 4.3% | 16.1% | 12.7% | 8.2% | 14.6% |
| Adapting product to customer needs | 12.6% | 11.4% | 5.7% | 12.2% | 4.2% |
| Innovation, new technology | 7.2% | 5.7% | 8.2% | 14.3% | 10.4% |

Source: Georgia Manufacturing Survey 2016, weighted responses of 526 manufacturers.

More than half (51%) of the survey respondents introduced a new or significantly improved product or service during the 2013-to-2015 period.

Creation and Dissemination of New Knowledge

When manufacturers were asked to indicate the extent to which their facilities undertook any of 13 innovation-related activities during the 2013-to-2015 period, the most common innovation activities were: (1) cooperating with customers for innovation; (2) purchasing machinery, equipment, computers or software to implement innovations; and (3) signing a confidentiality agreement.

The least common innovation activities undertaken were: (1) purchasing external research and development; (2) purchasing or licensing patents, inventions, know-how, or other types of knowledge; and (3) publishing papers or technical articles.

Firms Find Diverse Ways to Innovate

Adoption of Specialized Innovation Activities

(Percentage of establishments that engaged in the activity)

| | |
|---|-----|
| Cooperate with customers for innovation | 61% |
| Purchase equipment | 52% |
| Sign a confidentiality agreement | 51% |
| Cooperate with suppliers for innovation | 39% |
| In-house R&D | 37% |
| Planning and development | 32% |
| Training | 32% |
| Market research | 16% |
| Apply for a patent | 13% |
| Register a trademark | 13% |
| Publish papers | 7% |
| Purchase patent | 6% |
| Purchase R&D | 4% |

Source: Georgia Manufacturing Survey 2016, weighted responses of 526 manufacturers.

Comparing R&D intensity – which is calculated by dividing R&D expenditures by sales and shown as a percentage – from respondents to the Georgia Manufacturing Survey and from the National Science Foundation’s Business R&D and Innovation Survey, we see that Georgia manufacturers’ R&D expenditures as a whole were lower than the U.S. benchmark, with variations by major industry group. Georgia’s food/textiles, materials, machinery and science-based groups had higher R&D intensity levels than the U.S. benchmark, while the electronics/electrical/transportation group had R&D intensity levels below the U.S. benchmark.

Four Types of Innovation

- **Product Innovation** - New products or significantly improved existing products
- **Process Innovation** - New or significantly improved practices, technologies or delivery
- **Organizational Innovation** - New or significant changes in manufacturer’s structure, management methods or information exchange systems
- **Marketing Innovation** - New or significant changes to packaging, design, sales methods or distribution channels

R&D Intensity: Georgia versus U.S.

(R&D intensity measured by R&D expenditures as a percentage of sales)

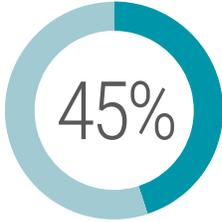
| | R&D Intensity 2015 Georgia* | R&D Intensity 2013 US (domestic**) |
|-----------------------|-----------------------------|------------------------------------|
| Total | 3.42% | 3.75% |
| Industry Group | | |
| Food-text | 3.59% | 0.70% |
| Material | 3.90% | 1.68% |
| Mach | 3.47% | 2.39% |
| Elec-Trans | 3.49% | 6.21% |
| Science | 2.76% | 3.75% |

*5% trimmed means shown to control for outlying responses.

**Domestic means R&D is conducted at any U.S. location in the enterprise group.

Sources: Georgia Manufacturing Survey 2015, weighted responses of 354 manufacturers; U.S. National Science Foundation/Division of Science Resources Statistics, Business R&D and Innovation Survey: 2013

Only 21% of manufacturers who introduced a new product developed it cooperatively with another company, university, research institute or laboratory. Most manufacturers developed their new products by themselves. Another 19% adapted or modified goods originally developed by others, and 4% used goods developed by others.



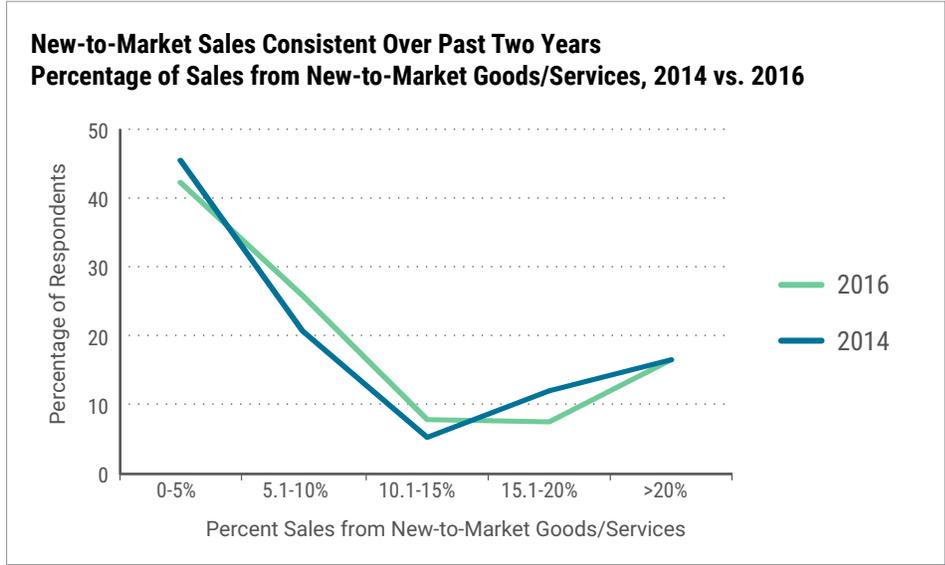
Forty-five percent of survey respondents introduced a new or significantly improved product during the 2013-to-2015 period.



Larger manufacturers were more likely to introduce new goods.

Manufacturers that introduced new-to-market goods or services reported that these goods and services typically accounted for more than 13% of the facility's sales. Fifty-eight percent of companies with new-to-market goods or services received at least 5% of their sales from these new goods or services.

The Percentage of Sales from New-to-Market Goods and Services in 2016 is Higher than It Was in 2014.



Source: Georgia Manufacturing Survey 2016, weighted responses of 206 manufacturers; Georgia Manufacturing Survey 2014, weighted responses of 191 manufacturers.

Financial concerns are a major limitation on innovation. However, only 2% of Georgia manufacturers use public loans or grants, only 3% received private equity support such as venture capital and fewer than 1% of the respondents used the Small Business Innovation Research (SBIR) program. These low usage rates exist despite more than half of manufacturers having introduced a new product and 37% of manufacturers conducting in-house R&D; these groups could have made use of these resources. Just over 30% of respondents financed innovations with private conventional loans.

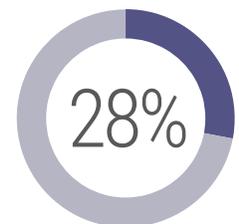
Large manufacturers with 250 or more employees were more likely than small manufacturers to have received public support. The use of personal or family funds was more prevalent among smaller facilities.



Only 16% of manufacturers said they use R&D tax credits even though 37% conduct R&D in-house.



Fifteen percent introduced a new or significantly improved service.

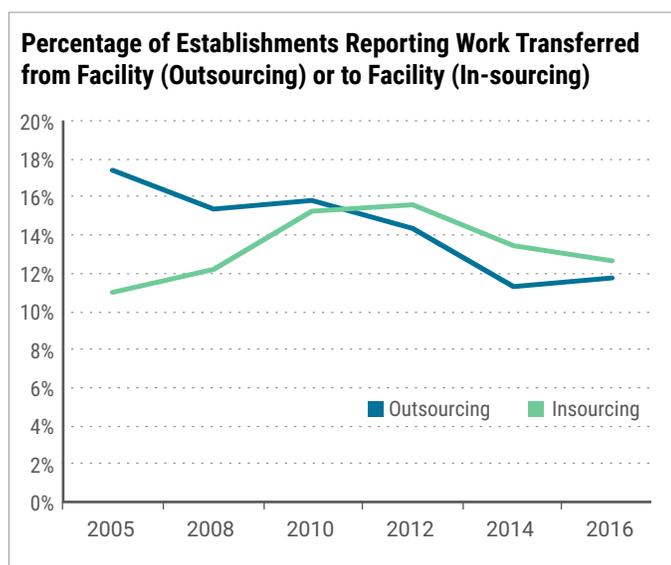


Twenty-eight percent of respondents introduced a new-to-market product or service in the 2013-to-2015 period.

Outsourcing and In-sourcing

Between 2013 and 2015, only 12% of Georgia manufacturers were affected by outsourcing, slightly more than the 11% reported in the 2014 survey. For those affected, the most common outsourcing locations were elsewhere in the United States, followed by Asia and Mexico/Central/South America. In-sourcing also occurred. The rate of transfer of work to Georgia manufacturers was nearly 13%, about the same as the percentage of firms affected by outsourcing and below 2014 survey levels. There was a slight decrease in respondent percentages reporting work transferred from Mexico to Georgia manufacturers (from 1.8% in 2014 to 1.2% in 2016) and from Asia to Georgia (from 3.4% in 2014 to 2.0% in 2016), while reports of work from Europe to Georgia somewhat increased (from 1.2% in 2014 to 1.7% in 2016). In-sourcing and outsourcing are not mutually exclusive; nearly 23% of manufacturers affected by in-sourcing and outsourcing were involved in both.

In-sourcing Exceeds Outsourcing Rates

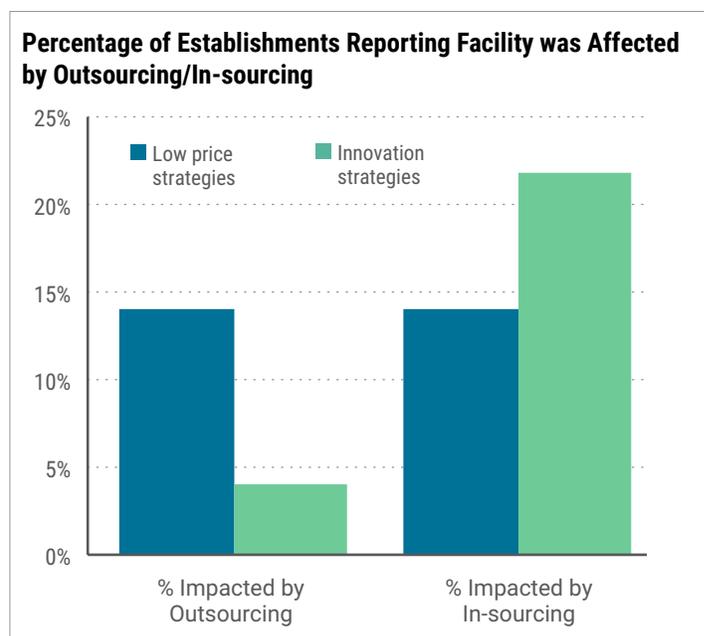


Source: Georgia Manufacturing Survey 526 weighted responses (2016); Georgia Manufacturing Survey 504 weighted responses (2014); Georgia Manufacturing Survey 528 weighted responses (2012); Georgia Manufacturing Survey 494 weighted responses (2010); 676 weighted responses (2008); Georgia Manufacturing Survey 617 weighted responses (2005).

Manufacturers that prioritized competing on innovation were much less likely to be affected by outsourcing than those prioritizing low price strategies. They were also more likely to benefit from in-sourcing than manufacturers competing based on low price.

- Seven percent of manufacturers had work moved from Georgia to another establishment within the United States.
- Three percent had work moved from Georgia to Mexico or other Central or South American country.
- Three percent also had work moved from Georgia to Asia (including China and India).

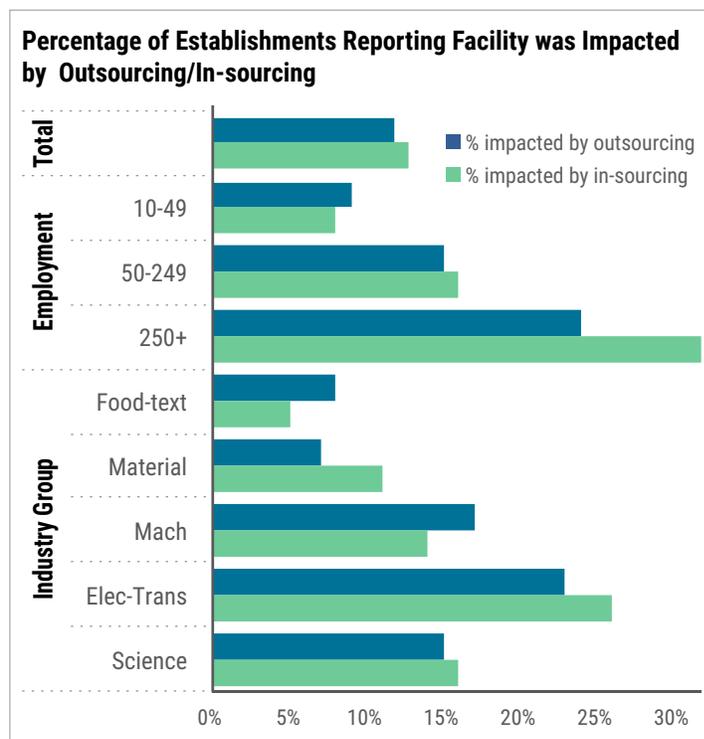
Innovation Means Less Outsourcing, More In-sourcing



Source: Georgia Manufacturing Survey 2016, weighted responses of 526 manufacturers.

The rate of outsourcing and in-sourcing was higher for larger companies than for smaller companies. The rate of in-sourcing was significantly higher for electronics-transportation establishments.

Large Firms Outsource More



Source: Georgia Manufacturing Survey 2016, weighted responses of 526 manufacturers.



Manufacturers with 50 or more employees were more likely to have greater concern about finding employees with basic or technical skills.

But small manufacturers with 10-49 employees were more concerned about marketing and sales (45%) than their larger firm (with 250 or more employees) counterparts (24%).

The need for technical skills was most prevalent in machinery industries (43%), while those in the food-textiles and materials group were more likely to prioritize basic skills needs (33% and 34% respectively). Marketing needs were most common in machinery (39%), electronics/transportation (37%) and materials industries (36%). Lean manufacturing was a need for about one-third of the establishments in all but the food-textiles group.

Basic and Technical Skill Needs Rise in 2016

Marketing and sales remained the most common problems or needs among Georgia manufacturers in 2016, slightly more prevalent than in 2014.

Technical and basic skills have become more important in the last two years. Thirty-five percent of respondents indicated problems finding employees with technical skills and 29% with basic skills. These percentages are 7% higher than 2014 levels.

Lean manufacturing challenges were the third most common need or problem, more prevalent than in 2014. Expansion planning needs also were on the rise, with 19% of respondents indicating this area to be a need. This figure is slightly higher (2% higher) than 2014 levels. Quality assurance concerns were prominent for 14% of respondents, 4% higher than 2014 levels.

These responses likely reflect the influence of the increased demand for quality manufactured products in the current economic cycle, resulting in higher sales of existing products increasing the skills needs and plans for expansion.

Energy cost management diminished as a problem since the 2014 survey. Only 9% of respondents reported energy cost management to be a problem, compared to 11% in 2014 and 21% in 2012. This decline reflects a reduction in energy costs, which dropped as a percentage of sales by nearly 4% for the median manufacturer; the decline was even greater for the median large manufacturer with 250 or more employees (10%) and for the median manufacturer in the science-based and electronics-transportation industry groups (6%). Environmental, health, and safety concerns also declined, with only 11% of respondents reporting a problem in this area.

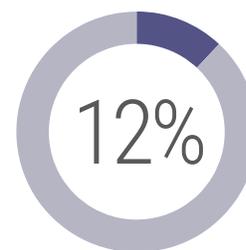
Manufacturing Problems and Needs, 2014 – 2016

| Problems/Needs | COMPARISON | | DIFFERENCE |
|---|------------|-------|------------|
| | 2016 | 2014 | 2016-2014 |
| Marketing and sales | 35.3% | 32.3% | 3.0% |
| Technical skills | 34.7% | 27.5% | 7.2% |
| Manufacturing process/lean | 30.8% | 27.9% | 2.9% |
| Basic skills | 28.6% | 21.8% | 6.8% |
| Expansion planning, facility layout | 18.6% | 16.3% | 2.3% |
| Quality assurance | 14.3% | 10.4% | 3.9% |
| Product development, design | 14.0% | 12.2% | 1.8% |
| Information systems & hardware | 13.5% | 11.2% | 2.3% |
| Management and leadership | 12.0% | 12.9% | -0.9% |
| Business, finance | 11.9% | 11.1% | 0.8% |
| Environmental, safety compliance, health, workplace | 11.1% | 12.1% | -1.0% |
| Energy costs management | 8.5% | 11.4% | -2.9% |

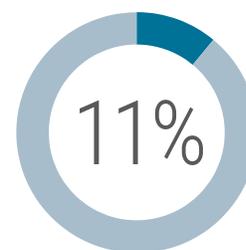
Source: Georgia Manufacturing Survey 2016, weighted responses of 526 manufacturers; Georgia Manufacturing Survey 2014, weighted responses of 504 manufacturers.

Workforce Skills Remain Unsupported

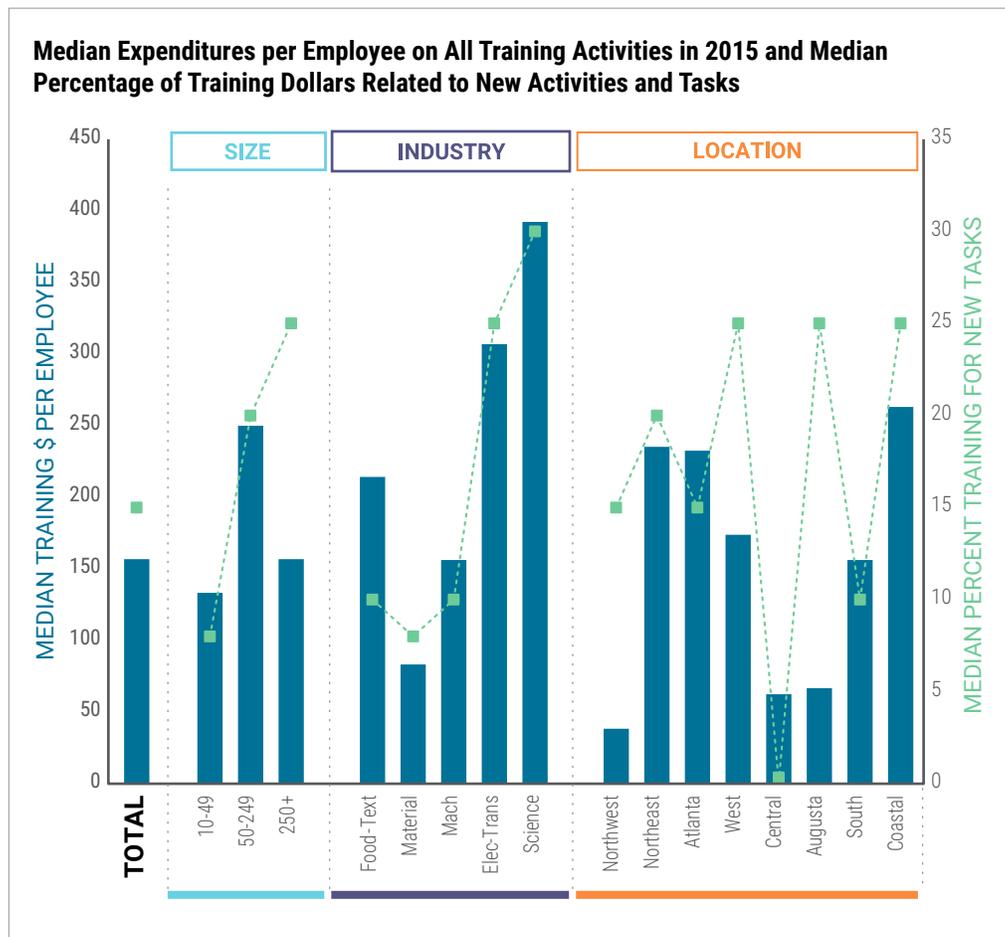
Twenty-five percent of manufacturers spent no money on training in 2015. Among manufacturers that spent money on training in 2015, the median respondent reported that only 15% of training dollars were spent on training related to new activities and tasks (i.e., not routine training). Some 20% of respondents spent more than 50% of their training dollars on new activities and tasks. Small manufacturers not only spent less, but most of their spending was for routine training.



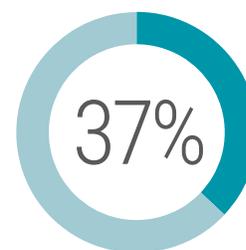
The median manufacturing establishment had only 12% of employees with two or more years of technical or vocational college.



Eleven percent also had bachelor's degrees in at least half of their workforce.

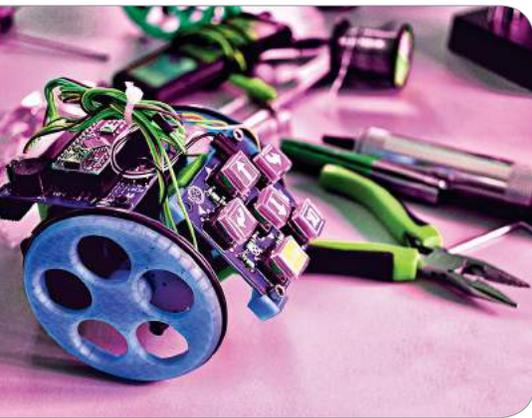


Source: Georgia Manufacturing Survey 2016, weighted responses of 328 manufacturers.



Thirty-seven percent of manufacturers had at least one employee with a master's or doctorate in science, engineering, or information technology; this is an indicator of innovation capability.





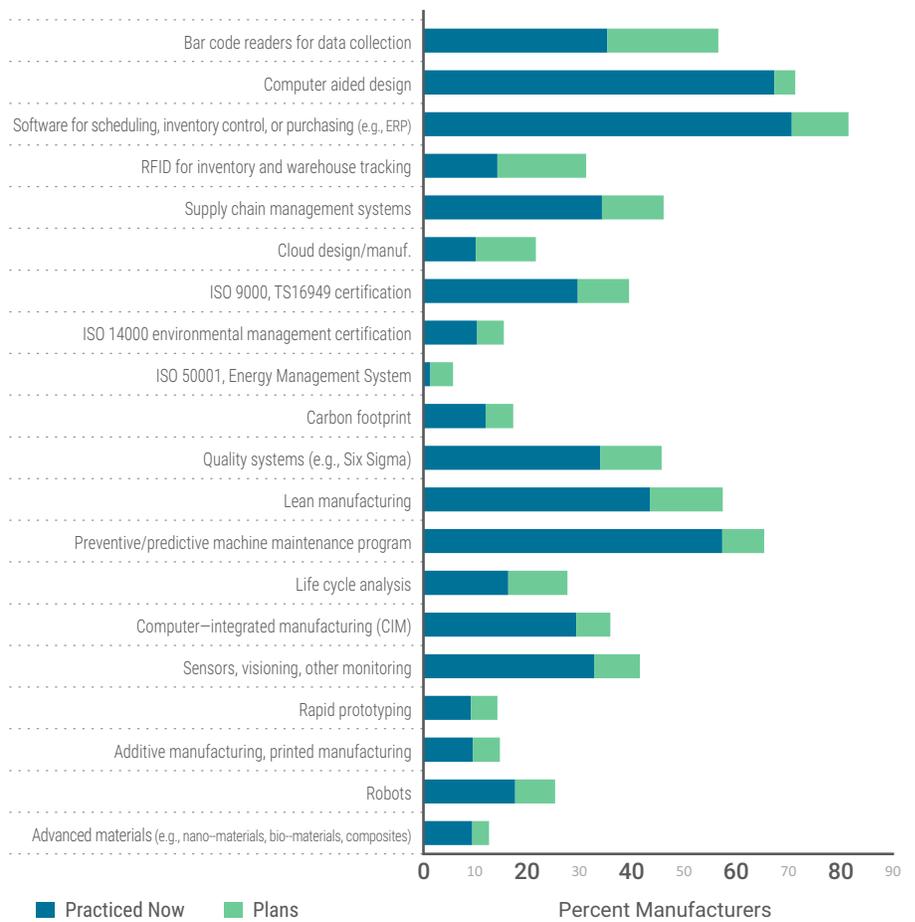
Manufacturing Technology and Sustainability

Manufacturers used a range of information technologies, quality management and sustainable manufacturing practices, and manufacturing production technologies in 2016, and use is higher than in 2014. Software for scheduling, inventory control or purchasing such as enterprise resource planning (ERP) was the most commonly used in the 2016 survey (71%), followed by computer aided design (CAD) (67%) and preventive and predictive maintenance (57%). Plans for acquiring new technologies were most common for bar code readers (21%), followed by radio frequency identification (RFID) for inventory and warehouse tracking (17%) and lean manufacturing (14%).

Ninety-three percent of Georgia manufacturers used at least one basic technology (such as machine maintenance, computer aided design or ISO 9000), while 75% used at least one advanced technology (such as RFID, additive manufacturing, or new materials).



Technologies and Techniques Manufacturers Use and Plan to Use



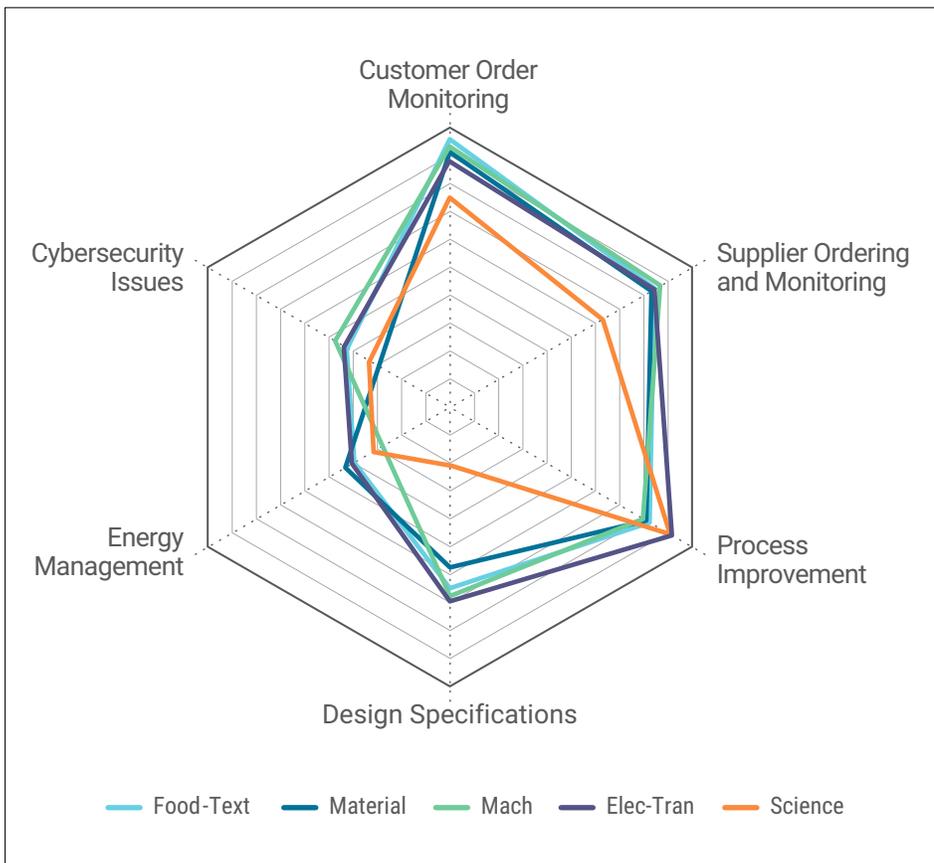
Source: Georgia Manufacturing Survey 2016, weighted responses of 503 manufacturers.

Use of technologies and techniques increases with facility employment size. By industry, the electronics/electrical/transportation group had the greatest use of these technologies and techniques. RFID was most prevalent in the food/textile/apparel/leather group (used by 26% of these respondents) and CAD in the machinery and electronics/electrical/transportation groups (used by 76% of respondents in these groups).

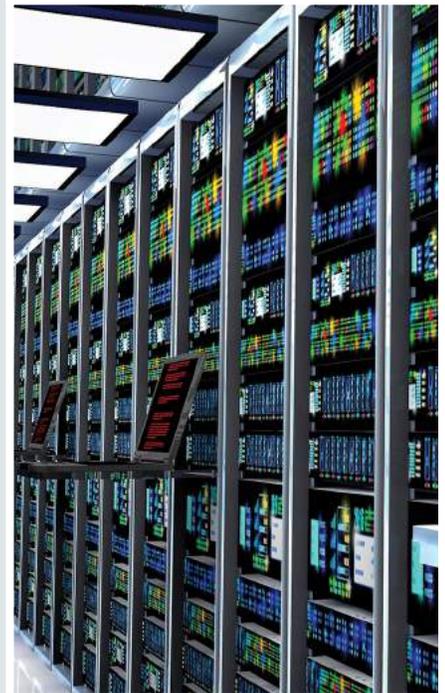
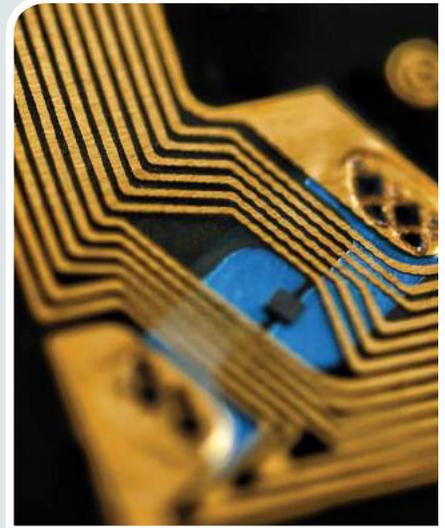
Sustainable manufacturing practices are in use by a small set of manufacturers. Only 12% of manufacturers conducted emission inventories of their carbon footprint. However, more than half of large manufacturers (57%) conducted these inventories, while only 17% of medium-sized and 4% of small manufacturers produced an inventory. Likewise, life cycle analysis was more likely to be used by large manufacturers (48%) than by medium-sized (26%) and small (8%). Use of ISO 14000 and ISO 50001 was also more prevalent among manufacturers with 250 or more employees (59% and 15% respectively) than among those with 10-49 employees (2% and 0% respectively).

Smart Manufacturing was Used by Nearly Half of Georgia Manufacturers, but Few are Concerned about Cybersecurity.

Forty-nine percent of Georgia manufacturers electronically collected and analyzed data for improvement. Just over 30% of small manufacturers collected and analyzed data, but this percentage rose to 69% for medium-sized manufacturers and 90% for large manufacturers. Manufacturers in science-based industries were most likely to collect and use data (69%), followed by electronics/transportation manufacturers (60%). Nearly all manufacturers that electronically collected and analyzed data for improvement used it for customer order monitoring (90%), followed by process improvement (84%), supplier monitoring (81%) and design specifications (58%). Less common were uses for cybersecurity (38%) and energy management (37%). Energy management had the largest percentage of respondents planning to use a smart manufacturing application (23%), followed by cybersecurity (16%).



Only 5% of manufacturers considered cybersecurity a problem. Yet one-third of manufacturers had production workers using a mobile device at least once a day as part of their job. Nearly 70% of manufacturers had at least 1% of their production workers using the Internet at least once a day as part of their job. A few manufacturers (5%) had more than half of their production workers using a mobile device on a daily basis, and 13% had more than half of their production workers using the Internet on a daily basis.



“Maintaining high quality levels is a concern of Georgia manufacturers in this period of continued growth and profitability. Smart manufacturing technologies can help with these needs, but the limited attention to cybersecurity remains an issue for the future.”

Jan Youtie



DR. JAN YOUTIE is the director of the 2016 Georgia Manufacturing Survey. Youtie is a director of policy research services in Georgia Tech's Enterprise Innovation Institute and an adjunct with Tech's School of Public Policy. She specializes in technology-based economic development, emerging technology assessment, and advanced manufacturing.



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DIMITRI DODONOVA at Kennesaw State University (KSU) led survey research and analysis at KSU. Dodonova is assistant director of the Econometrics Center at KSU.



ADAM BECKERMAN, partner-in-charge of Manufacturing & Distribution at HA&W, has led manufacturers to success for nearly 20 years by providing the services, advice and resources they need to drive growth at every stage of the business lifecycle. Adam comes to the table with more than a CPA mindset and engages as a business advisor who thinks about what is right for the business and its employees.

“Georgia manufacturers have benefitted from the recovery in the manufacturing sector. Yet, they also indicate problems with basic and technical workforce skills, and there are concerns that investment in innovation is lagging.”

Philip Shapira

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Georgia Manufacturing Extension Partnership (GaMEP); Georgia Tech Enterprise Innovation Institute; School of Public Policy, Ivan Allen College, Georgia Tech; Georgia Department of Labor; Kennesaw State University; and Habif, Arogeti and Wynne, LLP.

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Visit <http://www.gms-ei2.org> for more information about the survey.