Innovation in Manufacturing: Needs, Practices, and Performance in Georgia 2012-2014

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INVESTING IN THE FUTURE: THE 2012 GEORGIA MANUFACTURING SURVEY EXECUTIVE SUMMARY

The Georgia Manufacturing Survey (GMS) is a statewide study conducted every 2-3 years by Georgia Tech's Enterprise Innovation Institute and School of Public Policy to assess the business and technological conditions of Georgia's manufacturers. The theme of GMS 2012 is investing in the future.

New Business Needs Still Most Common in 2012

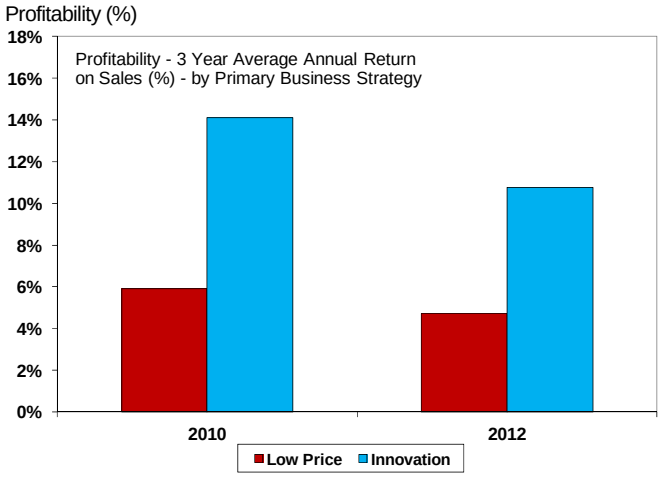
Marketing and sales are the most common problem or need among Georgia manufacturers in 2012, although the percentage reporting this problem has declined somewhat since 2010. Lean manufacturing priorities are still prevalent and the need for technical skills is also important. Energy management, which declined in importance between the 2008 and 2010 surveys, rose again in the 2012 survey, as did quality assurance. Fewer manufacturers expressed needs for product development in the 2012 than in the 2010 survey. In addition, needs for business and finance and management and leadership were less prevalent in 2012 compared to 2010 levels.

In-sourcing Exceeded Outsourcing Rates

Fourteen percent of manufacturers were affected by outsourcing in 2012, a slight decline from the 2010 survey levels. At the same time, 16 percent of manufacturers benefitted from in-sourcing, which is slightly higher than in previous surveys. In-sourcing from Asia grew from 2.6% in 2010 to 4.3% in 2012. In-sourcing was most prevalent among manufacturers in chemicals, medical devices and other science-based industries.

Profitability Gap Between Innovation and Low Price Strategies Maintained

Seventeen percent of Georgia manufacturers compete in the marketplace through offering low prices compared to fewer than 10 percent that compete primarily through being innovative or using new technology. Manufacturers that prioritize innovation have more than twice the profitability of those that prioritize low prices.



Resources for Innovation Not Widely Used

More than half of manufacturers have introduced a new product and one-third of manufacturers conduct in-house R&D. However, only 4% use public loans or grants, and fewer than 20% claimed an R&D tax credit.

Investing in the Future

Manufacturers are investing in the future through using a range of information technologies, quality management and continuous improvement techniques, and manufacturing production technologies. Software for scheduling, inventory control of purchasing such as enterprise resource planning (ERP) is the most commonly used (71 percent), followed by computer aided design (65 percent), preventive and predictive maintenance (60 percent), and lean manufacturing (50 percent). Plans for acquiring new technologies are most common for bar code readers (21 percent) and radio frequency identification (RFID) for inventory and warehouse tracking (18 percent).

About the Survey

- Mail surveys were sent to more than 4,000 manufacturers with 10 or more employees from February to May 2012. Completed surveys from 604 manufacturers were weighted to reflect employment and industry distributions in the Georgia Department of Labor database. Small manufacturers are those with 10-249 employees; large manufacturers are those with 250 or more employees.
- Survey results are used to improve manufacturing assistance programs and regional innovation initiatives in Georgia.
- Survey web site: http://www.gms-ei2.org

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Introduction: The 2012 Georgia Manufacturing Survey

The Georgia Manufacturing Survey 2012 is the eighth in a series of statewide manufacturing surveys conducted since 1994.[1] The survey benchmarks manufacturing performance in the state and identifies needs, issues, challenges, capabilities, and opportunities facing Georgia manufacturers so that strategies for enhancing their competitive advantages can be developed and improved. The 2012 survey focuses on how manufacturers are investing in the future in manufacturing technologies and techniques. The survey also includes questions about sustainable manufacturing goals and measurement; trends in product, process, and organizational innovation; operational performance; and the impact and effectiveness of Georgia's manufacturing assistance programs.

The 2012 survey went to all Georgia manufacturing firms with 10 or more employees. Of the 604 responses received, 528 surveys met the criteria of manufacturers with 10 or more employees. These 528 surveys were weighted to reflect the actual distribution of manufacturers by industry and employment size in Georgia and form the basis for the results described in this report.

This report is divided into eight sections. Chapter 2 examines manufacturer problems and needs. Chapter 3 looks at manufacturing strategies. Chapter 4 focuses on innovation practices, benefits, and barriers. Chapter 5 examines use of manufacturing technologies and techniques and sustainable manufacturing practices. Chapter 6 examines workforce training and organizational approaches. Chapter 7 reports manufacturing performance metrics. Chapter 8 summarizes survey responses about use of information and assistance sources, including Georgia Tech. For more information about the survey, see Appendix 1.

Definitions

Throughout this report, information will be broken down by employee size, industry group, and Georgia Tech service delivery region in 2012. Industry groupings and their North American Industrial Classification System (NAICS) are described in Box 1. These breakdowns are based on Pavitt's technology trajectories sectoral model.[2] Results will also be presented terms of Georgia major geographic service areas—

[1] Jan Youtie and Philip Shapira, "Manufacturing Needs, Practices and Performance in Georgia: 1994 Georgia Manufacturing Technology Survey," GMEA Evaluation Working Paper E9501, Revised, March 1995; Jan Youtie and Philip Shapira, "Manufacturing Needs, Practices and Performance in Georgia, 1994-1998," GMEA Evaluation Working Paper E9703, May 1997.

[2] Keith Pavitt. (1984) 'Sectoral patterns of technical change: towards a taxonomy and a theory', Research Policy, Vol. 13, pp. 343–373

Northwest (Dalton, Rome, Cartersville), Northeast (Gainesville, Athens), Atlanta (North Metro, South Metro), West (Columbus, LaGrange), East (Augusta), Central (Macon, Dublin, Warner Robins), South, (Albany, Douglas), and Coastal (Savannah, Brunswick). (See Figure 1.)

Table 1.1. Industry Group Definitions

Industry Group	Abbreviation	NAICS	Description
Supplier sectors	Food-Text	311	Food Manufacturing
		312	Beverage and tobacco product manufacturing
		313	Textile mills
		314	Textile product mills
		315	Apparel manufacturing
		316	Leather and allied product manufacturing
Scale intensive	Material	321	Wood product manufacturing
		322	Paper manufacturing
		323	Printing and related support activities
		326	Plastics and rubber products manufacturing
		327	Non-metallic mineral product manufacturing
		337	Furniture & related product manufacturing
Specialized suppliers	Mach	331	Primary metal manufacturing
		332	Fabricated metal product manufacturing
		333	Machinery manufacturing
Specialized suppliers	Elec-Trans	336	Transportation equipment
		334	Computer and electronic product manufacturing
		335	Electrical equipment, appliance & component manuf.
Science-based	Science	324	Petroleum & coal products manufacturing
		325	Chemical manufacturing
		3391	Medical equipment and supplies manufacturing

Figure 1. Georgia Regions Used in Analysis

Chapter
2

Problems and Needs

We start by examining the most significant problems or needs of Georgia manufacturers. The Georgia Manufacturing Survey 2012 asked a question that has been posed in all six manufacturing surveys, including those conducted in 1994, 1996, 1999, 2002, 2005, 2008, and 2010: "In which of the following areas does your facility have the most significant problems or needs?"

Nearly all of the respondents (95 percent) indicated that they had at least one significant problem or need at their facility. The average respondent checked 2.3 problem areas. Although 31 percent noted only one problem, a handful (1%) reported seven to nine problems.

Manufacturers' Problems – Search for Sales, Energy Resources

Although manufacturer's priorities have maintained marked stability over time, the 2012 survey underscores several important changes (Table 2.1). First, marketing and sales were a significant need of 36 percent of respondents. This percentage is slightly below 2010 levels but well above the percentage for 2008.

Second, lean manufacturing has maintained its position as the second most prevalent manufacturing concern, with 32 percent indicating a need in this area. The percentage of respondents reporting a need for lean manufacturing and workflow improvement is the same as it was in 2010.

Third, human resource problems are still at the forefront of manufacturers' issues. Nearly 40 percent of manufacturers have one or more human resource needs. Needs for workers with technical skills are more common than the need for workers with basic skills. Nearly 24 percent of manufacturers have a need for technical workers versus 16 percent with a need for basic skills. This difference stands in contrast with the 2008 survey results, in which the percentage of respondents expressing needs for the two types of skill levels was nearly equal. The percentage of manufacturers with basic skills needs – which rose from 2002 to 2005 – declined markedly in 2010 and rose again only slightly in 2012. Management and leadership needs in the 2012 survey are at the same levels as they were in the 2010 survey.

Fourth, the 2012 survey showed a slight increase in the percentage of respondents with worries about energy cost management. Twenty-one percent of Georgia manufacturers reported a significant problem with energy cost management versus 19 percent of in 2010. Still energy cost management is the fourth most common area of need and represents a significant rise in prominence since 1999 when only 10 percent of Georgia manufacturers were worried about energy costs.

Expansion planning needs continued their downward trend from 2002 levels. Fewer than 14 percent of respondents reported an expansion planning or facility layout need, the same as in 2010. However, past levels of expansion planning need were much higher, 18 percent in 2008 and 24 percent in 2002. Quality assurance and environmental, health, and safety compliance also recorded nearly a 14 response, both slightly above 2010 levels.

Twelve percent of manufacturers reported an IT problem or need. More than 11 percent of respondents to the 2012 survey registered a need in the product development and design area. This figure is below 2010 levels. Business and finance needs also garnered an 11 percent response.

Table 2.1. Manufacturing Problems and Needs: 2012, 2010, 2008, 2005, 2002, 1999, 1996, 1994

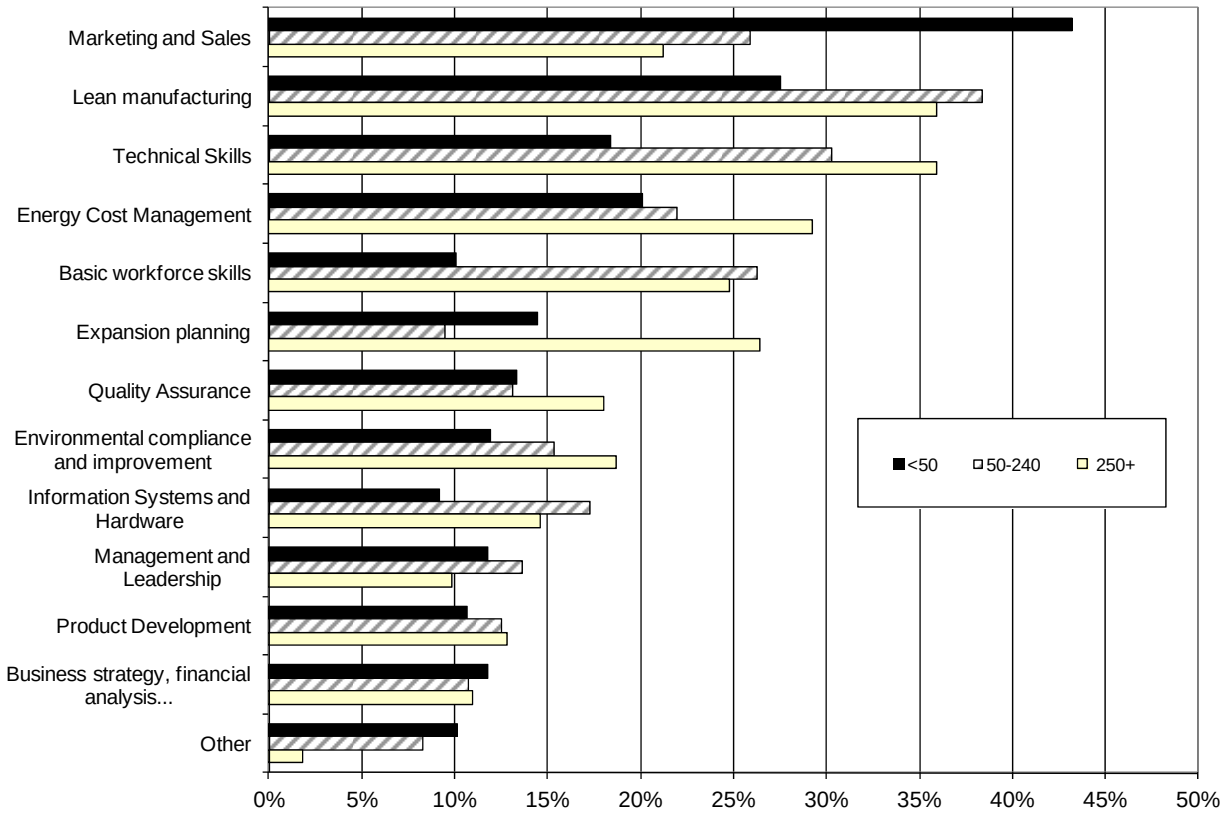
Problems/Needs	2012	2010	2008	2005	2002	1999	1996	1994	Diff. 2012-2010
Marketing and sales	36.0%	39.1%	32.9%	25.2%	36.9%	25.0%	17.0%	15.0%	-3.1%
Manufacturing process/lean	31.6%	31.6%	32.3%	38.9%	34.4%	29.0%	27.0%	37.0%	0.0%
Technical skills	23.5%	18.8%	23.8%	23.3%	26.6%	25.0%	31.0%	n/a	4.7%
Energy costs management	21.4%	18.9%	23.2%	19.1%	15.3%	10.0%	13.0%	16.0%	2.5%
Basic skills	16.4%	13.9%	21.9%	25.6%	10.6%	13.0%	16.0%	n/a	2.5%
Expansion planning, facility layout	13.8%	13.5%	17.6%	20.6%	24.0%	22.0%	22.0%	25.0%	0.3%
Quality assurance	13.6%	11.5%	17.1%	14.7%	17.2%	17.0%	19.0%	22.0%	2.1%
Environmental, safety compliance, health, workplace	13.5%	12.3%	13.3%	15.0%	17.6%	15.0%	17.0%	29.0%	1.2%
Management and leadership	12.2%	12.8%	12.6%	15.6%	26.2%	21.0%	33.0%	n/a	-0.6%
Information systems & hardware	12.2%	11.1%	10.7%	14.3%	20.1%	27.0%	17.0%	13.0%	1.1%
Product development, design	11.4%	15.4%	15.5%	12.5%	19.0%	13.0%	13.0%	12.0%	-4.0%
Business, Finance	11.4%	13.5%	13.0%	15.8%	19.7%	n/a	n/a	n/a	-2.1%

Source: Georgia Manufacturing Survey 2012, weighted responses of 528 surveys; Georgia Manufacturing Survey 2010, weighted responses of 494 surveys; Georgia Manufacturing Survey 2008, weighted responses of 677 surveys; Georgia Manufacturing Survey 2005, weighted responses of 648 surveys; Georgia Manufacturing Survey 2002, weighted responses of 636 surveys; Georgia Manufacturing Survey 1999, weighted responses of 727 manufacturers; Georgia Manufacturing Survey 1996, weighted responses of 1,002 manufacturers; Georgia Manufacturing Technology Survey 1994, weighted responses of 1,180.

Problems and Needs by Size, Industry, and Region

Large manufacturers with 250 or more employees were more likely to have a higher level of concern about finding employees with technical skills than were their smaller counterparts (Figure 2.1, yellow bar). Managing energy costs was also more prominent among large manufacturers, as was expansion planning, quality assurance, and environmental compliance. Medium-sized firms with 50 to 249 employees were most likely to express a need for lean manufacturing (cross-hatched bar). They also more frequently indicated problems finding employees with basic skills. Small businesses with 10 to 49 employees were more apt to indicate marketing was a great need compared to their larger-firm counterparts.

Figure 2.1. Manufacturing Needs and Problems by Facility Employment Size



Source: Georgia Manufacturing Survey 2012, weighted responses of 528 manufacturers.

The emphasis given to specific problems differed by industry groups. Marketing and sales was the top interest for the food/textile/apparel/leather, materials, and machinery groups. Lean manufacturing was most prominent in the electronics/transportation and science groups. The food/textile/apparel/leather group placed greater emphasis on energy cost management, as did materials industries. Metals and machinery industries often mentioned technical skill and quality assurance problems. Electrical, electronics, and transportation manufacturers also were more acutely focused on technical skills; in addition, they were the most likely to have needs for information technology and product development, in addition to the previously stated need for lean manufacturing. Science-based industries also had a distinctive need for lean manufacturing and product development. In addition, science-based industries exhibited a higher need for basic workforce skills and environmental management than the other industry groups (Table 2.2).

Table 2.2. Manufacturing Problems and Needs by Industry

Problems/Needs	Food-Text	Materials	Mach	Elec-Trans	Science
Marketing and Sales	41.6%	36.3%	39.5%	31.1%	21.6%
Lean Manufacturing	31.5%	28.5%	28.7%	44.4%	37.3%
Technical Skills	18.3%	16.4%	36.5%	33.3%	23.5%
Energy Cost Management	29.5%	27.5%	10.5%	11.1%	15.7%

Basic workforce skills	13.4%	15.8%	14.0%	22.2%	23.5%
Expansion planning	16.5%	9.0%	16.5%	15.6%	19.6%
Quality Assurance	10.9%	8.2%	21.9%	20.0%	15.7%
Environmental compliance and improvement	9.8%	13.8%	13.7%	13.3%	19.6%
Information Systems and Hardware	13.8%	10.8%	9.5%	22.2%	9.8%
Management and Leadership	8.2%	12.4%	16.1%	15.6%	7.8%
Product Development	9.6%	8.1%	14.1%	17.8%	15.7%
Business strategy, financial analysis	5.7%	13.7%	16.4%	2.2%	11.8%

Source: Georgia Manufacturing Survey 2012, weighted responses of 528 manufacturers.

Marketing and sales needs were the most widespread concern for manufacturers in the Coastal and Central regions. Lean manufacturing needs were most commonly expressed by respondents in the West regions. The West region was distinctive in that manufacturers in this region was more likely to mention problems and needs with lean manufacturing than with marketing and sales. The second most common concern among respondents in the West region, after lean manufacturing, was basic workforce skill needs, followed by energy cost management. Energy cost management was most often a concern of respondents in the Atlanta, Coastal, and East regions. The highest proportion of firms with quality issues were found in the Northwest and East regions (Table 2.3).

Table 2.3. Manufacturing Problems and Needs by Region

Problems/Needs	North-west	North-east	Atlan-ta	West	Cen-tral	East	South	Coast-al
Marketing and Sales	27.1%	34.2%	37.3%	35.2%	43.2%	12.6%	36.6%	48.1%
Lean Manufacturing	30.2%	32.2%	33.5%	44.5%	24.8%	21.5%	37.0%	20.5%
Technical Skills	27.0%	14.6%	24.7%	37.8%	20.3%	33.0%	15.6%	33.0%
Energy Cost Management	32.7%	19.6%	13.8%	32.3%	13.2%	37.1%	37.6%	20.1%
Basic workforce skills	21.2%	13.0%	15.2%	38.0%	14.2%	20.5%	11.9%	14.3%
Expansion planning	14.4%	10.7%	16.6%	10.0%	16.4%	19.0%	1.6%	17.8%
Quality Assurance	19.0%	12.2%	15.7%	12.8%	9.5%	20.5%	5.0%	11.4%
Environmental compliance and improvement	15.4%	12.0%	8.4%	18.6%	10.9%	26.1%	23.9%	22.6%
Information Systems and Hardware	22.6%	7.6%	12.9%	4.4%	5.5%	0.0%	14.2%	13.9%
Management and Leadership	9.7%	11.9%	10.0%	18.9%	13.0%	23.8%	20.0%	8.3%
Product Development	5.6%	13.1%	12.3%	18.9%	7.3%	0.0%	15.8%	15.6%
Business strategy, financial analysis	11.6%	19.2%	9.5%	4.4%	12.4%	14.9%	11.4%	7.1%

Source: Georgia Manufacturing Survey 2012, weighted responses of 528 manufacturers.

Chapter
3

Manufacturing Strategy

This section explores the strategies that manufacturers chose to compete for customer sales. The analysis is based on a series of questions that ask manufacturers to rank six strategies from 1 (highest importance) to 6 (lowest importance) based on how important the strategies are to the firm in competing in the marketplace for sales. The six strategies are low price, high quality, innovation/new technology, quick delivery, adapting to customer needs, and sustainable or green manufacturing. The latter strategy was substituted for value-added services, which was the sixth response choice in prior years' surveys. The results reported in this chapter represent the percentage of manufacturers that chose each strategy as their highest choice. This series of questions was also asked in the 1999, 2002, 2005, 2008, and 2010 which facilitates exploration of changes in primary manufacturing strategies over time.

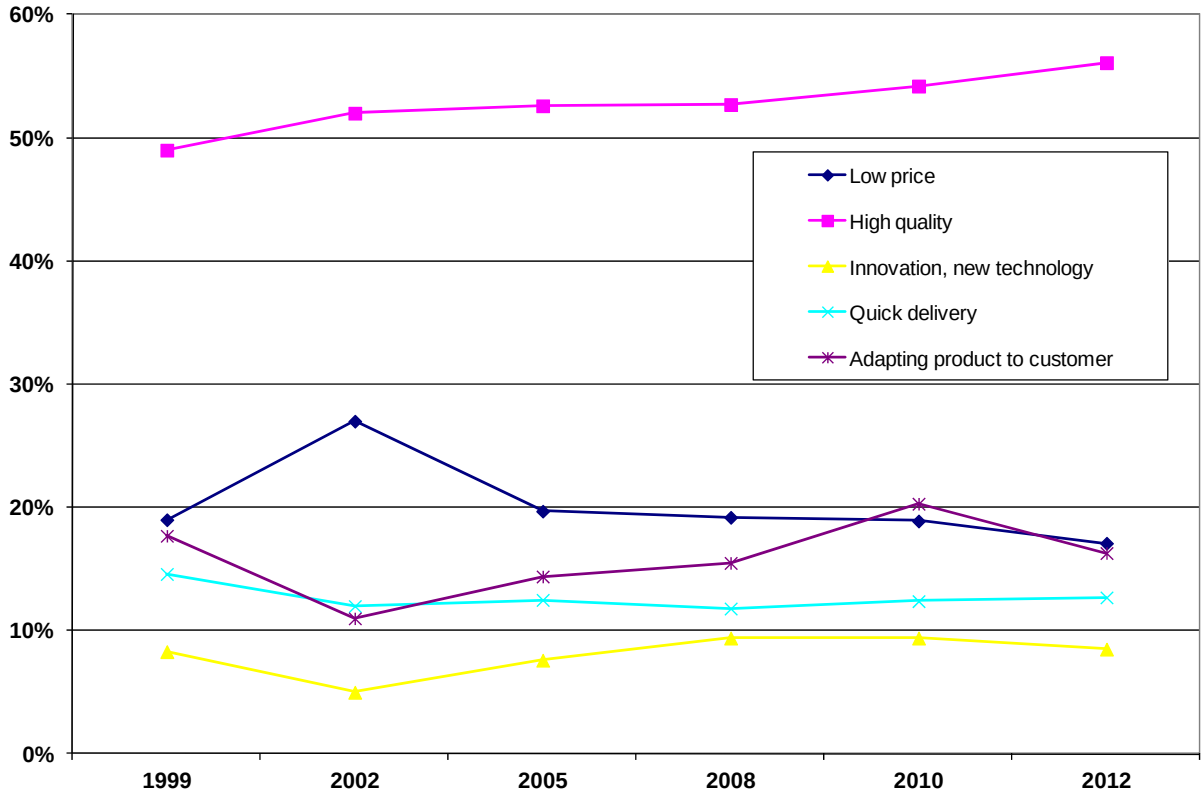
The 2012 survey (as has been noted in previous surveys) found that more than half of Georgia manufacturers chose quality of service as their primary strategy in competing for customer sales. Low price was a primary strategy for 17 percent of Georgia manufacturers. Adapting to customers' needs was cited by 16 percent of the manufacturers. Thirteen percent of respondents prioritized quick delivery as a top strategy. Innovation/new techniques constituted a top strategy for fewer than 10 percent of manufacturers. Only 3 percent of manufacturers indicated that sustainable or green manufacturing was their top strategy.

Since 2010, the percentage of respondents competing for sales primarily based on quality, low price, quick delivery, and innovation has remained constant. The percentage of firms competing for sales through adapting to customer needs dropped somewhat from 2010 levels (Figure 3.1).

Strategies by Firm Characteristics

Little difference by employment size is observed in prioritization of strategies for competing for sales (Table 3.1). Large manufacturers were less likely to compete based on quality and innovation. Low price was slightly more prevalent among mid-sized respondents. Adapting the product to customer needs was slightly more important among small manufacturing establishments.

Figure 3.1. Top Manufacturing Strategies: 1999-2012
(Percentage of Firms Ranking Strategy as the Most Important)



Source: Georgia Manufacturing Survey 2012, weighted responses of 528 surveys; Georgia Manufacturing Survey 2010, weighted responses of 494 surveys; Georgia Manufacturing Survey 2008, weighted responses of 738 surveys; Georgia Manufacturing Survey 2005, weighted responses of 648 surveys; Georgia Manufacturing Survey 2002, weighted responses of 636 surveys; Georgia Manufacturing Survey 1999, weighted responses of 727 manufacturers.

All industries favored high quality as a primary sales strategy. Manufacturers in food/textiles/apparel/leather industries placed a particularly high priority on quality strategies. High quality was least important to electronics/electrical/transportation manufacturers. Low price was most important to these electronics and transportation firms but least important to science-based respondents. Adapting the product to customer needs was a distinctive priority for materials establishments and also important to science-based industries. The importance of quick delivery was similar across all industries. Innovation strategies were most important to those in science-based industries (Table 3.2).

Competition based on high quality was the most common strategy for respondents in all regions of the state. High quality was most likely to be prioritized by manufacturers in the Coastal, South, and Central regions (65 percent, 59 percent, and 58 percent respectively). Adapting to customer needs attracted the highest percentage of respondents prioritizing this strategy in the Central region. Low price strategies are most prominent in the East, Central, and West regions, with more than 20 percent of manufacturers prioritizing this strategy in these regions. The Northeast had the highest percentage of firms that compete based on quick delivery (18 percent). Prioritization of

innovation-oriented strategies accounted for 8 to 11 percent of respondents in all but the East and Coastal regions, where the percentage was around 5 percent (Table 3.3).

Table 3.1. Most Important Manufacturing Strategies by Facility Employment Size
(Percentage of firms indicating strategy is of highest importance)

Strategy	10-49	50-240	250+
High quality	57.1%	51.2%	69.4%
Adapting product to customer needs	16.2%	20.3%	10.9%
Low price	18.6%	12.8%	13.2%
Quick delivery	14.1%	11.0%	8.5%
Innovation, new technology	8.2%	6.9%	17.9%

Source: Georgia Manufacturing Survey 2012, weighted responses of 528 surveys

Table 3.2. Most Important Manufacturing Strategies by Industry Group
(Percentage of firms indicating strategy is of highest importance)

Strategy	Food-Text	Material	Mach	Elec-Trans	Science
High quality	64.9%	55.9%	54.7%	46.7%	52.9%
Adapting product to customer needs	14.8%	19.0%	12.4%	33.3%	7.8%
Low price	13.8%	14.6%	23.7%	8.9%	19.6%
Quick delivery	12.9%	14.2%	12.8%	8.9%	9.8%
Innovation, new technology	5.0%	8.5%	9.2%	8.9%	13.7%

Source: Georgia Manufacturing Survey 2012, weighted responses of 528 surveys

Table 3.3. Most Important Manufacturing Strategies by Region
(Percentage of firms indicating strategy is of highest importance)

Strategy	North-west	North-east	Atlanta	West	Central	East	South	Coast-al
High quality	59.0%	51.9%	55.5%	47.9%	58.3%	41.2%	59.3%	65.3%
Adapting product to customer	19.1%	17.9%	15.4%	23.7%	21.8%	22.7%	12.1%	13.1%
Low price	12.0%	18.3%	17.0%	7.1%	21.6%	10.3%	15.5%	18.1%
Quick delivery	11.8%	18.4%	12.8%	11.4%	13.4%	12.4%	6.5%	11.4%
Innovation, new technology	7.4%	7.9%	8.8%	10.8%	11.0%	5.6%	8.8%	5.2%

Source: Georgia Manufacturing Survey 2012, weighted responses of 528 surveys

Outcomes of Strategies

How have these strategies fared in generating return on sales, which manufacturers care about, and employee wages, which economic developers care about? Average return on

sales over a three-year period is one measure of the profitability of an establishment. We found that there were more manufacturers with three to 15 percent profitability and fewer with negative profitability, except at the endpoints of the scale (i.e., more in the 2012 survey with -25 percent profitability than in the 2010 survey and fewer with +25 percent profitability than in the 2010 survey). In 2010, the mean (average) return on sales was 8.3 percent and the median (50^{th} percentile) was 9 percent. By 2012, the mean return on sales rose to 8.6 percent but the median dropped to 6 percent.

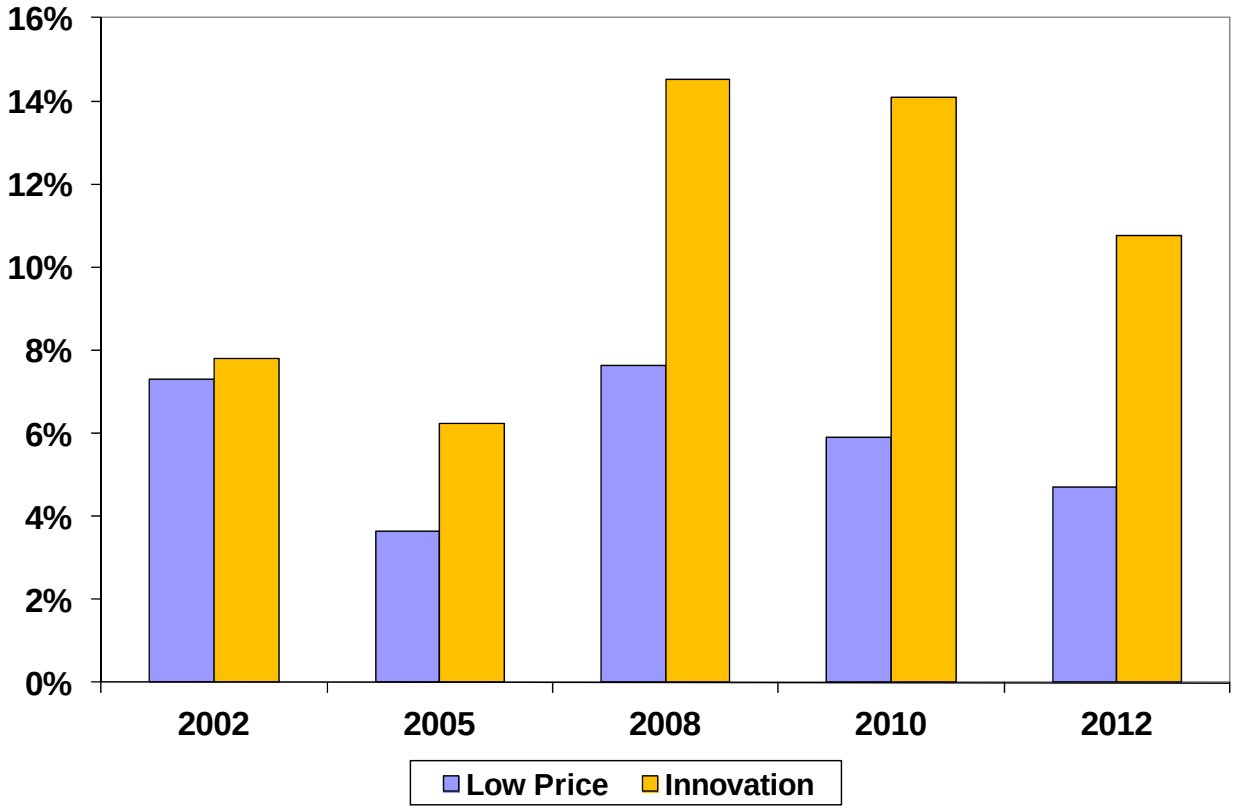
We found that the average return on sales for establishments that compete primarily on low price were pretty close to those of firms competing on innovation in 2002; only a half of a percentage point separated the two strategies. By 2005, these margins had widened. Establishments competing primarily through low price had margins that were two-and-a-half percentage points below those of firms competing primarily through innovation. In the 2008 survey, the margins had expanded yet again so that average return on sales for manufacturers prioritizing innovation strategies had profitability levels that were nearly twice that of those prioritizing low price. The 2010 survey showed that the profitability difference between manufacturers competing on low price and innovation widened even further, despite the drop in profitability. The 2012 survey also indicates a drop in profitability for both types of strategies. Even though the profitability drop was more precipitous for manufacturers that prioritize innovation strategies, these manufacturers still have more than twice the profitability of respondents that prioritize low price strategies (Figure 3.2).

Across all strategies, we found that strategies prioritizing innovation had the highest mean return on sales of nearly 11%. Low price had the lowest mean return on sales of less than 5 percent. High quality strategies were associated with margins in the 9 percent range, quick delivery in the 8 percent range, and adapting to customer needs in the 7 percent range.

Average wages are calculated by dividing annual payroll by number of employees. Average wages can be viewed as a “return to the community,” since well-paid employees can generate further “induced” economic development impacts through the purchase of additional local goods and services. Average wages of respondents by strategy ranged from $36,000 to $45,000, with innovation strategies associated with an average wage of roughly $45,000.

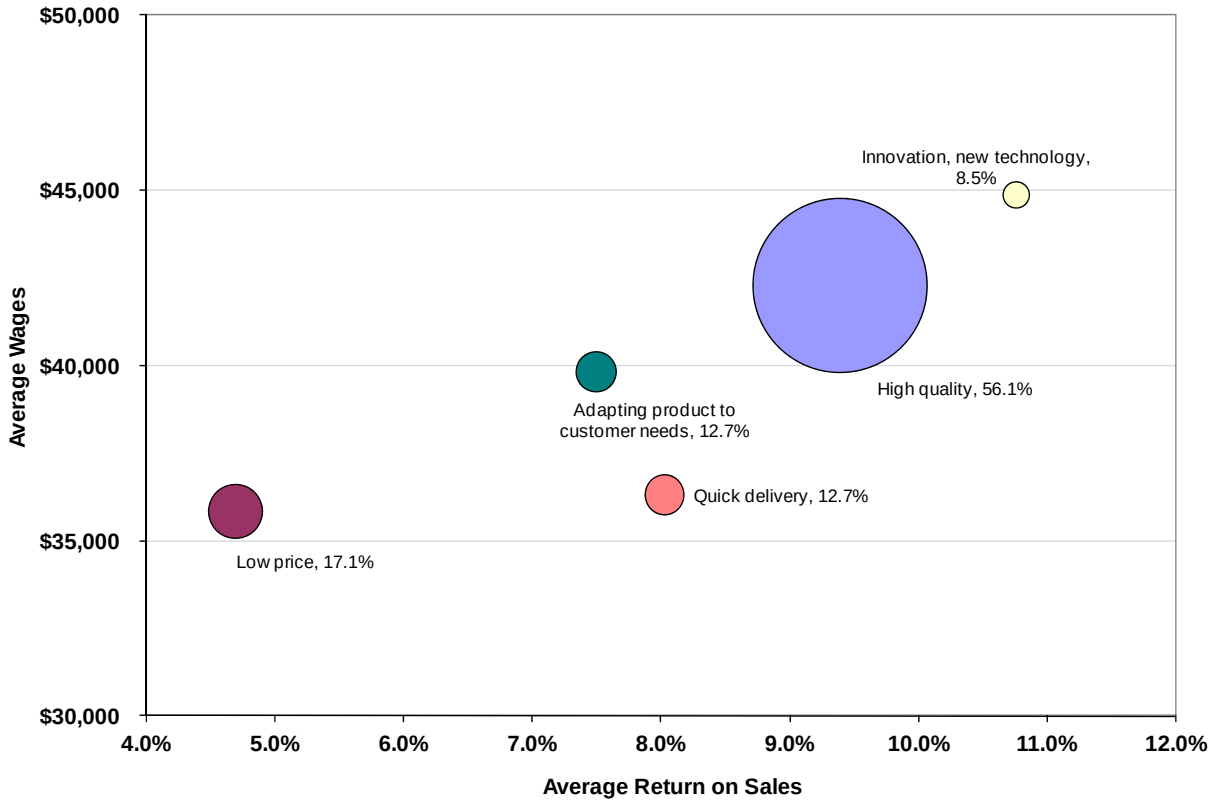
We can look at the relationship between the number of manufacturers that adopt various strategies to compete for customers, the “profitability” of these establishments, and the average wages they pay. The bubble chart (Figure 3.3) illustrates these findings graphically. The sizes of the bubbles represent the percentages of Georgia manufacturers that compete primarily through the various strategies. The vertical axis shows the average 20011 wages associated with these strategies. The horizontal axis shows average return on sales from 20010-20012 associated with these strategies. Manufacturers who compete primarily through innovation strategies have relatively higher returns on sales and higher employee wages. However, most Georgia manufacturers use strategies that are associated with lower wages and profitability levels.

Figure 3.2. Average Return on Sales for Manufacturers Competing Primarily Through Low Price vs. Innovation: 2002, 2005, 2008, 2010, and 2012
(mean return on sales shown on y axis)



Source: Georgia Manufacturing Survey 2012, weighted responses of 528 surveys; Georgia Manufacturing Survey 2010, weighted responses of 494 surveys; Georgia Manufacturing Survey 2008, weighted responses of 738 surveys; Georgia Manufacturing Survey 2005, weighted responses of 648 surveys; Georgia Manufacturing Survey 2002, weighted responses of 636 surveys.

Figure 3.3. Manufacturing Returns and Wages by Percentage of Respondents Ranking Strategies Highest in 2012



Source: Georgia Manufacturing Survey 2012, weighted responses of 528 manufacturers.

Summary

This chapter showed that about half the manufacturers compete for sales based on high quality strategies. There is little change in the percentage of manufacturers prioritizing the six strategies asked about in the survey from that of the 2010 survey. Innovation strategies continue to be associated with higher profitability and higher wages, particularly in comparison with low price strategies.

Chapter
4

Innovation

The previous chapter indicated that fewer than 10 percent of manufacturers employ innovation as their primary business strategy for competing for sales in the marketplace. However, there are many ways that a firm may be innovative or engage in innovative activities in addition to their business strategy. This chapter will examine innovation, beginning with the specification of a definition for it. We will then examine four general types of innovation and the extent to which these types are prominent among various types of Georgia manufacturers. Take-up rates of more explicit innovation activities will be gauged in the state's manufacturing base. We will consider the upside of innovation, including the types of impacts and benefits that manufacturing respondents report, as well as the downside factors that limit their ability to engage in innovation.

Innovation is the entire process through which new knowledge is created and disseminated into the market. [3] It contrasts with invention, which applies new knowledge often to patentable goods, and productivity, which applies conventional knowledge to existing commodity goods or services.

In the Georgia Manufacturing Survey, we define four types of innovation for innovation measurement and data gathering. Two are technological (product and process innovation) and two are considered non-technological (organizational and marketing innovation). In developing these definitions, we have sought consistency with the OECD's Oslo Manual and innovation surveys conducted by the European Community and other countries.[4] These four types are defined as:

1) Product innovation in goods or services—technologically new products or existing products that are significantly improved.

2) Process innovation—technologically new or significantly improved practices, technologies, or delivery.

3) Organizational innovation—new or significant changes in firm structure, management methods, or information exchange systems.

4) Marketing innovation—new or significant changes to design, packaging, sales methods, or distribution channels.

[3] J. Schumpeter, 1934. The Theory of Economic Development. Harvard University press, Cambridge, MA.
[4] OECD, 1997, Proposed Guidelines for Collecting and Interpreting Technological Innovation Data, Manual Oslo, Eurostat.

Product Innovation

We asked survey respondents to tell us whether their facility introduced any new or significantly improved goods or services during the period 2009 to 20011. Excluded were small changes to the color or look or resale of goods purchased elsewhere. Forty-six percent of the respondents had introduced a new or significantly improved good. Fourteen percent of the establishments had introduced a new or significantly improved service. In total, 51 percent of respondents had introduced either a product innovation involving either a new good or service. This figure is substantially higher than the 22 percent reported for the 2006-2008 time period in the new national Business, Research & Development, and Innovation Survey (BRDIS).[5]

Introduction of new goods was most likely among larger manufacturing establishments. However, smaller and medium-sized establishments with less than 250 employees were more likely to have introduced a new service than were their large manufacturing counterparts (Figure 4.1).

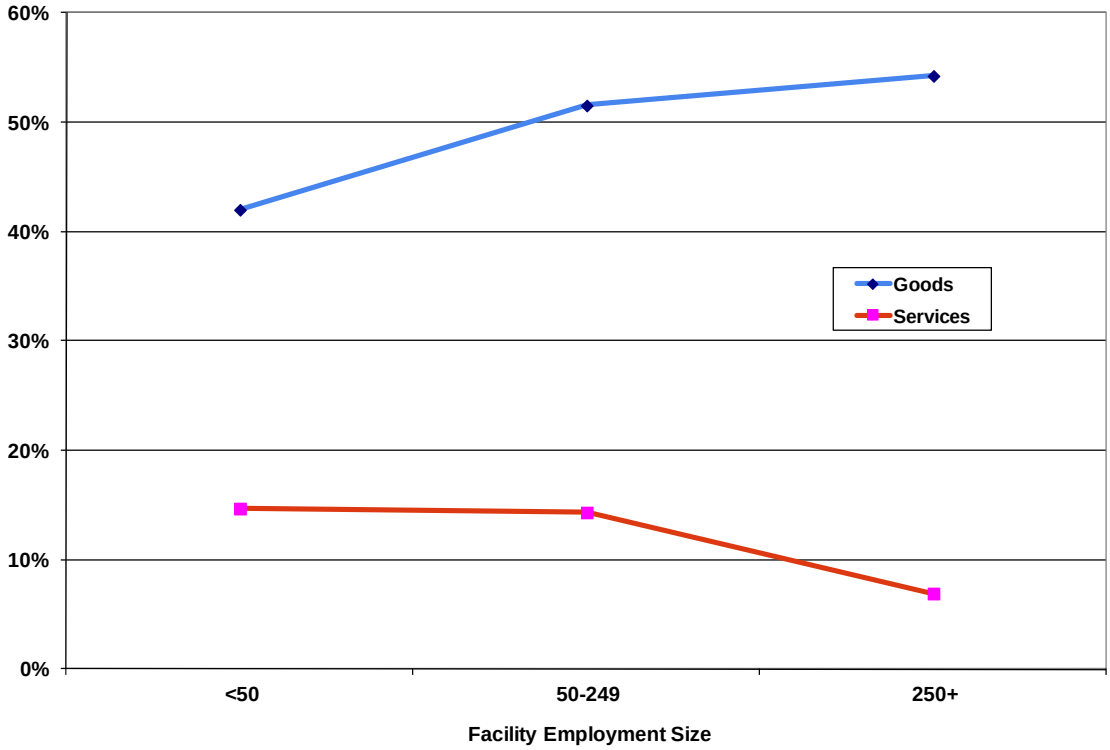
The science-based industry group had the highest percentage of establishments that had introduced a new good, followed by the electrical/electronic/ transportation and food/textile/apparel/leather groups. Machinery manufacturers were least likely to have introduced a new good but among the most likely to have introduced a new service. New services were also especially prevalent among food/textile/apparel/leather and science-based respondents (Figure 4.2).

By region, the Northwest and East regions had the highest percentage of establishments that introduced new goods (around 50 percent), with the Coastal and South coming in at the lowest percentages (around 40 percent). This difference in range between regions with the highest and lowest incidence of introduction of new goods is less than it was in the 2010 survey. New services were slightly more prevalent among establishments in the West region, with more than 20 percent of manufacturers in these regions having introduced new services. Branch plants are more likely to have introduced new products and services than are single establishment firms. Likewise, publicly traded firms were significantly more likely to have introduced new products and services than were privately held firms. Because so few publicly traded or multi-facility establishments are small, this finding is not surprising. Indeed fewer than 10 percent of publicly traded manufacturing respondents and 8 percent of Georgia-based multi-facility respondents have fewer than 50 employees.

[5] Mark Boroush, NSF Releases New Statistics on Business Innovation, October 2010, http://www.nsf.gov/statistics/infbrief/nsf11300/ (accessed July 18, 2012).

Figure 4.1. Introduction of New or Significantly Improved Goods and Services by Facility Employment Size

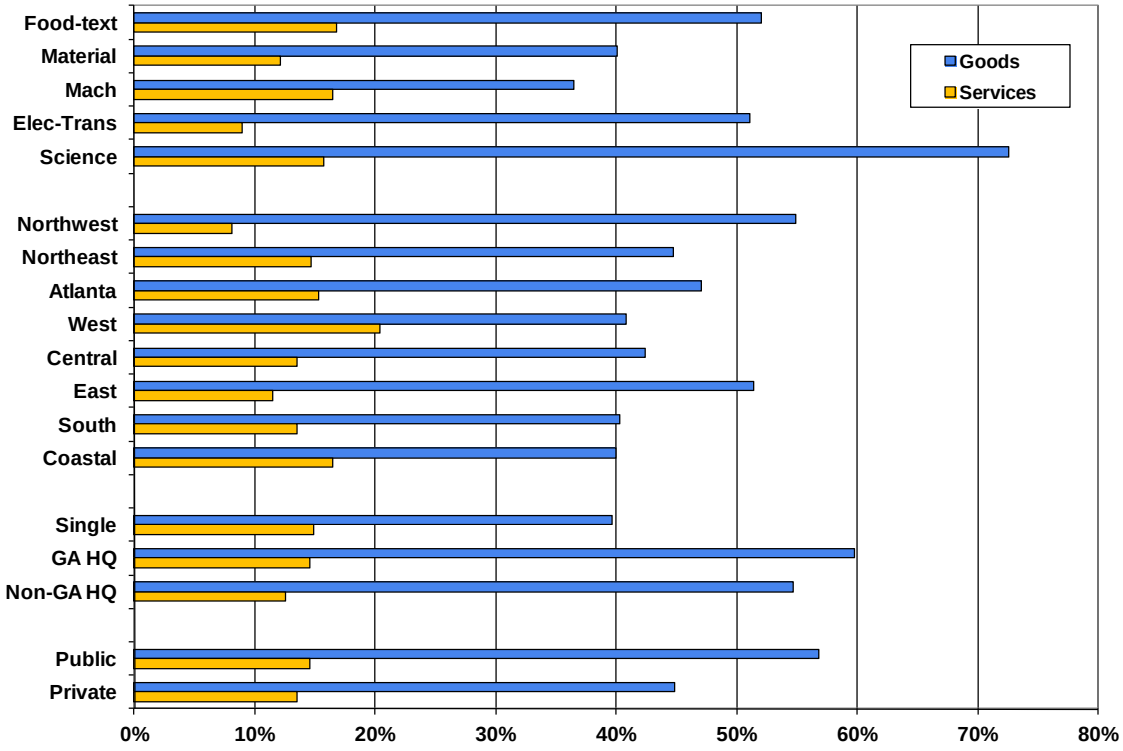
(Percentage of Establishments that Introduced New Goods or Services from 2009-2011)



Source: Georgia Manufacturing Survey 2012, weighted responses of 528 manufacturers.

Figure 4.2. Introduction of New or Significantly Improved Goods and Services by Industry Group, Region, Ownership

(Percentage of Establishments that Introduced New Goods or Services from 2009-2011)



Source: Georgia Manufacturing Survey 2012, weighted responses of 528 manufacturers.

We asked whether these product innovations were new to the market or new to the facility. New-to-the-market innovations were defined as those that were introduced before the competition, whereas new-only-to-the-facility innovations were defined as those already available from the competition.

Nearly 30 percent respondents reported that they had introduced a new-to-the -market product in the 2009 to 20011 timeframe. This percentage is slightly below 2010 and 2008 levels. The percentage of establishments introducing new-to-the-market innovations increases is about the same for large and medium-sized establishments, but markedly less for establishments with fewer than 50 employees. Roughly one-third of medium-sized and large establishments have introduced new to the market product innovations. There also is a size-based effect evident in the percentage of establishments with new-to-the-facility innovations by facility employment size, which shows more differentiated increases between small and medium-sized classes on the one hand and large size classes on the other. By industry, establishments in the science categories had the highest percentage of respondents reporting introduction of new-to-the-market product innovations. The lowest percentage of new-to-the-market product innovations is in the materials and machinery groups. By region, the Northwest, Atlanta, Central and East regions had the highest percentage of establishments

introducing new-to-the-market innovations, and the West and South regions had the lowest. (See Table 4.1)

Table 4.1. New to Market vs. New to Facility Innovations
(Percentage of Establishments that Introduced the Innovations)

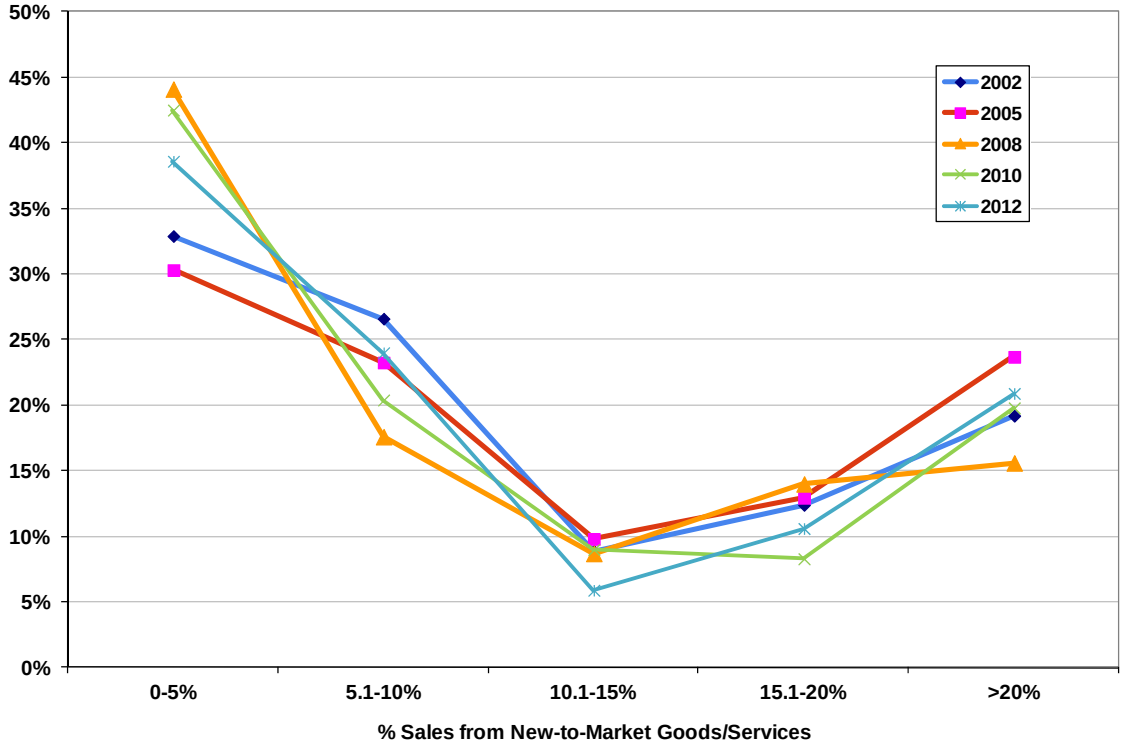
	New to Market	New to Facility
Total	28.4%	23.3%
Employment		
10-49	25.0%	21.0%
50-249	33.0%	24.7%
250+	36.3%	35.3%
Industry		
Food-text	34.1%	19.8%
Material	23.0%	22.1%
Mach	24.0%	21.8%
Elec-Trans	33.3%	17.8%
Science	43.1%	43.1%
Region		
Northwest	32.4%	28.7%
Northeast	26.6%	26.1%
Atlanta	30.9%	22.8%
West	20.3%	19.8%
Central	29.9%	17.6%
East	29.9%	25.1%
South	22.6%	21.8%
Coastal	20.5%	21.8%

Source: Georgia Manufacturing Survey 2012, weighted responses of 528 manufacturers.

New-to-the-market products rarely make up the lion's share of a manufacturing establishment's sales. The average respondent that introduced new-to-the-market goods or services reported that these goods and services accounted for nearly 16 percent of the facility's sales. However, for more than 5 percent of the respondents with new-to-the-market products or services, these offerings comprised half or more of their sales. Figure 4.3 shows that the percentage of sales from new-to-the-market goods and services is about the same as it was in 2010 except that the number of establishments reporting that more than one-fifth of sales came from new-to-the-market products was slightly higher in the 2010 survey than in the 2008 survey.

Figure 4.3. Percentage of Sales from New-to-the-Market Goods/Services: 2002, 2005, 2008, 2010, 2012

(Y-axis represents percentage of firms)



Source: Georgia Manufacturing Survey 2012, weighted responses of 215 manufacturers; Georgia Manufacturing Survey 2010, weighted responses of 199 manufacturers; Georgia Manufacturing Survey 2010, weighted responses of 326 manufacturers.

Process Innovation

Over the last three years, 51 percent of the respondents introduced processes that were new to or significantly improved the firm. This figure is higher than the 22 percent reported in the national BRDIS survey manufacturing results as was the case with product innovation. Of these processes, new manufacturing technologies and techniques on the shop floor were most common, introduced by 38 percent of respondents. Logistics and distribution innovations were introduced by 12 percent of respondents. Purchasing, accounting, maintenance, or other similar processes were introduced by about 19 percent of respondents. Smaller establishments lagged larger ones in all process innovations. Shop floor innovations (i.e., techniques and technologies) were most common in science-based firms. Office innovations (i.e., purchasing and accounting) and logistics were least common in food-text and materials industry groups. By region, establishments in the Northwest areas had the highest rates of process innovation introduction, while the establishments in the West and East had the lowest rates (Table 4.2).

Table 4.2. Process Innovations Introduced from 2007 to 2009
(Percentage of Establishments that Introduced the Innovations)

	Techniques, Technologies	Logistics, Distribution	Purchasing, Accounting	Materials	Any Process
Total	37.8%	11.9%	19.2%	13.7%	50.7%
10-49	29.6%	8.8%	14.8%	12.5%	42.3%
50-249	47.6%	15.8%	23.5%	14.4%	61.6%
250+	61.6%	20.1%	36.0%	20.4%	71.9%
Industry					
Food-text	36.4%	19.4%	20.4%	16.2%	53.2%
Material	36.9%	7.9%	17.5%	14.5%	45.3%
Mach	38.3%	8.0%	17.8%	7.1%	50.1%
Elec-Trans	33.3%	17.8%	22.2%	15.6%	57.8%
Science	47.1%	15.7%	23.5%	17.7%	60.8%
Region					
Northwest	50.0%	11.2%	18.6%	22.1%	55.0%
Northeast	36.5%	14.0%	14.4%	19.7%	48.6%
Atlanta	35.6%	11.3%	20.9%	9.3%	50.6%
West	24.1%	1.9%	23.7%	15.1%	36.4%
Central	49.9%	14.2%	11.3%	13.0%	57.9%
East	29.4%	0.0%	31.0%	5.6%	38.7%
South	25.2%	10.5%	26.5%	17.0%	43.4%
Coastal	37.7%	22.5%	15.5%	6.0%	59.3%

Source: Georgia Manufacturing Survey 2012, weighted responses of 528 manufacturers.

Organizational Innovations

Respondents were asked whether their facility had introduced any organizational innovation activities that involved improved strategic planning, management systems, restructuring of management or departmental configurations, or relationships with other firms (e.g., alliances, partnerships, outsourcing, subcontracting). More than half of all manufacturing establishments (57 percent) reported that they introduced at least one of these organizational activities (Table 4.3). Restructuring of management or departments was the most common organizational introduction, reported by one-third of respondents. New strategy was reported by 22 percent as was new management systems, followed closely by relationships with other firms reported by 21 percent. Organizational innovations were much more common among large manufacturing establishments with at least 250 employees, with more than three-quarters of respondents having introduced an organizational innovation over the 2009 to 2011 time period. By industry, there was not much difference in the rate of introduction of organizational innovations, although science-based and electrical/electronics/transportation groups were slightly more apt to have introduced organizational innovations. Firms in the science-based group were most prone to having restructurings, while those in the

electrical/electronics/transportation group were more prone to having new relationships with other firms. Regional differences highlighted the Northwest region in its higher introduction of organizational innovations. Overall introduction of organizational innovations was lowest in the Central region.

Table 4.3. Organizational Innovations Introduced from 2009 to 2011
(Percentage of Establishments that Introduced the Innovations)

	Improved Management System	Improved Management System	Internal Restructuring	Relations with other Firms	Any Organizational Innovation
Total	22.8%	22.7%	32.0%	22.1%	56.8%
10-49	20.3%	15.9%	27.7%	21.8%	50.4%
50-249	25.5%	30.8%	37.1%	21.6%	63.9%
250+	31.1%	43.3%	44.0%	26.3%	77.8%
Industry					
Food-text	24.3%	25.6%	35.1%	23.4%	61.2%
Material	22.1%	19.0%	27.1%	19.6%	49.7%
Mach	23.5%	21.6%	30.3%	20.4%	58.3%
Elec-Trans	20.0%	28.9%	33.3%	33.3%	64.4%
Science	23.5%	27.5%	47.1%	21.6%	64.7%
Region					
Northwest	24.1%	30.2%	36.8%	24.3%	66.3%
Northeast	28.6%	21.4%	26.5%	16.3%	55.9%
Atlanta	23.0%	26.4%	35.3%	24.6%	60.3%
West	24.0%	7.1%	30.9%	29.9%	47.6%
Central	17.8%	14.7%	21.1%	9.1%	37.5%
East	5.6%	31.0%	25.8%	11.2%	51.2%
South	22.7%	18.8%	36.7%	30.0%	58.5%
Coastal	20.8%	15.5%	28.2%	24.6%	57.8%
Total	22.8%	22.7%	32.0%	22.1%	56.8%

Source: Georgia Manufacturing Survey 2012, weighted responses of 528 manufacturers.

Marketing Innovations

More than one-third of the manufacturers participating in the survey introduced at least one marketing innovation during the 2009 to 2011 time period. This suggests that marketing innovations are the least common improvement in manufacturing. Introduction of new sales and distribution channels was more slightly common than introduction of new designs or packaging – 25 percent versus 16 percent respectively. Differences by size, industry, and region were less pronounced in the marketing area than in the product, process, or organizational areas. Small establishments were more apt to introduce sales or distribution channel innovations than their larger counterparts. Respondents in the food / textile / apparel / leather firms were most likely to have introduced sales or

distribution channel innovations. Regional differences were most prevalent in the South, and least prevalent in the East and West regions.

Table 4.4. Marketing Innovations Introduced from 2009 to 2011
(Percentage of Establishments that Introduced the Innovations)

	Design/ Packaging	Sales	Any Marketing Innovation
Total	15.6%	24.8%	35.4%
Employment Size			
10-49	11.4%	27.3%	34.4%
50-249	22.5%	20.8%	37.6%
250+	20.1%	21.9%	34.0%
Industry			
Food-text	24.3%	36.2%	50.0%
Material	13.0%	19.5%	31.1%
Mach	7.8%	26.7%	32.1%
Elec-Trans	17.8%	26.7%	33.3%
Science	23.5%	17.7%	33.3%
Region			
Northwest	17.6%	18.7%	33.7%
Northeast	10.7%	26.6%	35.2%
Atlanta	15.4%	26.9%	36.6%
West	17.7%	13.2%	27.1%
Central	23.0%	22.7%	34.8%
East	21.3%	4.7%	26.0%
South	12.3%	30.5%	41.5%
Coastal	11.0%	32.6%	32.6%

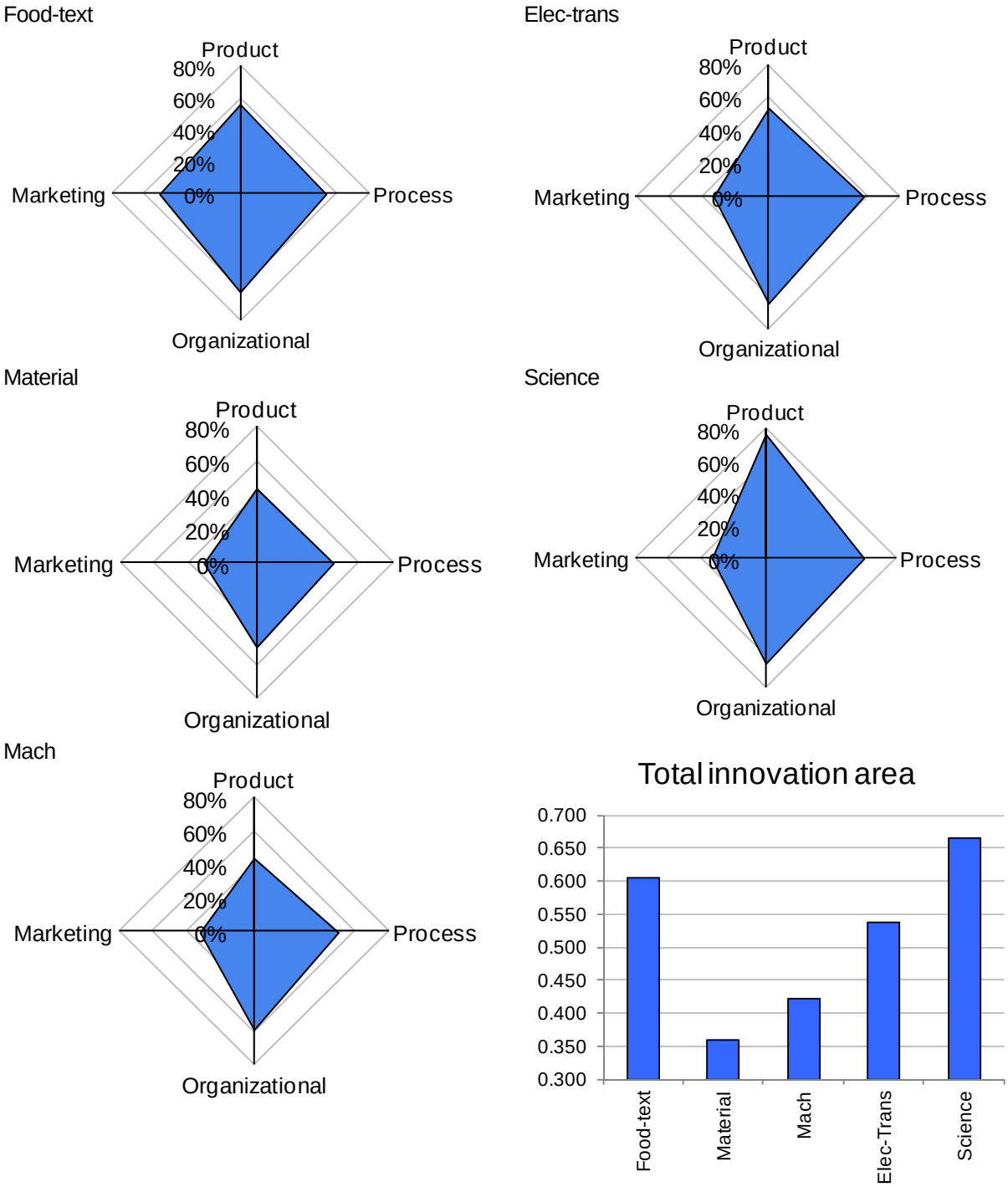
Source: Georgia Manufacturing Survey 2012, weighted responses of 528 manufacturers.

Industry Group Innovation Framework

We examined each of the four general innovation areas individually and found that they range from an overall take-up rate of less than 30 percent for marketing innovations to more than 50 percent for product, process and organizational innovations. Figure 4.4 brings the four types of innovation together and presents them on a “radar graph” to show the innovation framework in each industry group. Each axis on the radar graph represents one general innovation area. The proportion of respondents in an industry group that report using a particular innovation area is indicated in the shaded area on the scale of the axis, which ranges from 0 to 0.8. Where a measure is closer to the outside perimeter of the graph, this represents a stronger sector performance in terms of introducing the innovation. Conversely, where a measure is closer to the center of the graph, this represents a weaker performance in that innovation area. The shaded area provides the basis for visual comparison of industry group performance by

innovation component. Visually, the greater the total shaded area of the radar's octagon, the higher is the industry group's innovation content (Total Innovation Area chart).

Figure 4.4. Radar Charts of Innovation Area Adoption by Industry



Science-based establishments have the largest shaded area. These firms maximize product innovation, with process and organizational innovation in the middle, and marketing innovation at the low end. The food-text group has a similarly balanced area with marketing being prominent in this group. The elec-trans group looks like a right-pointing diamond, with relatively higher levels of product, process, and organizational innovation and lower levels of marketing innovation. The machinery group also follows this right-pointing visual profile. The metals and machinery and materials groups have the smallest albeit balanced visual innovation profile.

Specialized Innovation Activities

The four general areas of innovation can elicit a relatively high level of response. In this section, we follow up these general innovation areas with more explicit items that ask about the adoption of specific innovation-related practices, such as research and development (R&D), capital purchases, engineering, patents,[6] training, marketing research, inter-firm relationships, and the like.

We asked respondents to indicate the extent to which their facility engaged in any of a series of 13 innovation-related activities during the 2009-to-2011 time period. The average respondent implemented three of these activities. The most common activities, as shown in Figure 4.5, were:

- Working with customers to create or design a product, process, or other innovation – 65 percent,
- Signing a confidentiality agreement – 49 percent,
- Purchasing machinery, equipment, computers, or software to implement innovations – 45 percent.
- Working with suppliers to create or design a product, process, or other innovation – 43 percent,
- Engage in in-house R&D – 32 percent

The least common activities were:

- Purchasing R&D from research organizations or other branches of the company (the latter applicable to facilities in a multi-establishment enterprise) – 5 percent.
- Publishing papers or technical articles – 7 percent.
- Purchasing or licensing patents, inventions, know-how, or other types of knowledge – 9 percent.

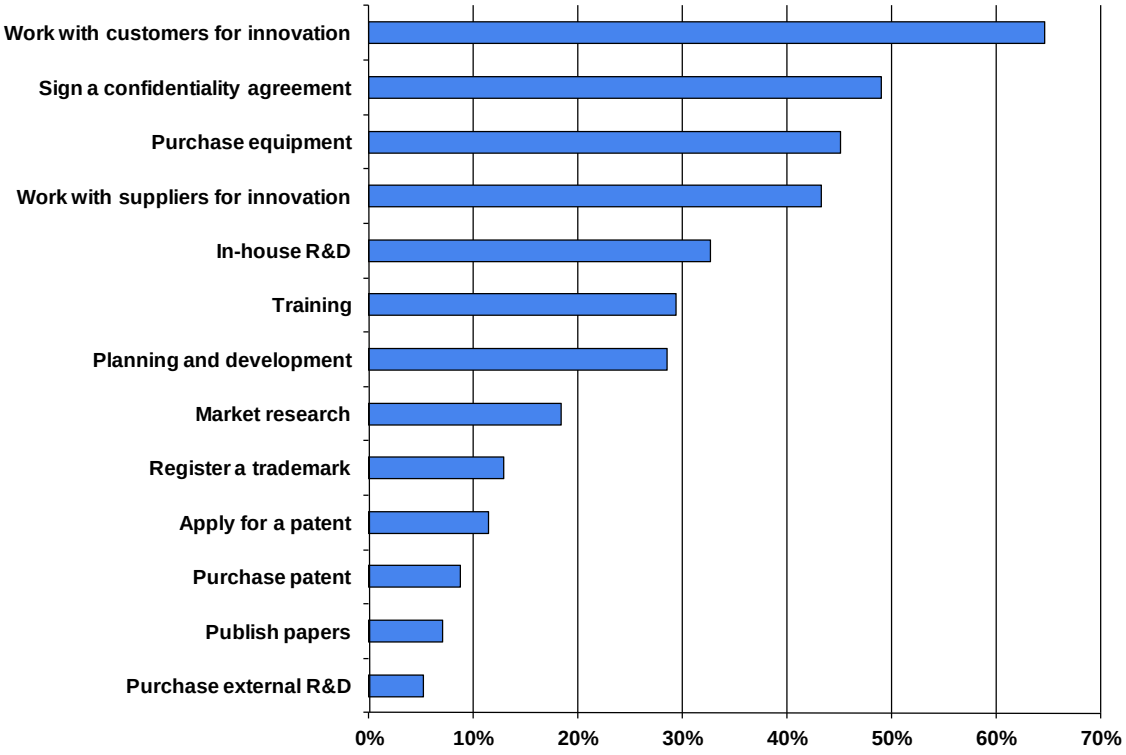
[6] The patenting information is based on manufacturers' survey responses and has not been verified against patent database information.

Several of these activities were particularly affected by facility employment size (Table 4.5). Larger establishments were much more likely than their smaller establishment counterparts to have introduced most of these types of specific innovations. Medium-sized manufacturers (with 50-249 employees) had rates of adoption of working with suppliers, in-house R&D, market research, purchasing a patent, and publishing papers similar to that of large manufacturers (with 250 or more employees) and higher than small manufacturers (with 10 to 49 employees). Small manufacturers were about as likely as medium-sized manufacturers to have conducted market research.

By industry, the elec-trans and science-based industries have the highest take up rate for the 13 activities (Table 4.6). Science-based industries have the highest incidence of purchasing equipment, in-house R&D, market research, registering a trademark, and purchasing external R&D, while the elec-trans group is highest or tied with science-based industries in the rest of the areas. The materials and machinery groups had the lowest take up rates.

The Atlanta and Northwest regions have the highest take up of these activities (Table 4.7). Working with customers to create an innovation is most prevalent among manufacturers in Atlanta, Northwest, and Northeast regions and least prevalent in the West and South regions.

Figure 4.5 Adoption of Specialized Innovation Activities
(Percentage of Establishments that Engaged in the Activity)



Source: Georgia Manufacturing Survey 2012, weighted responses of 528 manufacturers.

Table 4.5. Adoption of Specialized Innovation Activities from 2009 to 2011 by Facility Employment Size

(Percentage of Establishments Engaged in Innovation Activities)

Innovation Activity	10-49	50-249	250+
Work with customers for innovation	62.4%	67.0%	71.6%
Sign a confidentiality agreement	44.6%	54.4%	61.5%
Purchase equipment	39.3%	49.5%	72.9%
Work with suppliers for innovation	32.2%	59.7%	63.2%
In-house R&D	27.0%	41.4%	40.7%
Training	24.7%	34.8%	42.6%
Planning and development	21.8%	36.5%	47.6%
Market research	17.6%	19.2%	20.1%
Register a trademark	10.3%	16.3%	19.4%
Apply for a patent	6.7%	18.0%	23.0%
Purchase patent	6.0%	12.8%	12.9%
Publish papers	4.9%	10.4%	9.9%
Purchase external R&D	3.8%	6.7%	9.9%
Mean # Innovation Activities	3.0	4.2	4.8

Source: Georgia Manufacturing Survey 2012, weighted responses of 528 manufacturers.

Table 4.6. Adoption of Specialized Innovation Activities from 2009 to 2011 by Industry Group

(Percentage of Establishments Engaged in Innovation Activities)

Innovation Activity	Food-text	Material	Mach	Elec-Trans	Science
Work with customers for innovation	64.9%	63.2%	60.7%	77.3%	64.7%
Sign a confidentiality agreement	36.7%	40.9%	55.8%	68.2%	70.0%
Purchase equipment	50.4%	39.3%	38.7%	51.1%	64.7%
Work with suppliers for innovation	51.3%	38.9%	36.1%	56.8%	46.0%
In-house R&D	40.0%	24.9%	25.1%	42.2%	54.9%
Training	35.9%	25.5%	19.5%	40.0%	41.2%
Planning and development	23.9%	22.1%	26.9%	46.7%	47.1%
Market research	25.3%	15.9%	10.5%	22.2%	27.5%
Register a trademark	13.1%	9.4%	7.1%	20.0%	31.4%
Apply for a patent	8.5%	9.9%	10.4%	20.5%	16.3%
Purchase patent	11.5%	5.6%	6.9%	15.6%	11.8%
Publish papers	5.0%	6.5%	5.4%	15.6%	7.8%
Purchase external R&D	9.1%	2.7%	1.3%	8.9%	11.8%
Mean # Innovation Activities	3.7	3.0	3.0	4.8	4.9

Source: Georgia Manufacturing Survey 2012, weighted responses of 528 manufacturers.

Table 4.7. Innovations Introduced from 2009 to 2011 by Region
(Percentage of Establishments Engaged in Innovation Activities)

Innovation Activity	North-west	North-east	Atlanta	West	Central	East	South	Coastal
Work with customers for innovation	69.9%	66.9%	68.7%	52.1%	62.9%	40.2%	54.5%	61.2%
Sign a confidentiality agreement	55.2%	41.8%	55.1%	38.7%	32.5%	43.1%	48.3%	54.0%
Purchase equipment	42.9%	42.2%	51.6%	32.9%	33.8%	36.3%	49.7%	42.7%
Work with suppliers for innovation	46.6%	40.5%	49.2%	34.7%	36.0%	27.4%	40.4%	35.0%
In-house R&D	41.8%	26.8%	38.5%	22.8%	29.4%	33.0%	20.1%	22.6%
Training	30.5%	35.5%	30.3%	10.1%	25.7%	33.2%	35.0%	16.1%
Planning and development	31.9%	24.7%	31.3%	24.0%	27.2%	33.2%	18.1%	32.7%
Market research	14.5%	13.2%	21.8%	22.1%	16.4%	20.4%	17.5%	18.9%
Register a trademark	16.5%	12.9%	13.5%	13.9%	6.0%	14.8%	13.3%	11.9%
Apply for a patent	15.2%	8.1%	14.9%	7.3%	8.0%	20.4%	5.0%	5.2%
Purchase patent	10.2%	9.3%	9.7%	0.0%	8.2%	25.1%	7.4%	0.0%
Publish papers	7.8%	4.7%	9.6%	7.7%	1.2%	12.5%	7.7%	1.9%
Purchase external R&D	4.4%	3.9%	5.9%	0.0%	3.6%	6.9%	11.8%	0.0%
Mean # Innovation Activities	3.8	3.3	4.0	2.7	2.9	3.5	3.3	3.0

Source: Georgia Manufacturing Survey 2012, weighted responses of 528 manufacturers.

Sectoral Innovation Gaps Between Small and Large Firms

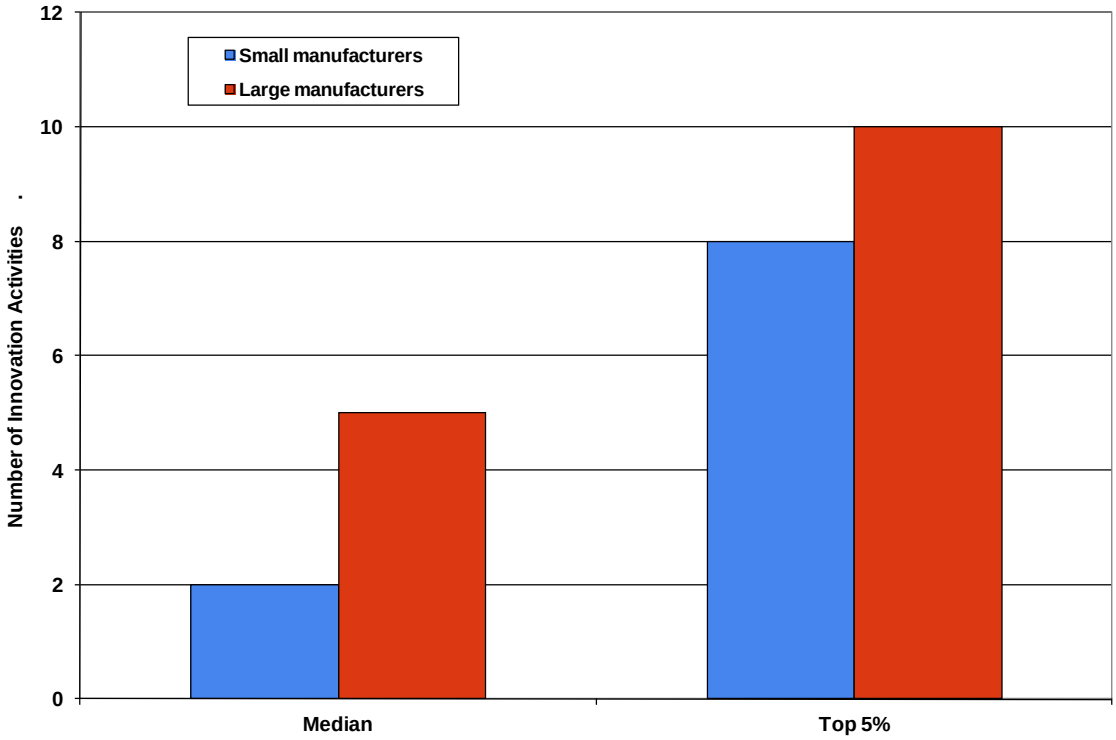
To further probe the patterns of industry group innovation, this section looks more closely at variations by establishment employment size. In general, our analysis shows that large establishments achieve higher levels of innovation activity than smaller ones. We find that median-sector innovation activity level for large establishments is 5, while for smaller firms the comparable median-sector innovation measure is 2. The "gap" between small and large establishments (by the median-sector knowledge content measures) is 3 innovation activities (Figure 4.6).

The observation that an innovation gap exists between small and large establishments is not unexpected. However, some small establishments do slightly better than their median counterparts. Indeed, we find that the top 5 percent of small Georgia establishments are engaged in eight innovation activities – an innovation activity profile that is much higher than median large establishment's average take-up of innovation. *Narrowing* the size of the innovation gap between SMEs and large establishments in Georgia is an important concern.

Moreover, while in overall terms we have established differences by employment size, we also find rather significant variations by industry group. We suggest that it is highly informative to track these industry group differences in innovation activities by employment size. In this analysis, Figure 4.7 presents the mean

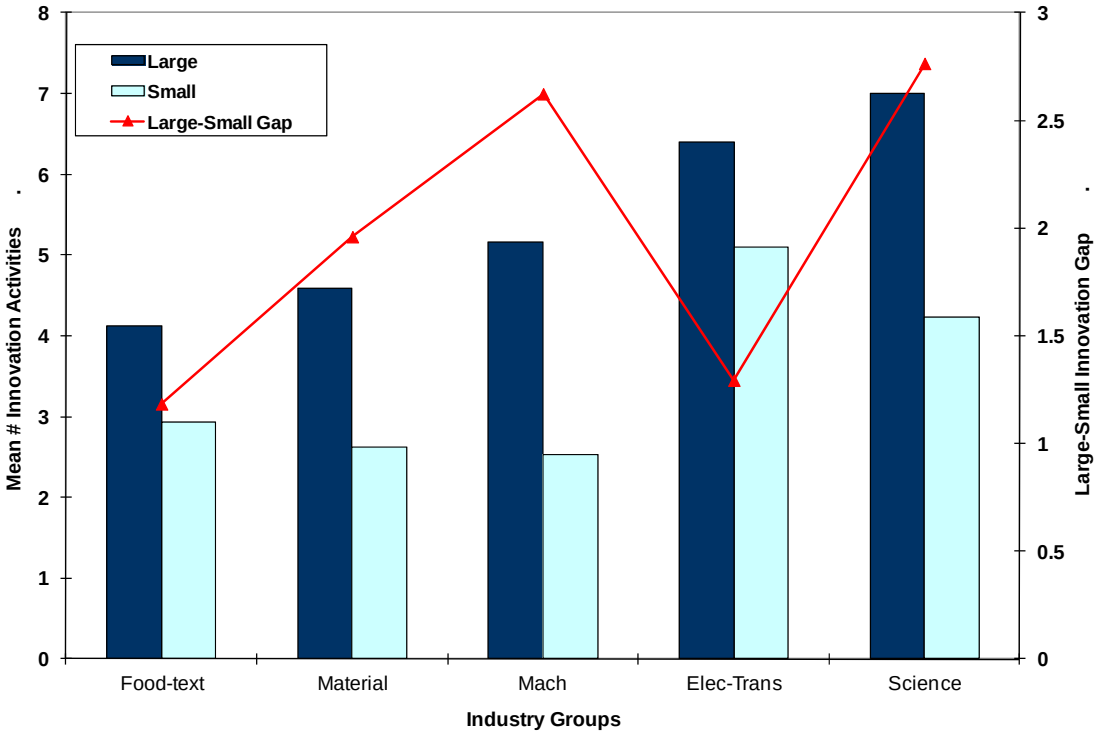
sector innovation measures for SMEs and large establishments (the bars of the graph) and then calculates the difference between these two measures (the line on the graph). The food/textile/apparel/leather and electrical / electronics / science groups have the smallest gap between large and small establishments. The SME-large establishment innovation gap is greatest for science-based industries, followed by the machinery group. One way to interpret these findings is in terms of opportunities for transfer of innovation activities. Thus, it seems that there could be useful opportunities for exchange and learning by other SMEs on the innovation strategies used by SMEs in the food/textile/apparel/leather and electronics/electrical/transportation sector. Strategies to assist SMEs in science-based and machinery groups with many less well-performing SMEs to catch up with the leading edge of innovation practices in their sectors could be helpful (Figure 4.7).

Figure 4.6. Number of Innovation Activities Used by Establishment Size



Source: Georgia Manufacturing Survey 2012, weighted responses of 528 manufacturers.

Figure 4.7. Number of Innovation Activities Used by Establishment Size within Industry Groups



Source: Georgia Manufacturing Survey 2012, weighted responses of 528 manufacturers.

Innovation Expenditures and Investments

Fifty-six percent of the manufacturers participating in the Georgia Manufacturing Survey furnished estimates of their expenditures for: (1) in-house R&D personnel; (2) acquisition of external R&D; (3) acquisition of machinery, equipment, and software; and (4) other development work for innovation. Expenditures for the average respondent, on a per employee basis show that the median establishment that made an investment in innovation spent only $1,917 per employee in innovation, mostly in R&D capital investments (Table 4.8). The distribution of innovation expenditures is skewed, with a small number of establishments investing substantially in innovation, while the majority invests little or nothing by comparison. After capital investments, in-house R&D garnered the next highest level of expenditures. Most respondents expended little or nothing in acquiring external R&D and other development work.

Table 4.8: Average Innovation Expenditures and Investments Per Employee
(medians and trimmed means are reported)

	Mean	Mean (trimmed)*	Median
In-house R&D	$4,015	$1,819	$690
Purchased R&D (from external sources)	$334	$16	$0
R&D capital investments	$6,628	$1,493	$1,000
Other R&D	$747	$133	$0
All R&D Expenditures	$7,887	$4,734	$1,917

*Trimmed mean is the mean that would be obtained if the upper and lower 2.5 percent of the distribution were excluded.

Source: Georgia Manufacturing Survey 2012, weighted responses of 296 manufacturers.

Small manufacturers with 10-49 employees have higher in-house R&D expenditures on a per employee basis than their medium-sized and large counterparts. Purchased R&D per employee is highest for large manufacturers while R&D capital investments per employee is somewhat higher among medium-sized manufacturers . Electrical / electronics / transportation has the highest values for non-capital innovation expenditures relative to establishments in the other industry groups. However, innovation-related capital investments on average were highest for the science-based group. By region, the South and Atlanta regions had the highest average R&D expenditures (Table 4.9).

Table 4.9: Average Innovation Expenditures and Investments Per Employee
(Trimmed means are reported)

	In-house R&D	Purchased R&D	R&D Capital Investments	Other R&D	All R&D Expenditures
Total	$1,819	$16	$1,493	$133	$4,734
Employment					
10-49	2,686	11	1,188	111	6,052
50-249	994	14	1,954	172	3,998
250+	2,074	111	1,860	137	5,250
Industry					
Food-text	295	0	1,492	250	2,477
Material	994	63	757	36	2,284
Mach	1,443	0	1,740	96	4,073
Elec-Trans	7,040	51	1,940	508	13,087
Science	6,010	114	5,929	440	12,916
Region					
Northwest	1,620	n/a	1,240	193	3,265
Northeast	233	2	1,080	89	1,917
Atlanta	3,552	85	1,650	310	7,948

West	3,045	50	1,247	124	4,895
Central	173	10	1,599	38	2,307
East	55	7	1,444	90	1,683
South	6,218	323	1,534	1	9,548
Coastal	448	1240	4,436	290	5,262

Source: Georgia Manufacturing Survey 2012, weighted responses of 296 manufacturers.

How do Georgia manufacturers' R&D expenditures compare with the manufacturers throughout the US? We can use the National Science Foundation's (NSF) Business R&D and Innovation Survey (BRDIS) to compare these results. This comparison is based on R&D intensity, which is calculated by dividing R&D expenditures by sales and reporting the results as a percentage. Georgia Manufacturing Survey respondents have an overall R&D intensity of 1.25, with the science-based group having the highest intensity (more than 2%) and the machinery group at the lowest level (less than 1%). In comparing the Georgia results to that of BRDIS, it is not possible to review this comparison across the same years because the most recent BRDIS results are for 2009. Still the results are close enough in time to provide some insights in how the state's manufacturing R&D intensity matches up with that of the US. The results show that Georgia manufacturers are well below the US benchmark (Table 4.10). By industry, Georgia's food/beverage/textiles/apparel/leather and materials groups have higher R&D intensity levels than the US benchmark, while the others have R&D intensity levels which are far below the US benchmark. One possible explanation for this finding is that Georgia has long had a concentration of manufacturers in the foot/textile/apparel and materials groups, including being a location for headquarters and related operations, including R&D. Indeed respondents in the food/beverage/textiles/ apparel/leather and material industry groups were more likely to be headquartered in Georgia (74 percent of respondents in these groups were headquartered in Georgia) while electronics/electrical/transportation and science-based groups were least likely to be headquartered in the state (60 percent were headquartered in Georgia). In sum, when Georgia manufacturers conduct R&D, these expenditures are below national levels; moreover, most manufacturers do not conduct R&D.

Table 4.10: R&D Intensity: Georgia versus U.S.
(R&D intensity measured by R&D expenditures divided by sales, reported as a percentage of sales)

	R&D Intensity 2011 Georgia	R&D Intensity 2009 US Domestic*
Total	1.25%	4.54%
Industry Group		
Food-text	1.65%	0.86%
Material	2.43%	1.46%
Mach	0.86%	4.03%
Elec-Trans	1.98%	7.77%

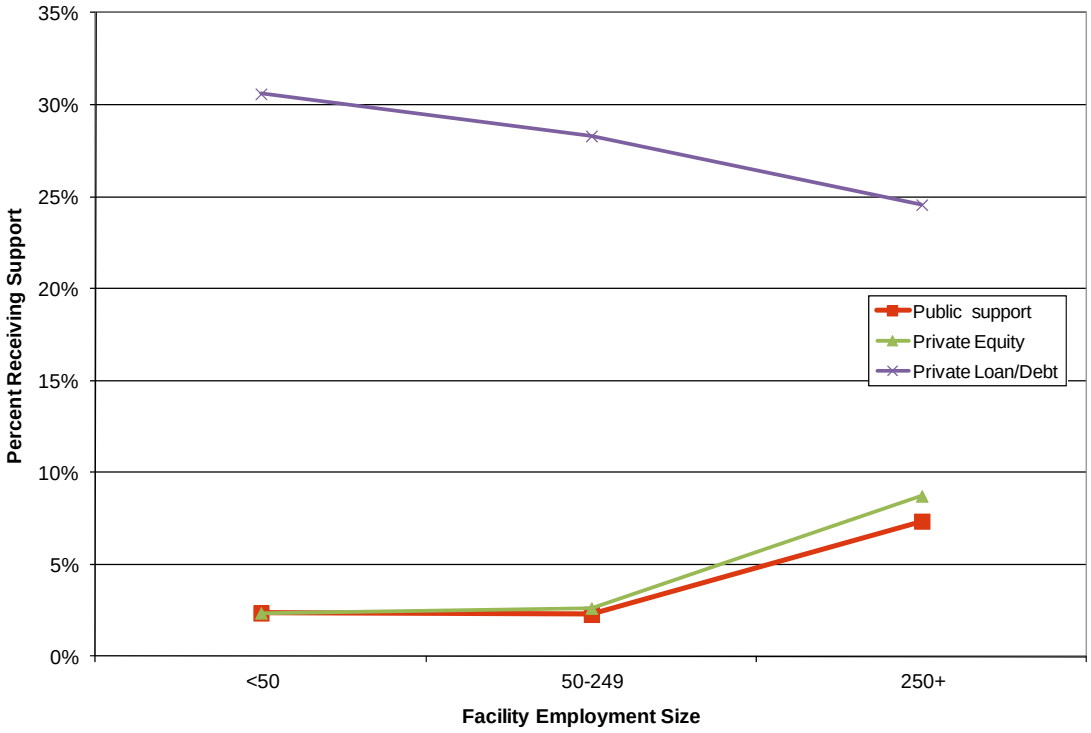
Science	2.24%	6.56%

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

Sources: Georgia Manufacturing Survey 2012, weighted responses of 296 manufacturers; U.S. National Science Foundation/Division of Science Resources Statistics, Business R&D and Innovation Survey: 2009.

Access to financial resources is important for innovation. Manufacturers were asked if their facility received public or private financial support for innovation activities in the 2009 to 2011 time period. Only 4 percent of manufacturers said they received public support such as loans or government grants (local, state, or national level). One percent of respondents reported using the Small Business Innovation Research (SBIR) and related programs. Private equity was similarly rare, with 3 percent of respondents reporting receipt of venture capital, angel financing, or other private equity investment. Conventional loans were more common, with 30 percent of respondents reporting receiving bank loans or other private debt to finance their innovation activities. Large manufacturers with 250 or more employees were somewhat more likely than small manufacturers to have received public support, while the use of private loans was inversely associated with facility employment size (Figure 4.8).

Figure 4.8. Receipt of Public and Private Support by Facility Employment Size



Source: Georgia Manufacturing Survey 2012, weighted responses of 528 manufacturers.

Chapter
5

Manufacturing Technologies and Techniques

This chapter examines use of manufacturing technologies and techniques. Current and planned use of sustainability, information technologies, quality management, and production practices are profiled.

Sustainable Manufacturing

Sustainable manufacturing involves minimizing use of natural resources, toxic materials, waste emissions and production materials over the life cycle of the product or part to achieve cost savings, environmental, and social benefits. This section examines sustainable manufacturing goals and methods that industries use to measure these goals. The specific emphasis is on measurement of carbon footprints of manufacturing facilities.

We asked manufacturers about their sustainable manufacturing goals and the extent to which these goals are put into practice in both the 2010 and 2012 surveys. The six goals under consideration were:

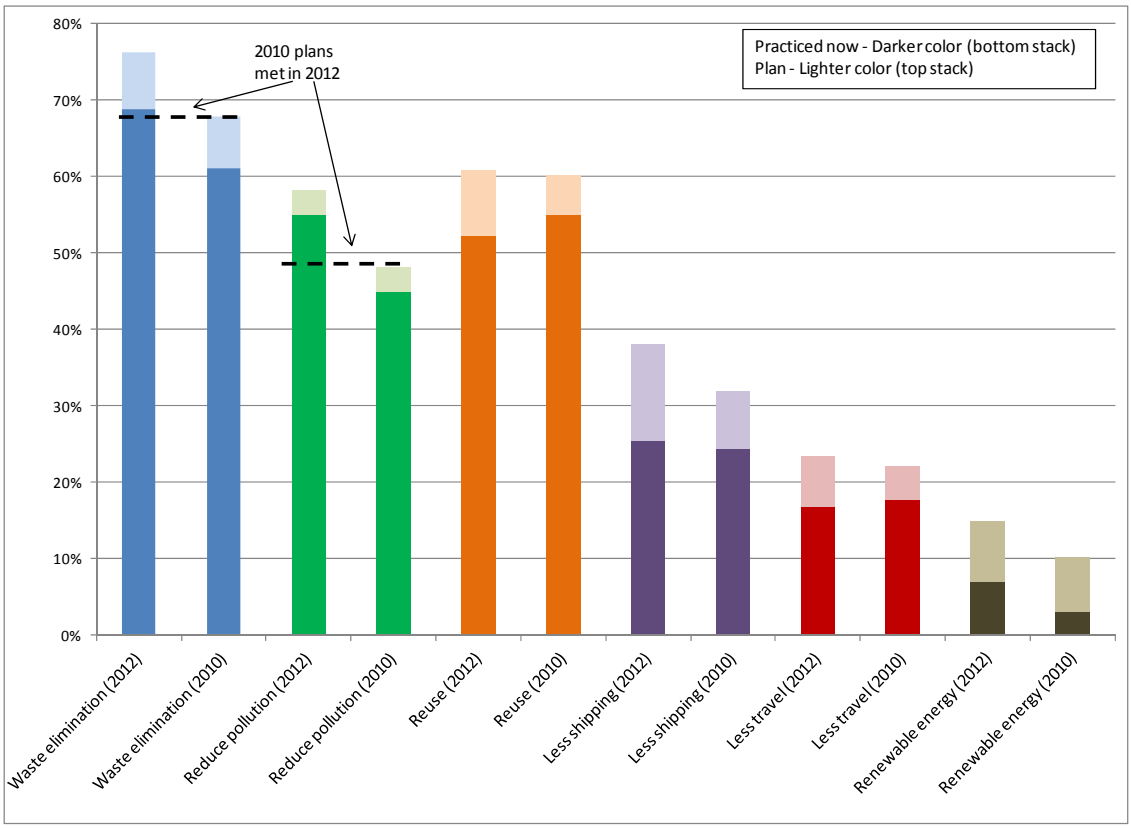
- Elimination of waste materials sent to landfills
- Reduce air or water pollution (reworded from “No smokestacks, effluent, or waste to atmosphere, ground, water, or sewer” in the 2010 survey)
- Operation of facilities with renewable energy sources (e.g., solar, wind, landfill gas, biomass)
- Recovery and reuse of discarded products and manufactured materials (closed loop)
- Reduce energy use and emissions in shipping (e.g. transport of input materials or finished products)
- Reduce energy use and emissions associated with employee commuting or business travel)

Nearly seven in ten manufacturers responding to the Georgia Manufacturing Survey currently set goals to eliminate waste materials sent to landfills. This is the most commonly implemented sustainability goal. The next most common goal, by 55 percent of respondents, is no air or water pollution, followed by

recovery and reuse of discarded products and manufactured materials (closed loop) (52 percent). The least common current sustainability goal, implemented by only 7 percent of respondents, is operation of facilities with renewable energy sources. Also rather less common are reduce energy use and emissions in shipping (25 percent) and reduce energy use and emissions associated with employee commuting or business travel (17 percent). The most common planned goal, by nearly 13 percent of respondents, is to reduce energy use in shipping.

We can compare current and planned use of these practices in 2010 to these same figures for 2012. The comparison enables highlighting of the extent to which plans set in 2010 were actually implemented in 2012. If plans set in 2010 are implemented in 2012, then the percentage of "Practiced now" for 2012 should at least equal the percentage of "Plan" + Practiced now" in 2010. The results indicate that this is the case for only two practices: waste elimination and reduced air/water pollutants. The latter was likely affected by a rewording of the question. Renewable energy also showed a little more progress in 2012 toward the "Plan" + Practiced now" goals of 2010. However, the percentages of manufacturers that reuse of discarded products and manufactured materials (close loop), reduce shipping, and reduce employee travel have not changed much in 2012 from 2010 levels (Figure 5.1).

Figure 5.1. Current and Planned Practice of Sustainable Manufacturing Goals
(Percentage of respondents that currently or plan to put goal into practice; darker colors represent current practices, lighter, represent plans, bars are color coded by goal)



Source: Georgia Manufacturing Survey, weighted responses of 528 manufacturers

We examined the percentage of respondents that currently use sustainable manufacturing goals by manufacturing establishment characteristics (Table 5.1). Large manufacturers were more likely to have set sustainable manufacturing goals than their smaller establishment counterparts. This size difference holds up across all six of the goals considered in this survey. On the other hand, small manufacturer incidence of practicing reduced shipping was nearly the same as that of medium-sized manufacturers and small manufacturer incidence of practicing reduced travel was higher than that of medium-sized manufacturers.

By industry, materials manufacturers were more likely to have eliminated waste and reused products. Science-based manufacturers had the highest share of manufacturers practicing pollution reduction. Reduced shipping was highest for the food-text, materials, and elec-trans groups. Reduced employee travel is highest among manufacturers in the electronics/electrical/transportation group. The food/textiles/apparel/leather and materials groups had the highest rates of operation with renewables, although at less than 10 percent, the use of renewables is still the least common.

By region, the West region had the highest overall rate of adoption of sustainable manufacturing goals. The South and Northwest regions also had a relatively high rate of adoption of these goals. The Central region had the lowest rate of adoption of sustainable manufacturing goals. (See Table 5.1)

Table 5.1. Current Use of Sustainability in Manufacturing Processes by Facility Characteristics

(Percentage of establishments reporting that they currently use sustainability in manufacturing processes)

	Elimi-nation of waste	Reduce pollution	Recovery, reuse of products	Reduced energy shipping	Reduced energy travel	Operate with renewables
Total	68.9%	54.9%	52.3%	25.4%	16.7%	7.1%
Employment						
10-49	64.3%	47.5%	48.2%	23.1%	19.8%	3.4%
50-249	72.3%	60.5%	54.8%	25.9%	9.8%	10.1%
250+	87.3%	82.8%	73.7%	39.6%	23.9%	20.3%
Industry						
Food-text	69.9%	52.1%	49.1%	28.9%	13.4%	9.6%
Material	72.8%	59.6%	59.2%	26.1%	17.1%	9.4%
Mach	62.6%	47.7%	48.0%	21.8%	17.1%	2.5%
Elec-Trans	65.1%	48.8%	41.9%	27.9%	23.8%	7.1%
Science	69.6%	63.8%	53.2%	21.7%	13.3%	4.4%

Region						
Northwest	74.5%	67.0%	54.8%	23.5%	12.5%	14.0%
Northeast	72.1%	56.0%	49.9%	21.4%	17.2%	5.7%
Atlanta	66.0%	52.9%	50.3%	26.7%	19.3%	3.0%
West	74.8%	61.5%	62.9%	30.4%	26.5%	13.5%
Central	60.6%	41.6%	52.6%	24.0%	10.7%	1.5%
East	70.3%	64.7%	56.9%	16.3%	0.0%	17.2%
South	73.3%	50.8%	59.9%	36.3%	19.4%	13.3%
Coastal	69.3%	56.5%	43.2%	15.1%	15.6%	9.6%
Total	68.9%	54.9%	52.3%	25.4%	16.7%	7.1%

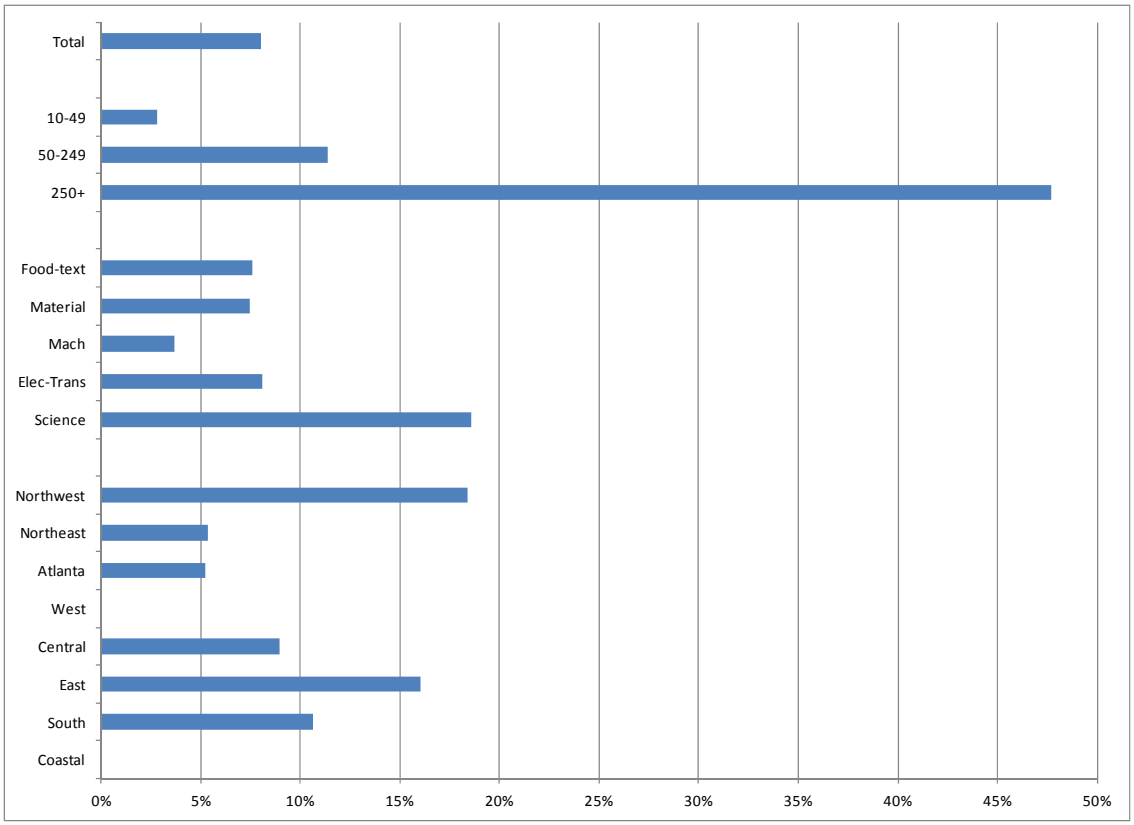
Source: Georgia Manufacturing Survey 2012, weighted responses of 413 manufacturers.

We also found a relationship between introduction of innovation practices and selected areas in which improvement of the sustainability of the processes has been adopted. Manufacturers that had introduced a process innovation in the last three years were more likely to have practiced elimination of waste, pollution reduction, and recovery and reuse than were non-process innovators.

The 2012 questionnaire asked respondents to indicate whether their facility has produced a carbon footprint (i.e., carbon dioxide equivalent emissions) estimate or emissions inventory in the last three years. Eight percent of respondents reported having produced a carbon footprint of their facility. This figure is down slightly from the 11 percent reporting having produced a carbon footprint estimate in 2010.

Carbon footprints or emissions inventories were most common among large facilities with 250 employees or more. Nearly half of these respondents had produced carbon footprint or emissions inventory. In comparison, only 11 percent of medium-sized manufacturing respondents and 3 percent of small manufacturing respondents had produced a carbon footprint or emissions inventory. Science-based industries were most likely to have produced a carbon footprint or emissions inventory. Metals and machinery industries were least likely to have produced a carbon footprint or emissions inventory. By region, footprints or inventories were most prevalent in the Northwest and East regions and least prevalent in the West and Coastal regions (Figure 5.2).

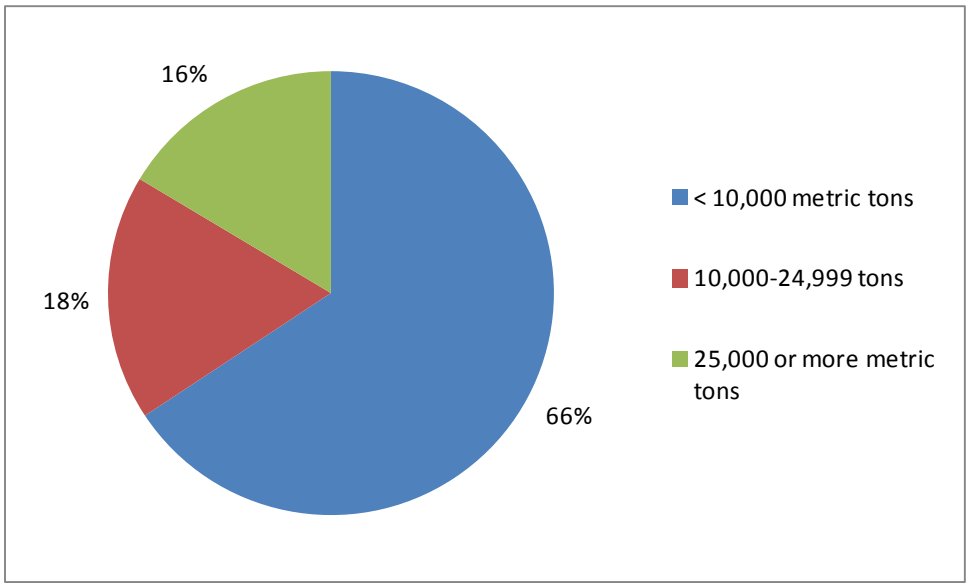
Figure 5.2. Percentage of Respondents That Produced Carbon Footprint by Facility Employment, Industry Group, and Region



Source: Georgia Manufacturing Survey 2012, weighted responses of 413 manufacturers.

Three quarters of these emissions estimates were at less than 10,000 metric tons per year. Fourteen percent were between 10,000 and 25,000 metric tons and eleven percent were for more than 25,000 metric tons. (See Figure 5.3).

Figure 5.3. Percentage of Respondents That Have Conducted a Carbon Footprint Estimate or Emissions Inventory by Annual Emission Level



Source: Georgia Manufacturing Survey 2012, weighted responses of 30 manufacturers.

Energy cost management is an important element of sustainable manufacturing. The Georgia Manufacturing Survey asked respondents to estimate energy expenditures (e.g., heat, electricity) in fiscal years 20011 and 2009. Energy costs declined for all but the top 5 percent most energy intensive users the last two years. The average (median) manufacturer spent 2.6 percent of total costs (e.g. purchased materials, parts, and services) on energy in 2011. Average (median) energy expenditures as a percentage of costs declined for facilities with 50 or more employees and stayed the same for smaller facilities with fewer than 50 employees. By industry, the percentage of costs devoted to energy needs was highest for the food-text and materials groups and lowest for the electronics/electrical/transportation industry group. By region, energy costs were highest for the median manufacturer in the Coastal and Northeast regions and lowest in the Atlanta region. The median manufacturer experienced declines in energy costs across all regions except for the West, Northeast, and Atlanta regions (Table 5.2).

Table 5.2. Median Energy Costs by Facility Employment Characteristics

	2011 Energy Expenditures as a % of Cost of Goods	2009 Energy Expenditures as a % of Cost Of Goods
All	2.6%	3.0%
Employment		
10-50	2.9%	3.3%
50-249	2.0%	2.1%
250+	2.7%	2.7%
Industry group		
Food-text	3.5%	4.1%
Material	3.7%	4.2%
Mach	2.0%	2.1%
Elec-Trans	0.9%	1.1%
Science	1.4%	1.5%
Region		
Northwest	2.5%	2.7%
Northeast	4.3%	3.7%
Atlanta	2.0%	1.9%
West	2.5%	2.2%
Central	2.9%	4.2%
East	2.8%	*
South	2.7%	3.0%
Coastal	4.5%	6.0%

*too few cases for analysis

Source: Georgia Manufacturing Survey 2012, weighted responses of 333 manufacturers.

One measure that is used to assess efficiency from an energy and sustainability perspective is the energy intensity ratio. In this analysis we use a definition of energy intensity that is energy expenditures (e.g., heat, electricity) per million dollars of total annual sales or gross value of shipments.

Energy intensity for the average (median) manufacturer in 2011 was less than $14,000 (Table 5.3). Small and medium-sized facilities with fewer than 250 employees had lower average energy intensity than their larger counterparts. Average energy intensity was relatively higher for manufacturers in the food/textiles/apparel/leather and materials industry groups and also for manufacturers in the Northeast, Coastal, West, and East regions. Energy intensity was relatively lower for manufacturers in the science and electronics/electrical/transportation sector, and for manufacturers in Atlanta.

In general, each manufacturing group has seen its energy intensity go up in 2011 over 2009 levels. This increase suggests that while energy costs

generally remained constant or even declined slightly, sales declined even more so from 2009 to 2011. Thus overall energy intensity went up from 2009 to 2011.

Table 5.3. Median Energy Intensity by Facility Employment Characteristics

	2011 Energy Expenditures per $ millions of sales	2009 Energy Expenditures per $ millions of sales
All	$13,669	$12,782
Employment		
10-50	$13,684	$13,796
50-249	$12,778	$10,000
250+	$20,249	$14,545
Industry group		
Food-text	$18,571	$19,298
Material	$18,182	$16,243
Mach	$10,277	$9,715
Elec-Trans	$5,434	$4,000
Science	$6,573	$5,372
Region		
Northwest	$13,669	$10,000
Northeast	$20,690	$19,524
Atlanta	$9,791	$8,000
West	$17,692	$11,894
Central	$15,283	$16,243
East	$17,524	$13,277
South	$14,432	$15,198
Coastal	$18,733	$15,668

Source: Georgia Manufacturing Survey 2012, weighted responses of 344 manufacturers.

Manufacturing Technologies and Techniques

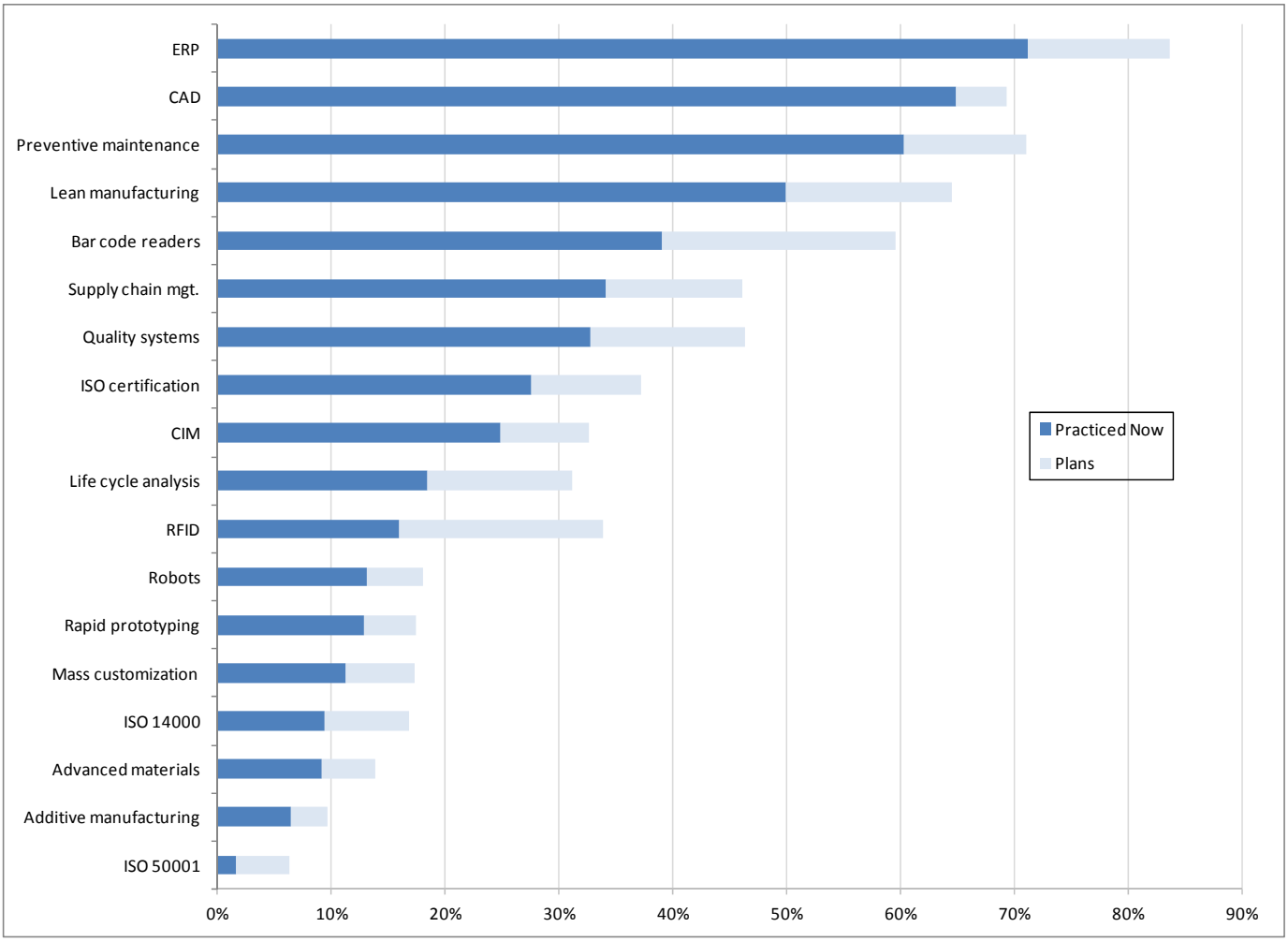
This section examines current and planned use of a set of 18 information technologies, quality management and continuous improvement techniques, and manufacturing production technologies. These technologies include:

- Bar code readers for data collection
- Computer aided design
- Software for scheduling, inventory control, or purchasing (e.g., ERP)
- RFID for inventory and warehouse tracking
- Supply chain management systems
- Mass customization systems

- ISO 9000, TS16949 certification
- ISO 14000 environmental management certification
- ISO 50001, Energy Management System
- Quality systems (e.g., Six Sigma)
- Lean manufacturing
- Preventive/predictive machine maintenance program
- Life cycle analysis
- Computer-integrated manufacturing (CIM)
- Rapid prototyping
- Additive manufacturing, printed manufacturing
- Robots
- Advanced materials (e.g., nano-materials, bio-materials, composites)

Eighty-six percent of respondents used at least one of these technologies and techniques. The median respondent used four of these technologies, while 5 percent of respondents used 10 or more. Software for scheduling, inventory control of purchasing such as enterprise resource planning (ERP) is the most commonly used (71 percent), followed by computer aided design (65 percent), preventive and predictive maintenance (60 percent), and lean manufacturing (50 percent). Plans for acquiring new technologies are most common for bar code readers (21 percent) and radio frequency identification (RFID) for inventory and warehouse tracking (18 percent) (Figure 5.4).

Figure 5.4. Technologies and Techniques Manufacturers Use and Plan to Use



Source: Georgia Manufacturing Survey 2012, weighted responses of 471 manufacturers.

Eighty-six percent of respondents used at least one of these technologies and techniques. The median respondent used four of these technologies, while 5 percent of respondents use 10 or more. In general, use of technologies and techniques increases with facility employment size. This is particularly true for use of supply chain management, quality systems, lean manufacturing, robots, and bar code readers. Rapid prototyping and advanced materials use are not related to employment size, however. By industry, the electronics/electrical/transportation and science-based groups tend to have the highest use of these technologies and techniques. However, RFID is most prevalent in the food/textile/apparel/leather group (used by 25 percent of these respondents) and CAD in the machinery group (used by 80 percent of these respondents). The materials group is generally least likely to use these technologies and techniques. The Northwest, Atlanta, and Central regions are most likely to have users of these technologies and techniques, while the East and Coastal are least likely (Tables 5.4, 5.5, 5.6).

Table 5.4. Current Use of Technologies and Techniques by Facility Employment Size
(Percentage of Establishments Using Technology)

Technology/Technique	10-49	50-249	250+
ERP	61.0%	84.5%	93.0%
CAD	59.7%	70.5%	81.1%
Preventive maintenance	53.9%	68.2%	73.8%
Lean manufacturing	41.8%	58.9%	72.8%
Bar code readers	26.3%	52.4%	78.4%
Supply chain mgt.	24.8%	42.1%	70.3%
Quality systems	19.9%	46.2%	69.1%
ISO certification	19.7%	37.4%	46.4%
CIM	20.2%	30.3%	38.2%
Life cycle analysis	13.7%	20.2%	46.7%
RFID	10.2%	21.7%	37.6%
Robots	6.6%	16.4%	48.9%
Rapid prototyping	11.6%	15.3%	12.4%
Mass customization	5.7%	16.5%	31.0%
ISO 14000	2.9%	15.0%	34.9%
Advanced materials	9.4%	9.1%	8.4%
Additive manufacturing	3.8%	9.1%	16.2%
ISO 50001	1.1%	1.2%	7.9%

Source: Georgia Manufacturing Survey 2012, weighted responses of 471 manufacturers.

Table 5.5. Current Use of Technologies and Techniques by Industry Group
(Percentage of Establishments Using Technology)

Technology/Technique	Food-text	Material	Mach	Elec-Trans	Science
ERP	71.2%	65.0%	70.4%	85.7%	81.6%
CAD	63.8%	57.9%	80.4%	70.7%	55.6%
Preventive maintenance	55.3%	56.1%	58.0%	64.3%	84.4%
Lean manufacturing	45.3%	46.9%	50.9%	60.5%	55.6%
Bar code readers	59.9%	32.6%	26.6%	42.9%	46.8%
Supply chain mgt.	38.5%	36.1%	20.4%	35.7%	43.8%
Quality systems	34.3%	23.9%	27.4%	51.2%	54.6%
ISO certification	14.4%	20.0%	29.8%	47.6%	52.3%
CIM	23.7%	23.9%	28.7%	34.2%	13.3%
Life cycle analysis	23.7%	14.3%	14.5%	25.0%	26.8%
RFID	24.4%	15.4%	11.5%	10.0%	18.8%
Robots	9.7%	12.2%	16.6%	21.4%	6.7%
Rapid prototyping	10.4%	11.0%	10.5%	33.3%	7.0%
Mass customization	10.6%	11.6%	9.0%	20.5%	6.3%
ISO 14000	14.4%	5.7%	6.9%	17.5%	12.2%
Advanced materials	11.8%	9.7%	3.4%	10.3%	13.6%
Additive manufacturing	7.5%	6.2%	4.0%	7.7%	9.1%
ISO 50001	3.7%	0.9%	0.7%	0.0%	4.8%

Source: Georgia Manufacturing Survey 2012, weighted responses of 471 manufacturers.

Table 5.6. Current Use of Technologies and Techniques by Region
(Percentage of Establishments Using Technology)

Technology/ Technique	North-west	North-east	Atlanta	West	Central	East	South	Coastal
ERP	81.7%	59.3%	73.9%	69.6%	74.1%	74.1%	65.4%	60.4%
CAD	58.3%	57.9%	69.2%	69.6%	62.5%	51.6%	69.5%	67.4%
Preventive maintenance	70.0%	61.6%	64.0%	61.8%	51.8%	52.9%	45.4%	48.8%
Lean manufacturing	50.3%	54.3%	50.3%	49.9%	50.1%	35.5%	50.1%	41.2%
Bar code readers	48.6%	33.6%	41.5%	36.6%	41.6%	33.8%	24.0%	37.6%
Supply chain mgt.	41.5%	34.7%	33.4%	37.9%	33.3%	37.4%	21.6%	38.3%
Quality systems	44.4%	27.9%	29.6%	18.9%	47.0%	28.5%	27.4%	31.1%
ISO certification	33.4%	24.8%	31.4%	22.5%	29.2%	13.6%	23.5%	8.0%
CIM	27.8%	20.8%	23.6%	27.9%	25.4%	9.5%	29.9%	28.8%
Life cycle analysis	8.4%	17.2%	25.5%	24.5%	15.2%	17.9%	13.4%	9.3%
RFID	22.2%	15.5%	12.1%	26.4%	19.7%	0.0%	18.1%	16.0%
Robots	16.7%	15.7%	15.6%	8.9%	8.5%	6.8%	9.3%	3.3%
Rapid prototyping	6.6%	13.2%	18.0%	9.5%	16.3%	0.0%	9.5%	1.7%
Mass customization	15.4%	12.7%	10.1%	23.5%	10.5%	15.1%	8.3%	0.0%
ISO 14000	16.6%	9.5%	10.0%	5.6%	6.1%	7.4%	4.5%	4.0%
Advanced materials	8.9%	9.9%	9.9%	0.0%	16.3%	6.7%	8.9%	0.0%
Additive manufacturing	7.9%	7.0%	5.1%	0.0%	10.7%	0.0%	13.0%	0.0%
ISO 50001	0.0%	0.0%	2.1%	0.0%	0.0%	7.4%	1.9%	7.3%

Source: Georgia Manufacturing Survey 2012, weighted responses of 471 manufacturers.

In this analysis, we distinguish (1) base entry use and (2) competitive or advanced entry use. These two categories are assessed along 11 dimensions:

- State of the art equipment
- Highly skilled people
- High levels of design
- Information technologies
- Product development
- New materials and processes
- Supplier engagement
- Customer engagement
- Life-cycle sustainability
- High quality and reliability
- Automation

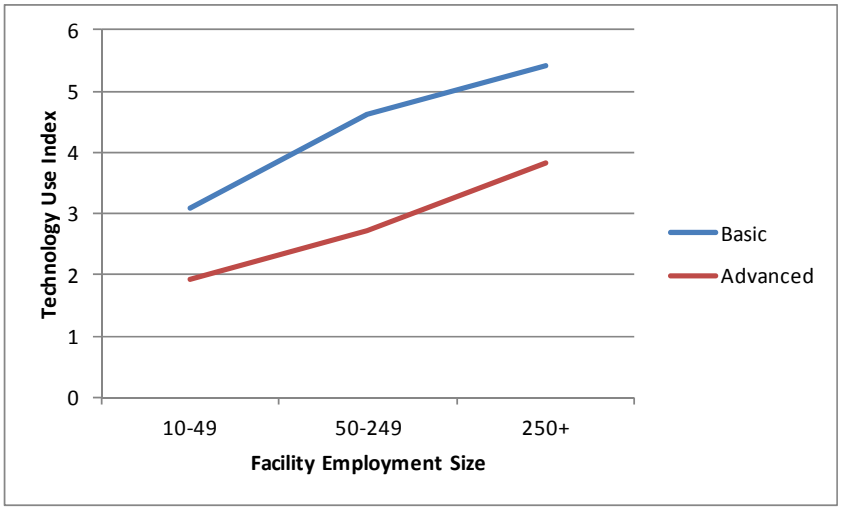
For each dimension, there is a base entry and a competitive/advanced entry (Table 5.7). A simple sum of each technology for basic and advanced entry shows the difference between levels of basic use of technology versus those of advanced use (Figure 5.5). Ninety-two percent of respondents used at least one base entry technology, while 84 percent used at least one advanced entry technology. Technology use differs by size, but medium-sized establishments are closer to large establishments in their use of basic technologies than advanced ones. Similarly, while the elect-trans group is the largest user of basic and advanced technology, followed by the science group, food-text and machinery manufacturers are closer to these leading groups in their use of basic technologies, while

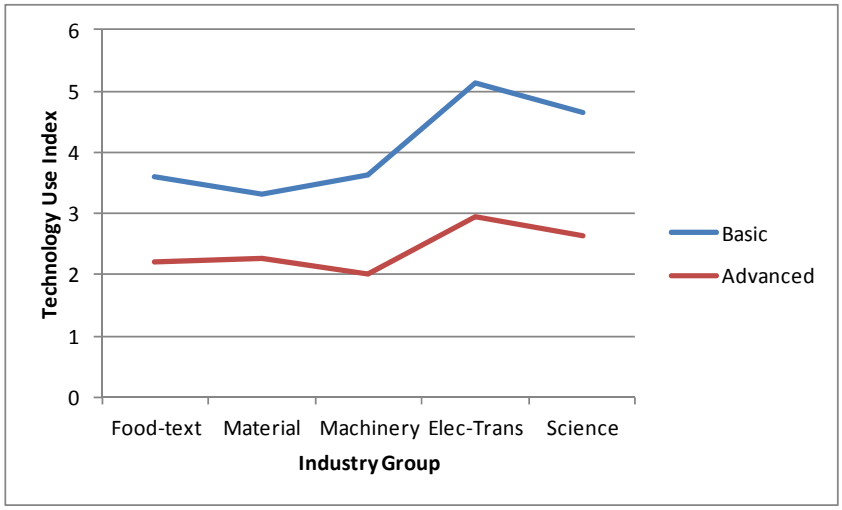
materials manufacturers are closer on advanced technologies. Regional differences are more pronounced in terms of use of basic technologies than advanced technologies, with Northwest region respondents more likely to use these technologies and those in the East, South, and Coastal less likely to use them.

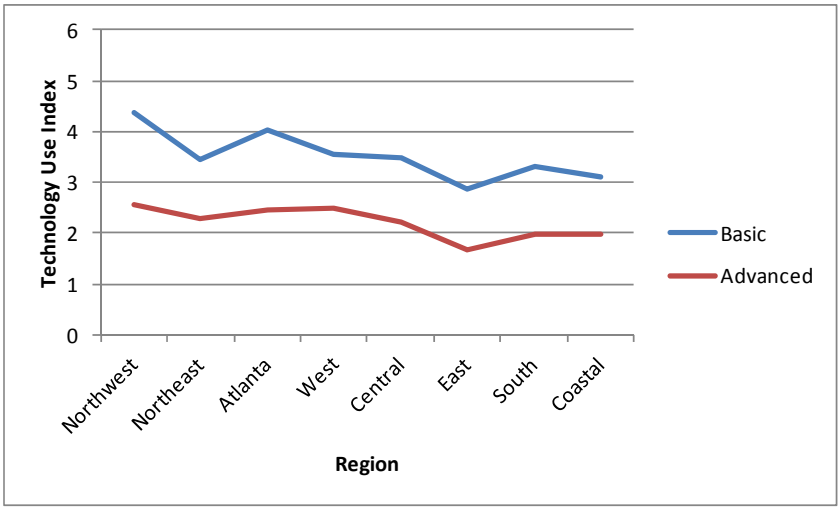
Table 5.7. Base Entry and Competitive/Advanced Entry: Manufacturing Technologies, Techniques

Component	Base entry measure	Competitive/advanced entry measure
State of the art equipment	Preventive/predictive machine maintenance program	Percentage of workers using computers 75 percent or more.
Highly skilled people	More than $100 spent on all training activities in fiscal year 2011	Percentage of training that is non-routine of 50 percent or more
High levels of design	Use of CAD	Use of mass customization design systems
Information technologies	Use of ERP	Use of RFID
Product development	Use of Rapid prototyping	Use of additive manufacturing, printed manufacturing
New materials and processes	Use of higher performing materials	Use of new materials (e.g., nano-materials, bio-materials, advanced composites)
Supplier engagement	Work with suppliers for innovation	Use of supply chain management systems
Customer engagement	Any marketing innovation	Work with customers for innovation
Life-cycle sustainability	Use of environmental (ISO 14000), energy (ISO 50001) management	Use of life-cycle analysis
High quality and reliability	Use of ISO 9000, QS-9000 certification	Use of lean manufacturing
Automation	Use of robots	Use of CIM

Figure 5.5. Usage of Basic and Advanced Technologies and Techniques by Size, Industry, Region



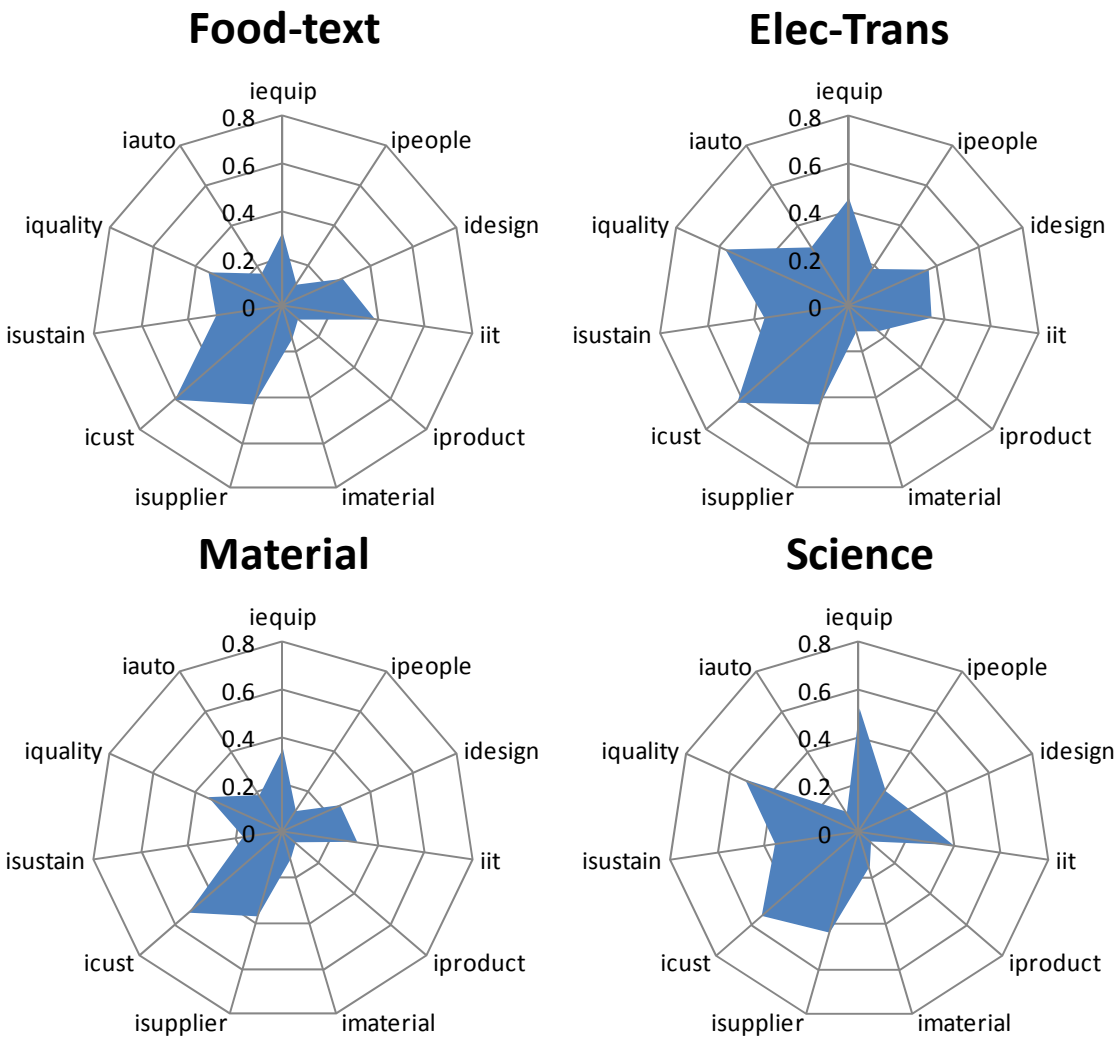


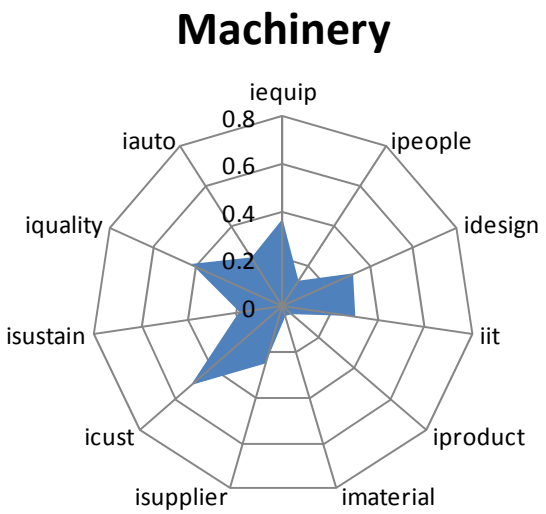


Source: Georgia Manufacturing Survey 2012, weighted responses of 471 manufacturers.

Differences are also apparent when considering each dimension separately. This can be done through an examination of radar charts showing an index score on each of the 11 dimensions. In this analysis, the basic entry technologies are given a score of "1" and the competitive/advanced, a score of "2". The results are normalized to a 0-1 scale. Most of the industries have significant usage of customer and supplier entry techniques, owing to the widespread work with customers and suppliers on innovation. The elec-trans and science groups tended to have the greatest usage along the 11 dimensions of analysis. Design, product, customer, quality, and automation dimensions were particularly prevalent in the elec-trans group. The science group tended to be strongest along equipment, IT, material, and people dimensions.

Figure 5.5. Usage of Basic and Advanced Technologies and Techniques





Source: Georgia Manufacturing Survey 2012, weighted responses of 471 manufacturers.

Technology use is often assessed relative to employment. Some contend that technology is used to substitute for workers. Others contend that the most efficient and effective firms use technology, which enables greater productivity and consequently more workers hired. Although results from this survey cannot address these points of view causally (due to the cross-sectional nature of the survey data), we can examine these perspectives as an association without attributing causal relationships. Across the technologies in this survey, about 50 percent are used by manufacturers with job gains, 35 percent are used by manufacturers with job losses, and 15 percent are used by manufacturers with neither job losses nor gains.

Drawing on the work of Haltiwanger and colleagues[7], we estimate change in employment from 2009 to 2011 as a function of: whether significant changes occurred in the facility in the last two years; change in sales from 2009 to 2011; change in capital investment from 2009 to 2011; year manufacturing began at the facility; and number of technologies used at the facility. Two dichotomous outcome models are estimated: one for positive change in employment and the other four negative change in employment. Of the 87 percent of respondents reporting employment information for both periods, half had increases in employment from 2009 to 2011, 36 percent had decreases in employment in the period, and 15 percent had the same employment. Because the employment estimates were highly heterogeneous, we are treating the changes as categories in the models. Logit models are used for these specifications. The results indicate that greater technology use is positively and significantly associated with higher employment, but not significantly associated with lower employment (Table 5.8). In addition, sales and capital investment increases are positively associated with both higher and lower employment; major change is negatively associated with higher employment and positively associated with lower employment; year established is negatively associated with lower employment (i.e., newer firms are less likely to have employment declines than older firms are); there are some industry relationships, with non-durable industries negatively associated with employment growth and positively associated with employment declines. A unit increase in technology use is associated with a 2.8 percent in the probably of employment increases from 2009-2011, holding the rest of the variables constant.

[7] Dunne, T, Haltiwanger, J., Troske, K (1996). Technology and Jobs: Secular Changes and Cyclical Dynamics, Working paper 5656. Cambridge, MA: National Bureau of Economic Research.

What are the implications of this model for the relationship between technology use and employment? The results suggest that technology is not associated with job losses. One caveat is that the model does not represent manufacturers that went out of business due to technological and other factors. That said, technology substitution-related job losses may have been offset by employment gains due to greater competitiveness.

Table 5.8. Employment and Technology Use

Variables	Employment Higher 2009-11	Employment Lower 2009-11
major change	-0.261 (0.101)***	0.461 (0.104)***
sales diff. 2009-11	0.000 (0.000)***	0.000 (0.000)***
capital diff. 2009-11	0.000 (0.000)***	0.000 (0.000)***
year established	0.003 (0.002)	-0.01 (0.002)***
number tech. used	0.108 (0.015)***	0.002 (0.015)
food-text	-0.825 (0.186)***	1.532 (0.245)***
materials	-0.803 (0.168)***	1.946 (0.230)***
machinery	-0.383 (0.178)**	1.48 (0.239)***
elec-trans	0.314 (0.214)	0.294 (0.295)
Constant	-5.099 (4.554)	16.772 (4.646)***
Pseudo R2	0.152	0.142
Log Likelihood	2875.927***	2670.483***
Observations	319	319

Standard errors in parentheses, parameters are log odds (logit models).
* significant at 10%; ** significant at 5%; *** significant at 1%
Percentages predicted correctly: 65% (Employment Higher), 69% (Employment Lower)

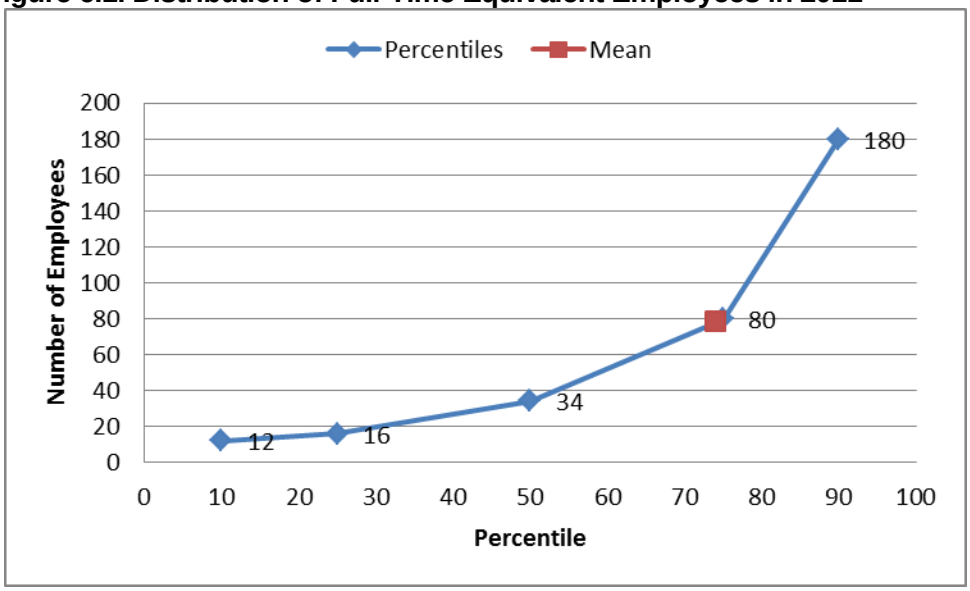
Chapter
6

Workforce and Training Practices

Workforce

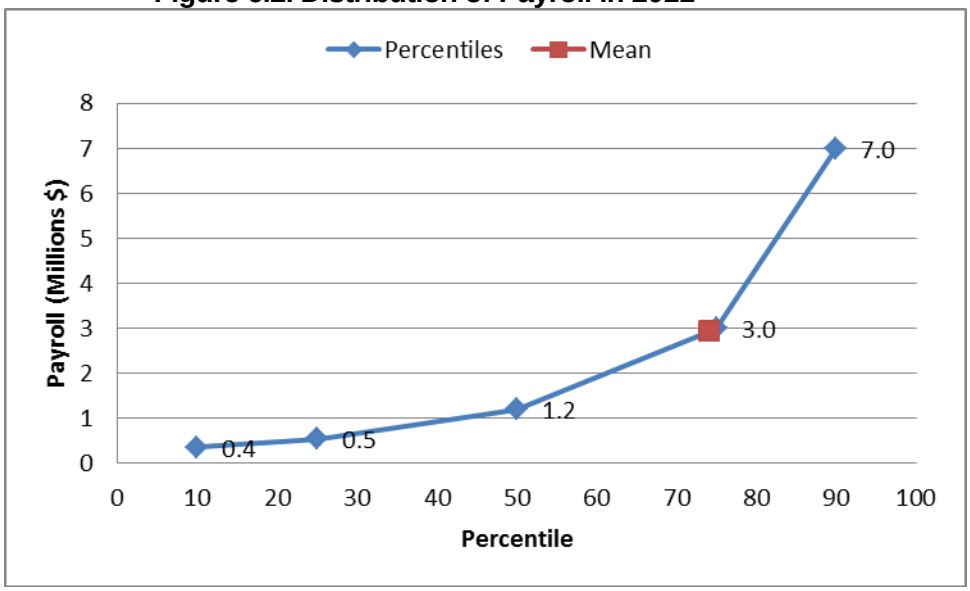
The mean and median employment size of manufacturers in 2011 was 78 and 34 full-time equivalent employees, respectively. The mean and median payroll was $3.0 million and 1.2 million, respectively. Figures 6.1 and 6.2 show the employment and payroll distribution for manufacturers in Georgia. The average pay per employee for 2011 was $37,100.

Figure 6.1. Distribution of Full-Time Equivalent Employees in 2011



Source: Georgia Manufacturing Survey 2012, weighted results of 528 manufacturers

Figure 6.2. Distribution of Payroll in 2011



Source: Georgia Manufacturing Survey 2012, weighted results of 339 manufacturers

Employment size and pay per employee did not reveal a relationship in the 2011 survey; the median pay for companies with less than 50 employees was $35,714; for companies between 50 and 249 employees, $40,125; and for companies with 250 or more employees, $35,862 (Table 6.1). Pay per employee varied significantly depending on the type of industry. The food and textiles group recorded the lowest median pay per employee, $32,500, while at the higher end science-intensive firms paid $44,601 per employee. Location was another factor that affected payroll. Companies located in the South and Central regions of Georgia reported the lowest pay per employee, with a median of $32,500 each. The Coast region, at the other end, showed a median compensation of $41,364 per employee.

Table 6.1. 2011 Median Number of Employees and Payroll per Employee by Employment Size, Industry, and Location

	Employees	Pay ($)
<50	18	35,714
50-249	82	40,125
250+	400	35,862
Food-text	52	32,500
Material	33	35,000
Mach	23	40,385
Elec-Trans	59	40,625
Science	34	44,601
NW	50	40,000
NE	39	39,008
ATL	29	40,625
West	55	37,500
Central	28	32,500
East	40	35,000
South	30	32,500
Coast	25	41,364
All	34	37,105

Source: Georgia Manufacturing Survey 2012, weighted results of 339 manufacturers

During continued economic uncertainty, many companies opted for temporary employees. On average, temporary workers represented 9 percent of full time employees during 2011, a 2 percent increase compared to 2009 (Table 6.2). Larger employers, especially with 250+ employees, maintained a greater percent of temporary workers. Employers with 250+ employees also increased their temporary employee percentage to 13 percent up from 8 percent in 2009. While most industry groups increased their percentages of temporary employees, the elec-trans did not do so substantially. The science-based manufacturers almost doubled their percentages from 7 percent to 13 percent. Most regions in Georgia were consistent by hiring more temporary workers during 2011, with a clear exception of the West, whose companies almost halved temporary workers since 2009.

Table 6.2. 2011 Mean Percent Number of Temporary Employees over Full Time Employees by Employment Size, Industry, and Location

	2011	2009
<50	8%	7%
50-249	9%	6%
250+	13%	8%
Food-text	5%	4%
Material	9%	7%
Mach	9%	7%
Elec-Trans	11%	10%
Science	13%	7%
NW	8%	5%
NE	8%	5%
ATL	9%	7%
West	6%	11%
Central	9%	8%
East	3%	3%
South	9%	5%
Coast	11%	8%
All	9%	7%

Source: Georgia Manufacturing Survey 2012, weighted results of 416 manufacturers

Employee Education and Training

More than three-quarters of employees in the typical Georgia manufacturing facility have a high school diploma or GED. However, fewer than 20 of employees have two-year technical training and fewer than 10 percent have four-year degrees. Smaller employers on average have a more educated workforce. Manufacturers with less than 50 employees reported an average of 13 percent and 10 percent of their employees with a four-year technical and non-technical degrees, respectively (Table 6.3). The elec-trans group showed the highest levels of education, followed by machinery and science-based. Atlanta and the Coastal region reported the highest education levels by region.

Table 6.3. Employee Education by Employment Size, Industry, and Location

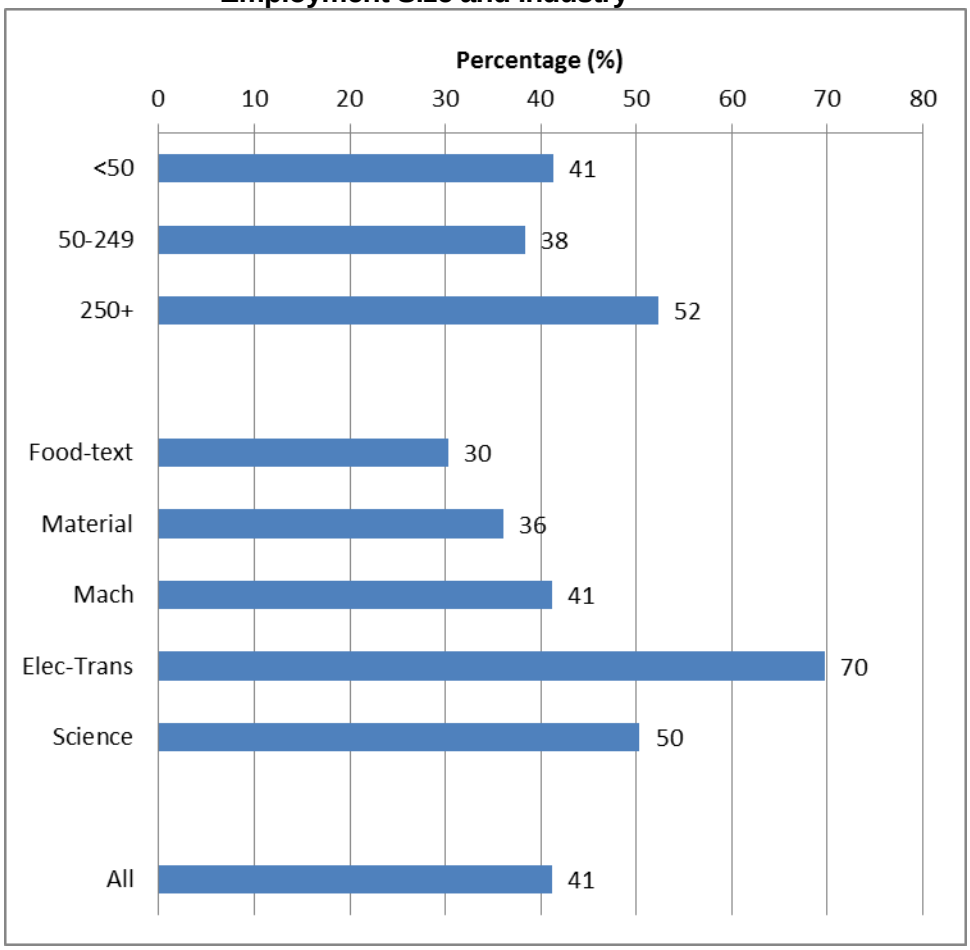
	HS Diploma or GED	2-year Technical Training	4-year Technical Degree	4-year non Technical Degree	Graduate Degree
<50	81%	22%	13%	10%	2%
50-249	76%	14%	6%	8%	1%
250+	84%	13%	8%	8%	1%
Food-text	73%	13%	10%	10%	1%
Material	78%	16%	7%	9%	1%
Mach	84%	27%	11%	8%	2%
Elec-Trans	89%	24%	16%	9%	4%
Science	83%	18%	16%	12%	3%
NW	75%	16%	9%	7%	1%
NE	76%	16%	7%	9%	2%
ATL	84%	21%	15%	12%	3%
West	77%	18%	6%	7%	1%
Central	81%	19%	6%	7%	1%
East	83%	13%	5%	5%	2%
South	76%	18%	8%	9%	1%
Coast	82%	23%	11%	12%	0%
All	80%	19%	10%	9%	2%

Source: Georgia Manufacturing Survey 2012, weighted results of 341 manufacturers

Computer Use

The typical manufacturer has more than 40 percent of its employees using a computer or programmable controller at least once a day. The largest manufacturers with 250+ employees and manufactures in the elec-trans group had substantially higher levels of computer usage (Figure 6.3).

Figure 6.3. Computer Usage of Production Workers At Least Once a Day By Employment Size and Industry



Source: Georgia Manufacturing Survey 2012, weighted results of 490 manufacturers

Training Expenses

Median training expenses per employee among manufacturers in Georgia was $581 during 2011, from which 29 percent corresponded to training for new tasks. Training expenses per employee increased in 2011 compared to 2009, which in part can be explained by a higher number of temporary workers during 2011. Smaller manufacturers invested higher percentages of total training on training on new tasks (Table 6.4). Manufacturers from the food-text and elec-trans groups spent almost half the amount on training that the other groups did during 2011. Training expenses by manufacturers' top competitive strategy showed some interesting differences. Companies that use low price as their top strategy reported the lowest training expenses among groups; companies focused on innovation and high quality spent four times more than the low price ones.

Table 6.4. Median Training Expenses per Employee By Employment Size, Industry, and Top Competitive Strategy

	Training Expenses per Employee ($)	Training Expenses for New Tasks ($)	Training New Tasks/Total Training (%)
<50	320	99	31
50-249	1106	307	28
250+	341	71	21
Food-text	336	92	27
Material	661	185	28
Mach	742	240	32
Elec-Trans	314	81	26
Science	635	202	32
Low price	195	34	18
High quality	745	229	31
Innovation	808	259	32
Quick delivery	249	82	33
Customization	385	114	30
Sustainability	202	0	0
All	581	168	29

Source: Georgia Manufacturing Survey 2012, weighted results of 395 manufacturers

Employee Incentives

Many manufacturers provide bonuses and other incentives to encourage employees to acquire new skills or education, encourage productivity increases, and encourage employees to provide new ideas. Based on the 2012 results, larger employers more commonly reward their employees for new ideas, skills or education acquired (Table 6.5). For instance, 32 percent of manufacturers with 250 employees or more provided incentives for new ideas, while only 13 percent of the companies with less than 50 employees provided the same benefit. Employee incentives by industry group showed some interesting associations. While only 8 percent of manufacturers in the 'food-text group rewarded employees for new skills or education, an impressive 46 percent did for productivity increases. The machinery group recorded the highest percentage for rewards for new skills and education. Science-based firms led in rewarding for new skills and productivity increases, and scored second in

rewarding for new ideas. Businesses that have innovation as their top competitive strategy most commonly rewarded for new skills or education (19 percent of them); manufacturers with quick delivery as their top strategy led in productivity increases and new ideas, with 54 percent and 33 percent, respectively.

Table 6.5. Percentage of Firms Offering Employee Incentives By Employment Size, Industry, and Top Competitive Strategy

	New Skills or Education	Productivity Increases	New Ideas
<50	10%	35%	13%
50-249	15%	48%	29%
250+	16%	43%	32%
Food-text	8%	46%	20%
Material	8%	38%	17%
Mach	19%	38%	19%
Elec-Trans	16%	33%	27%
Science	18%	47%	25%
Low price	7%	34%	18%
High quality	11%	41%	19%
Innovation	19%	35%	21%
Quick delivery	18%	54%	33%
Customization	13%	41%	16%
Sustainability	0%	24%	7%
All	12%	40%	20%

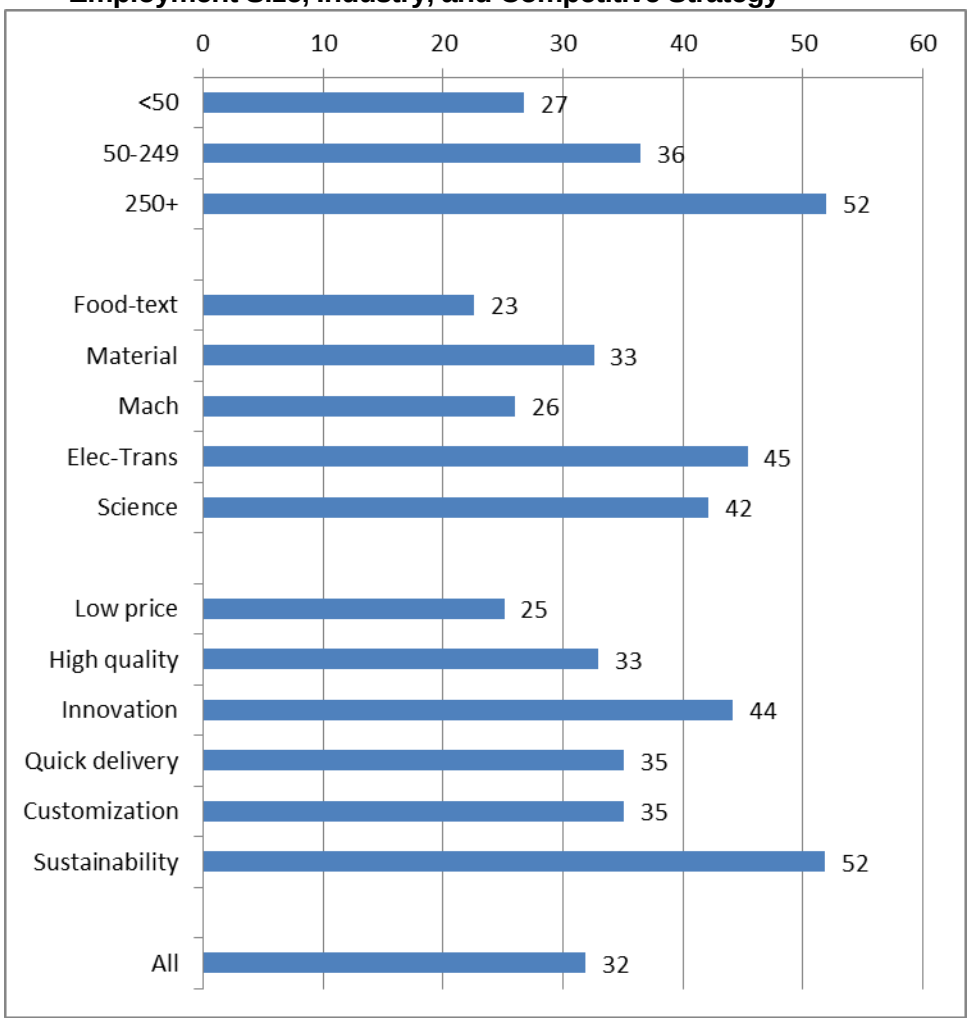
Source: Georgia Manufacturing Survey 2012, weighted results of 528 manufacturers

Production Work in Teams

On average, 32 percent of production workers in Georgia work in teams. The percentage of the workforce organized in teams depends on the size of the company; the larger the company, the greater the percentage of employees working in teams. For example, 52 percent of production employees at companies with 250 or more employees work in teams, while only 27 percent of the employees with companies with less than 50 employees work in teams (Figure 6.4). Some industry groups rely heavily on teamwork. 45% of workers in production from manufacturers in the elec-trans group work in teams.

Companies that have sustainability as their top competitive strategy rely more on work teams compared to the rest of the companies.

Figure 6.4. Mean Percentage of Production Employees that Work in Teams by Employment Size, Industry, and Competitive Strategy



Source: Georgia Manufacturing Survey 2010, weighted results of 439 manufacturers

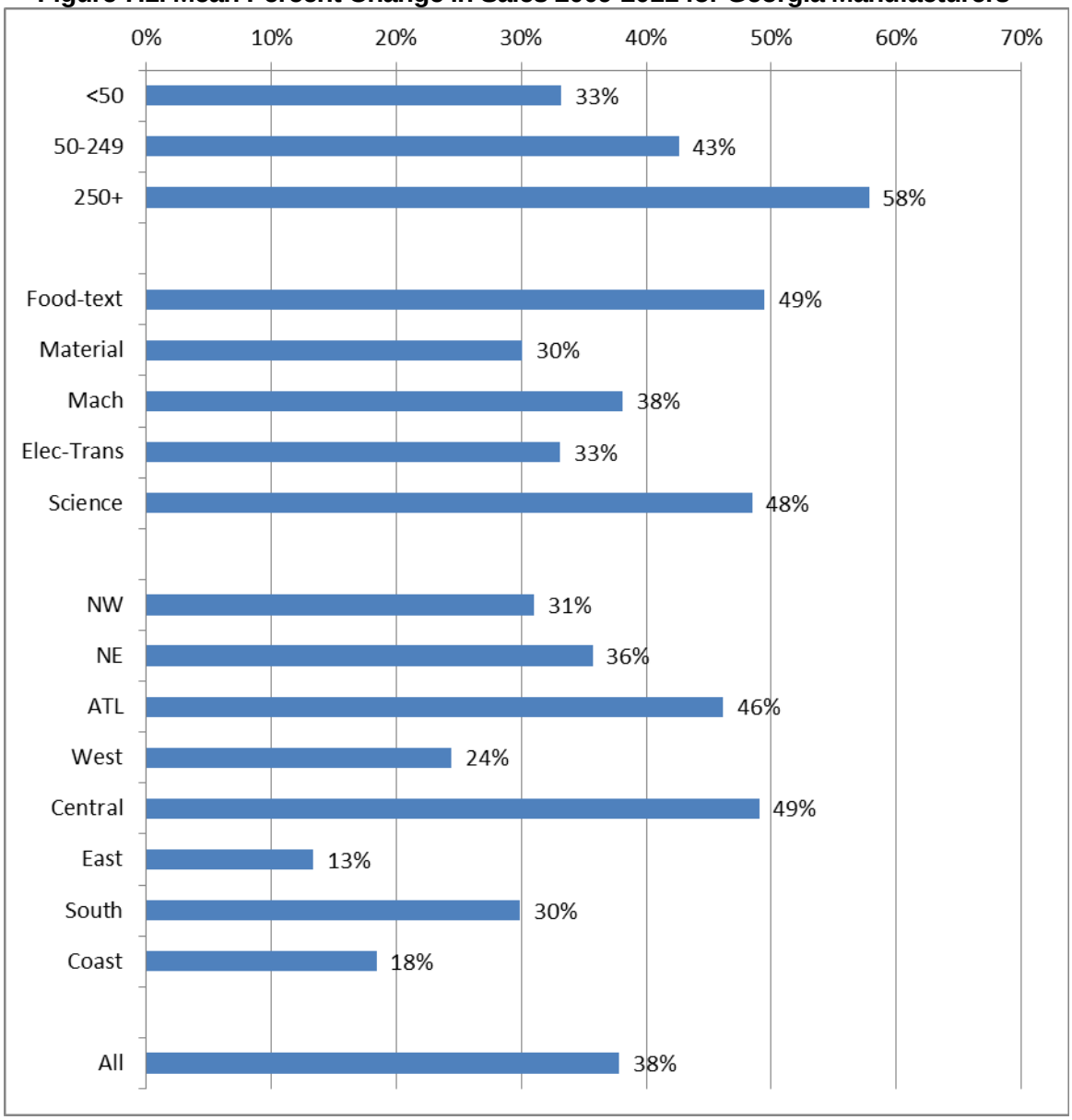
Chapter
7

Manufacturing Production and Performance

Sales, Purchases, and Investments

As a sign of economic recovery, Georgia manufacturers recorded a 38 percent mean increase in sales between 2009 and 2011. The percentage is obtained by subtracting total sales of 2009 from 2011, and dividing the difference by sales of 2009. Large employers enjoyed higher increases compared to smaller employers; companies with 250 employees or more registered a 58 percent sales increase during the two-year period, while companies with less than 50 employees observed an only 33 percent increase. The food-text and science-based groups experienced higher sales increases, with 49 percent and 48 percent, respectively. The elec-trans sector recorded a 33% percent increase for the lowest increase in sales. Manufacturers located in the Central region and in Atlanta outperformed the others in terms of sales increases for the 2009-2011 period.

Figure 7.1. Mean Percent Change in Sales 2009-2011 for Georgia Manufacturers

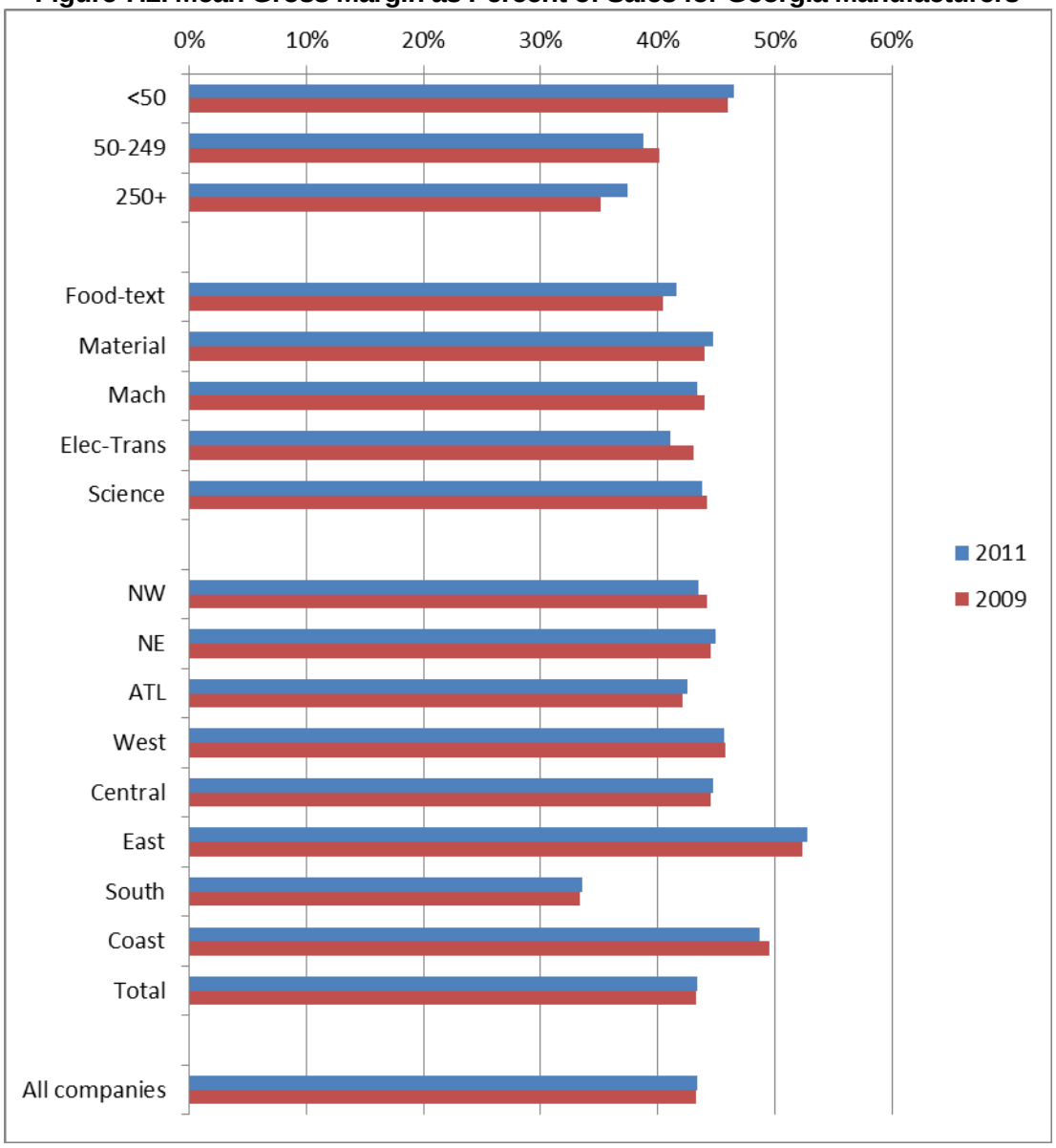


Source: Georgia Manufacturing Survey 2012, weighted results of 395 manufacturers

Gross margin as percentage of sales is an indicator calculated that is obtained by subtracting the cost of goods sold from total sales, and dividing the difference by total sales. Manufacturers in the less than 50 employer group recorded the highest gross margins. Companies in the 50-249 employee bracket reported a slight drop in their gross margin.. The 250+ group reported the lowest gross margin, even as it improved in 2011 (Figure 7.2). Manufacturers in the elec-trans group suffered the greatest drop between 2009 and 2011, which may be due to the competitive nature of their industry.

Manufacturers in the East and Coastal regions enjoyed the highest margins, clearly above the Georgia average.

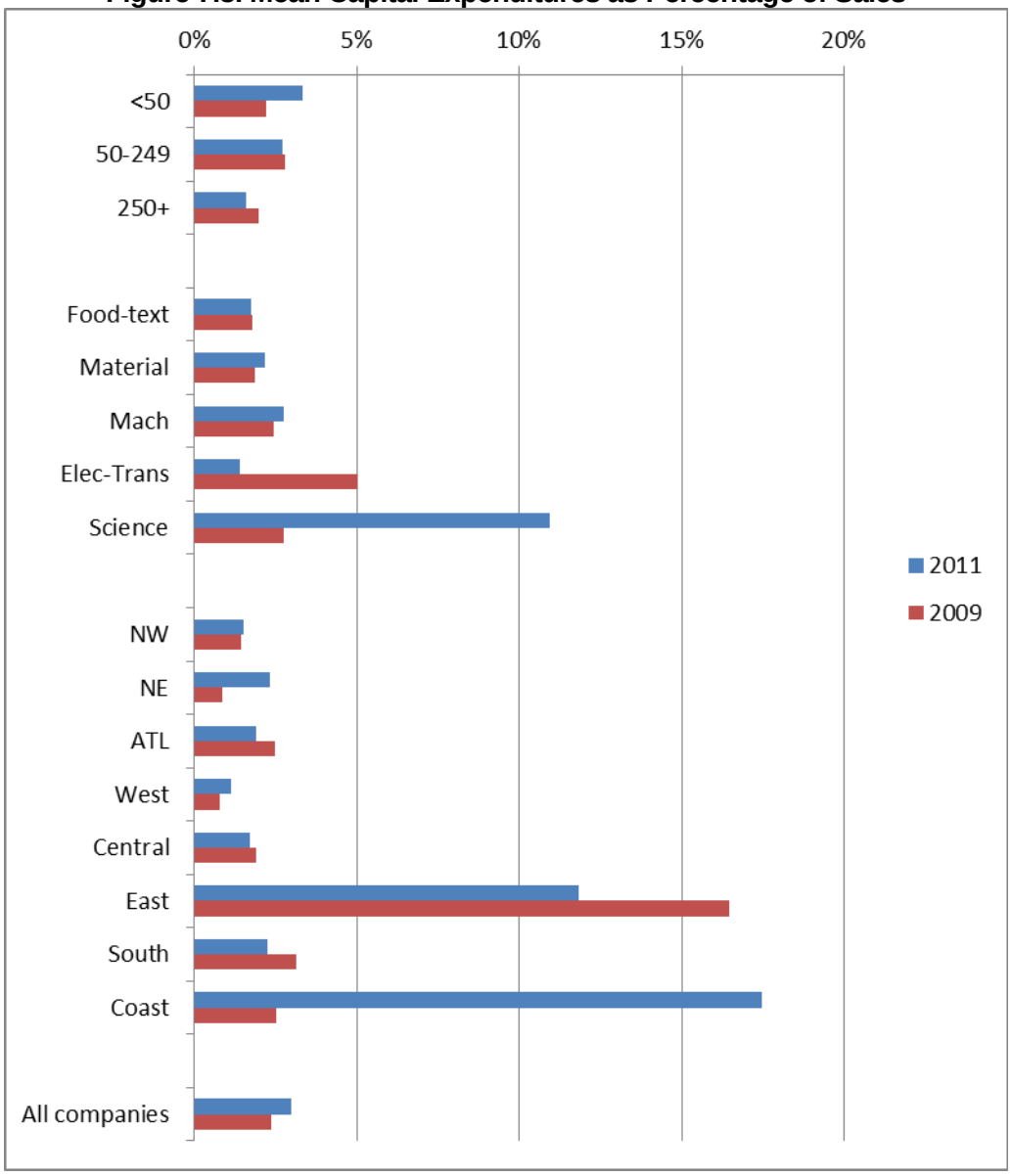
Figure 7.2. Mean Gross Margin as Percent of Sales for Georgia Manufacturers



Source: Georgia Manufacturing Survey 2012, weighted results of 465 manufacturers

In terms of capital expenditures as a percentage of sales, the 2011 survey results showed a negative correlation between employment size and capital expenditures over sales; companies with 250+ employees recorded lower figures compared to smaller firms (Figure 7.3). Manufacturers in the science sector reported a significant increase in capital expenditures in the past two years. Manufacturers from the Coast and East regions invested well above the state average with a substantial increase in 2011. Manufacturers in the West reported a substantial decrease in capital expenditures.

Figure 7.3. Mean Capital Expenditures as Percentage of Sales



Source: Georgia Manufacturing Survey 2012, weighted results of 465 manufacturers

Companies over 50 employees are more likely to be involved in international trade. On average, exports as a percentage of sales slightly increased, from 7 percent in 2009 to 8 percent in 2011. A similar trend was observed for imported materials over total cost, which went up from 11 percent to 12 percent during the same time interval (Table 7.1). Manufacturers with 50+ employees, companies in the elec-trans and science groups, and those located in the West, NW, and Central Georgia experienced the greatest exports. The elec-trans industry also reported the highest increase for imported materials and products.

Table 7.1. Mean Percentages for Sales Exported, Materials Imported, Products Imported

	2011			2009		
	Sales Exported	Materials Imported	Products Imported	Sales Exported	Materials Imported	Products Imported
<50	7	10	6	6	10	5
50-249	9	14	5	8	13	4
250+	9	14	2	7	15	2
Food-text	7	15	7	6	14	6
Material	6	9	4	5	8	3
Mach	7	9	5	6	9	5
Elec-Trans	13	20	5	10	17	4
Science	13	15	9	12	14	8
NW	7	12	3	5	11	3
NE	10	11	5	10	11	6
ATL	7	14	7	6	13	6
West	11	13	4	9	14	4
Central	7	5	3	5	5	2
East	10	3	1	11	2	0
South	3	12	6	2	11	6
Coast	14	14	3	13	13	2
All companies	8	12	5	7	11	5

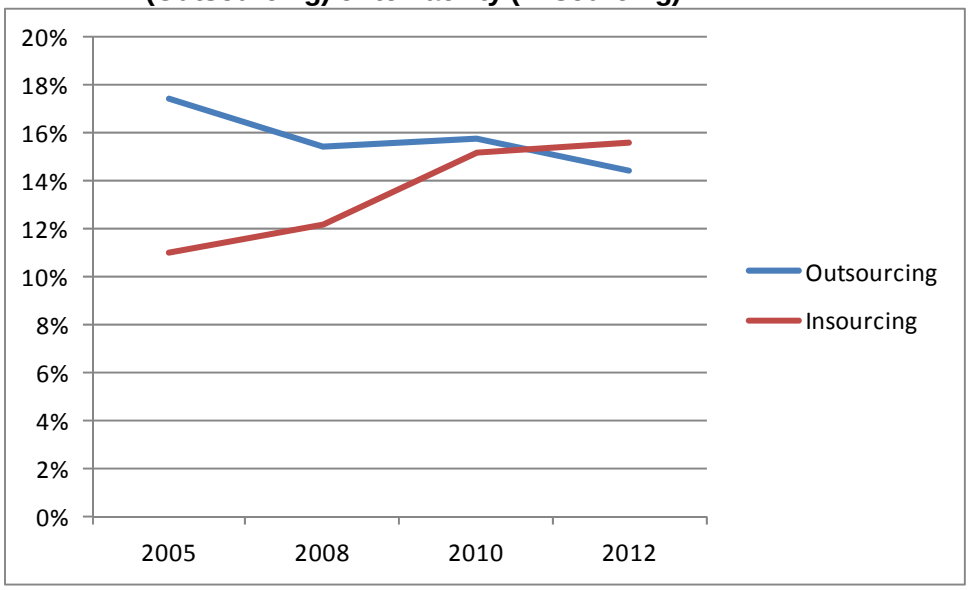
Source: Georgia Manufacturing Survey 2012, weighted results of 420 manufacturers

Outsourcing and In-sourcing

Outsourcing and in-sourcing are defined as work transferred from (outsourcing) or to (in-sourcing) the Georgia facility. Between 2009 and 2011, about 14 percent of Georgia manufacturers were affected by outsourcing, somewhat less than was reported in the 2010 survey. For those affected, the most common outsourcing locations were elsewhere in the United States (8 percent), followed by Asia (5 percent) and Mexico and Central and South America (4 percent). In-sourcing also occurred. The rate of transfer of work to Georgia manufacturers was 16 percent, higher than the percentage of firms affected by outsourcing (Figure 7.4). There was a marked increase in work transferred from Asia to Georgia manufacturers (from 2.6 percent in 2010 to 4.3 percent in 2012). Nearly 10 percent of respondents received work from elsewhere in the US, with

Latin America begin the third most common location (1.3 percent). In-sourcing and outsourcing are not mutually exclusive; nearly of manufacturers affected by in-sourcing and outsourcing were involved in both.

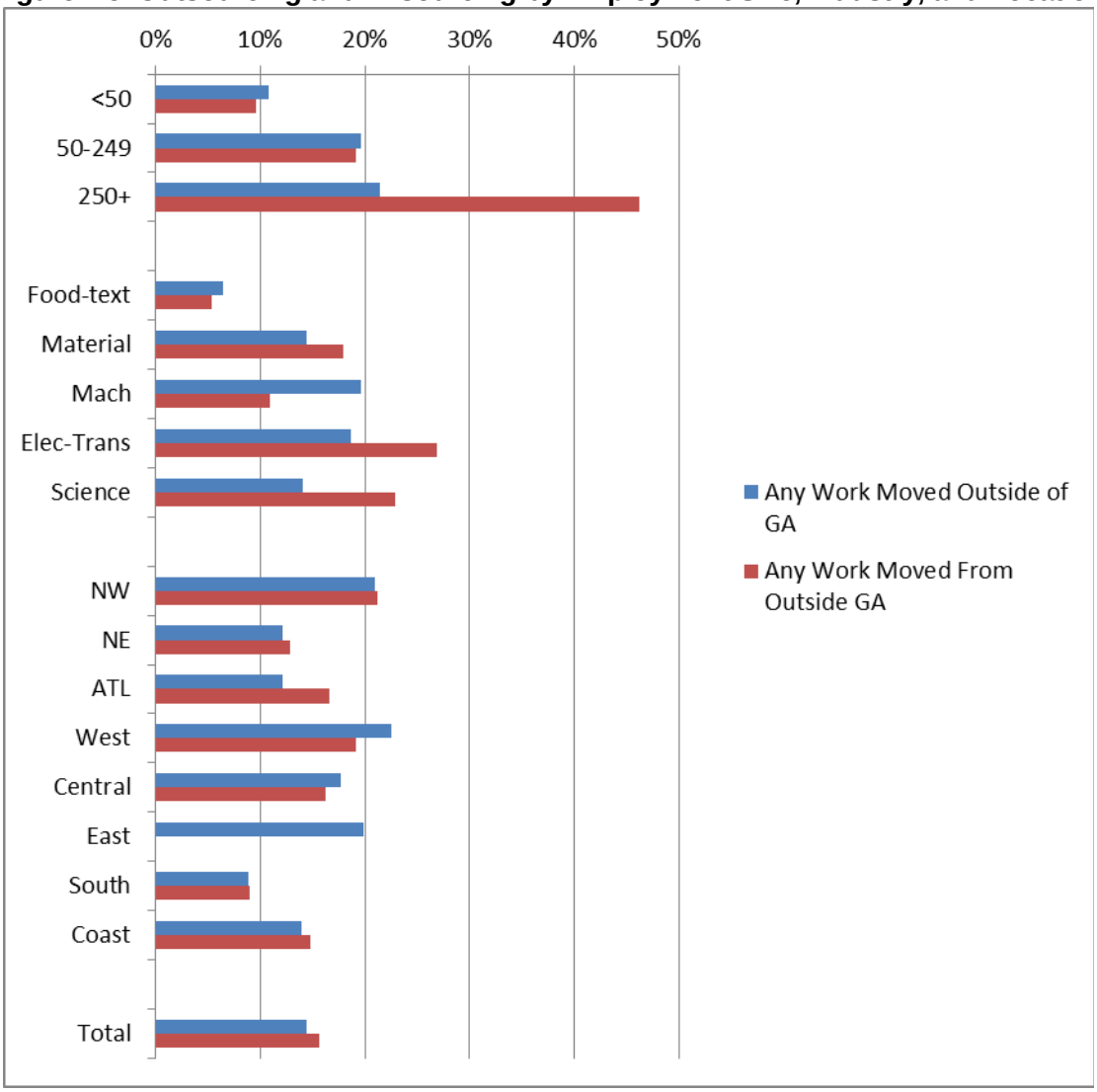
Figure 7.4. Percentage of Establishments Reporting Work Transferred from Facility (Outsourcing) or to Facility (In-sourcing)



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

Employment size, type of industry, and plant location are among the factors that contribute to making decisions on outsourcing or in-sourcing. The larger the employer, the greater the probability the firm will transfer part of its operations either outside of Georgia or back to Georgia. In 2011, 46 percent of companies with 250+ employees brought operations to Georgia. Industry type and geographic location revealed sourcing differences. For example, the food-text sector was less engaged with outsourcing/in-sourcing activity. Manufacturing establishments in the Northwest region experienced above average in-sourcing/outsourcing activity. Atlanta enjoyed a higher percentage of in-sourcing and a lower percentage of outsourcing compared to the Georgia average (Figure 7.5).

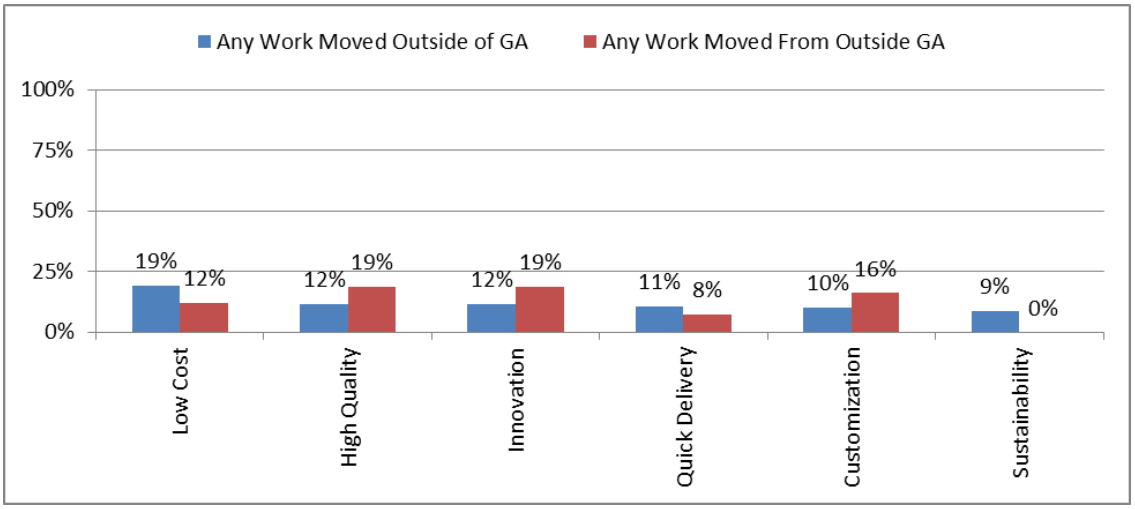
Figure 7.5. Outsourcing and In-sourcing by Employment Size, Industry, and Location



Source: Georgia Manufacturing Survey 2010, weighted results of 504 manufacturers

Georgia manufacturers following high quality, innovation, and customization strategies used more in-sourcing than those following other competitive strategies, such as low cost quick delivery, and sustainability (Figure 7.6). An increase in companies using more in-sourcing will benefit more Georgia businesses. These trends suggest a net increase in value added of the manufacturing sector in the state.

Figure 7.6. Outsourcing and In-sourcing by Competitive Strategy



Source: Georgia Manufacturing Survey 2012, weighted results of 504 manufacturers

State and Federal Benefits

The most commonly used tax credits by Georgia manufacturers were the R&D tax credit, job credit, and investment tax credit. Manufacturers with 50-plus employees are more effectively utilizing these tax benefits. Because science-based and elect-trans group manufacturers invest more in R&D, a much higher percentage of these respondents report taking this tax credit. The food-text and materials industries are more likely to take the investment tax credit than other sectors (Table 7.2).

Table 7.2. Percentage of Firms Using State and Federal Tax Credits By Employment Size, Industry, and Location

	R&D tax credit	Investment tax credit	Job credit	Retraining tax credit	Import/ export credit	Energy tax credit
<50	12%	10%	12%	3%	4%	5%
50-249	26%	26%	23%	11%	7%	11%
250+	31%	36%	45%	26%	7%	21%
Food-text	13%	24%	21%	13%	4%	15%
Material	14%	11%	15%	4%	5%	9%
Mach	13%	16%	17%	7%	4%	4%
Elec-Trans	27%	13%	24%	13%	7%	4%
Science	45%	27%	18%	4%	10%	6%
Low price	6%	10%	14%	8%	3%	9%
High quality	17%	17%	18%	8%	5%	8%
Innovation	35%	18%	11%	7%	11%	5%
Quick delivery	16%	19%	20%	1%	3%	10%
Customization	19%	17%	15%	5%	7%	6%
Sustainability	0%	0%	0%	0%	0%	0%
All	18%	17%	18%	8%	5%	8%

Source: Georgia Manufacturing Survey 2012, weighted results of 528 manufacturers

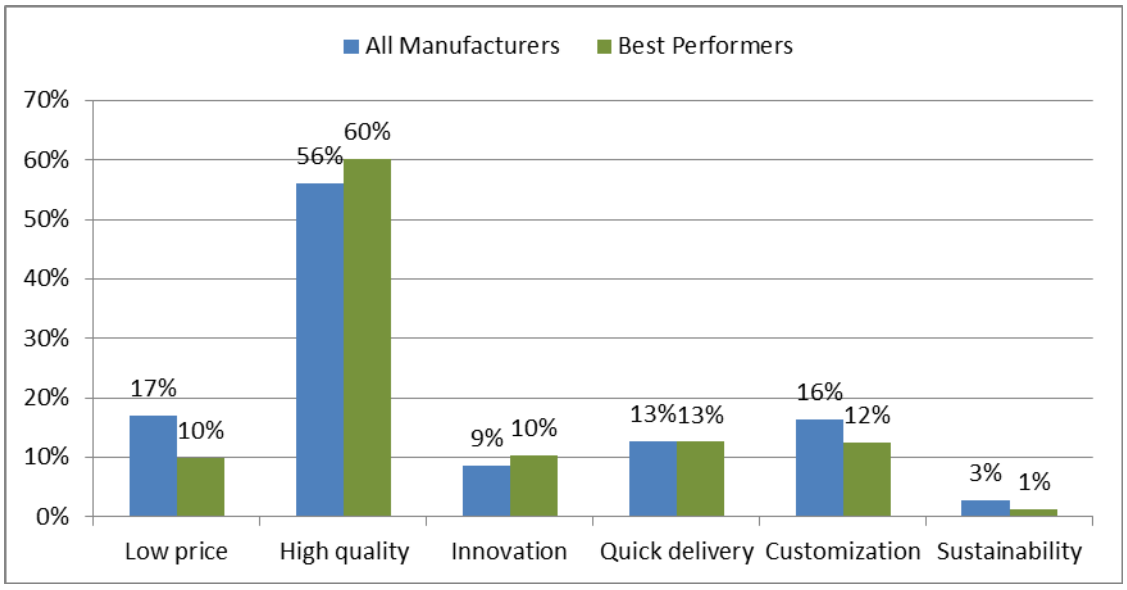
Best Performers

Return on sales is one of the key indicators that measures company profitability. We measure this in the Georgia Manufacturing Survey by asking respondents to report the average annual return on sales (pre-tax) for their facility over the last three years. This indicator will be used as a proxy to identify best performers among manufacturers. In this study, companies reported their average annual return on sales over the last 3 years. Manufacturers with average annual returns on sales 12 percent or more were considered best performers. The best performers group represents the top 27 percent of the companies. In the following section, we will discuss differences between this group and the rest of the companies in order to identify possible explanations of their great performance during the current economic slow recovery.

Our first analysis highlights differences in competitive strategy between best performers and all manufacturers (Figure 7.7). Best performers tend to choose high quality and innovation as their top competitive strategies and tend not to choose low cost and customization. For example, 60 percent of best performers

use high quality as their top competitive strategy, while only 56 percent of total manufacturers use the same strategy.

Figure 7.7. Outsourcing and In-sourcing by Competitive Strategy



Source: Georgia Manufacturing Survey 2012, weighted results of 528 manufacturers

The following table provides capital expenses to sales by industry for best performers versus all manufacturers. The typical manufacturer allocated 3 percent of sales to capital investments as opposed to the best firms, which allocated more – 5 percent. The greatest difference between the best and all other manufacturers is in the science group. It is reasonable to assume capital investment in new technology is critical to staying competitive in this industry. Given the sharp economic downturn in 2009 and the level of excess capacity left in its wake, many manufacturers may have put off investing in new capital (Table 7.3).

Table 7.3. Capital Expenses to Sales by Industry

	All	Best
Food-text	2%	2%
Material	2%	1%
Mach	3%	2%
Elec-Trans	1%	1%
Science	11%	19%
Total	3%	5%

Source: Georgia Manufacturing Survey 2012, weighted results of 528 manufacturers

In general, the best performers exported more during 2011, particularly in sectors such as food, textiles, and machinery. Manufacturers with more foreign related business, both exporting or importing, may be exposed to more price and cost competitive market conditions, pushing the best performers to buy abroad to stay competitive. The textile industry faces substantial labor cost disadvantages from abroad. The best performers, as a result, would buy more imports from abroad. The most profitable companies in the food and textiles group recorded an exporting average of 12 percent of total sales, while the group average was only 7 percent (Table 7.4). In regards to imports, with the exception of manufacturers in the food and textiles industry, no other group showed significant differences between best performers and the average company.

Table 7.4. Export and Imports by Industry

	Exports (% of total sales)		Imports (% of total costs)	
	All	Best	All	Best
Food-text	7%	12%	22%	42%
Material	6%	6%	12%	11%
Mach	7%	12%	14%	15%
Elec-Trans	13%	11%	25%	24%
Science	13%	11%	24%	23%
Total	8%	10%	17%	20%

Source: Georgia Manufacturing Survey 2012, weighted results of 528 manufacturers

Outsourcing or in-sourcing did not appear to play a meaningful role in profitability during 2011 at the aggregate level. At the industry group level, however, there were differences. For example, the results showed that the best companies in the food and textiles group tend not to outsource and the best companies in the elec-trans group in-sourced less (Table 7.5).

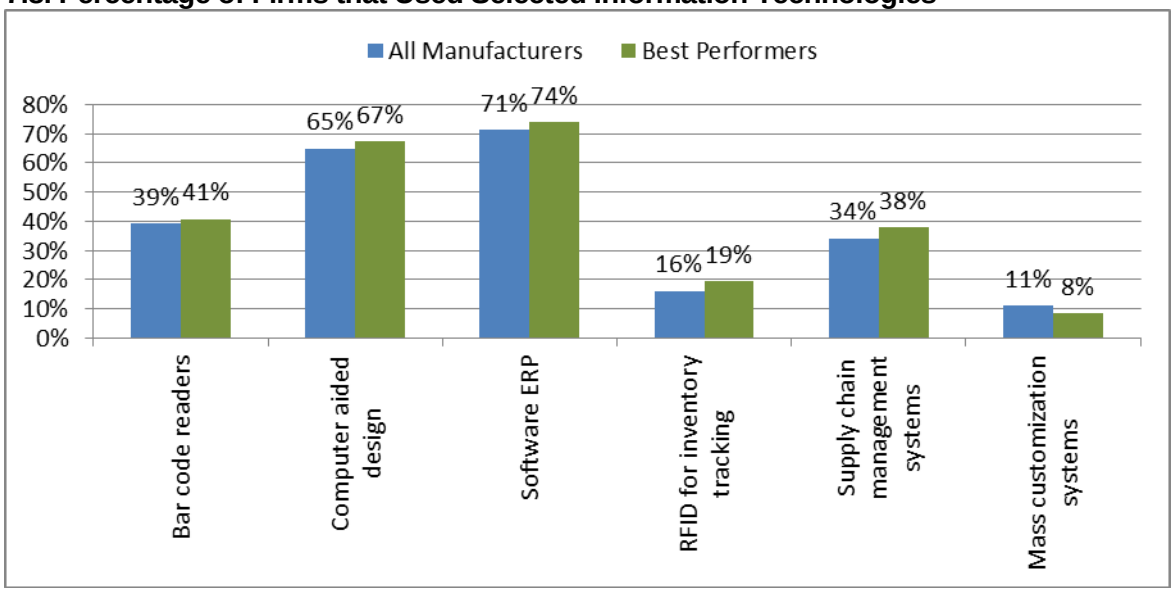
Table 7.5. Percentage of Firms Outsourcing and In-sourcing by Industry

	Outsource		In-source	
	All	Best	All	Best
Food-text	6%	0%	5%	5%
Material	14%	13%	18%	21%
Mach	20%	25%	11%	11%
Elec-Trans	19%	13%	27%	13%
Science	14%	15%	23%	32%
Total	14%	14%	16%	17%

Source: Georgia Manufacturing Survey 2012, weighted results of 503 manufacturers

It is more common for the best performers to use information technologies than the average firm. With the exception of mass customization systems, all the selected technologies were more popular among best performers during 2011, including bar code readers, computer aided design, software ERP, RFID systems, and supply chain management systems (Figure 7.8).

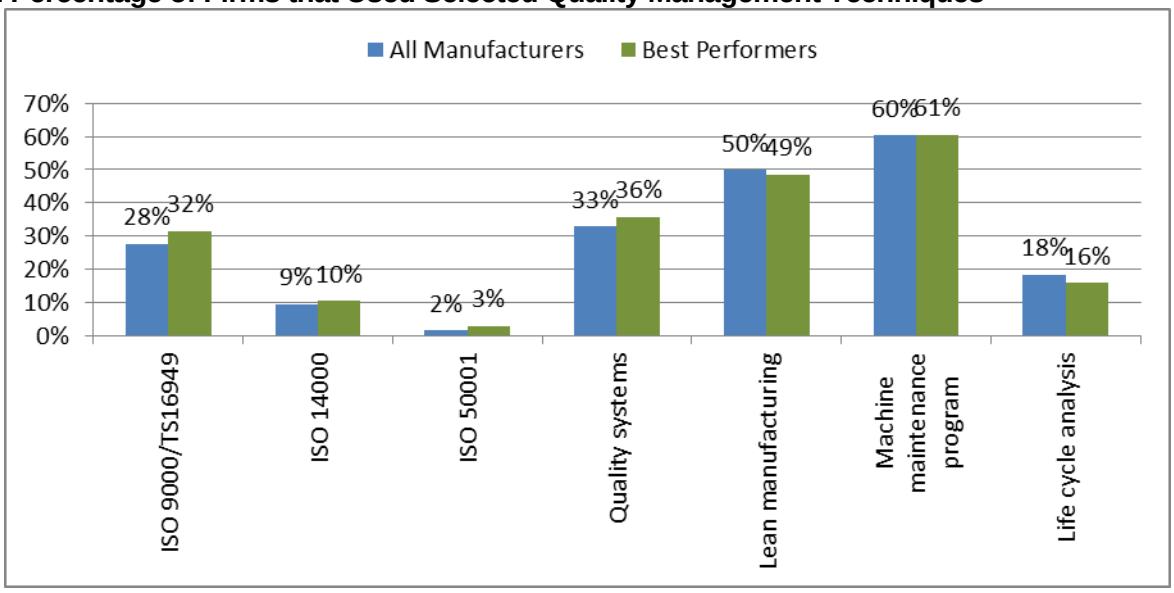
Figure 7.8. Percentage of Firms that Used Selected Information Technologies



Source: Georgia Manufacturing Survey 2012, weighted results of 528 manufacturers

ISO9000/TS16949 and Quality Systems (Six Sigma) are more common among most profitable firms; for example, 32 percent of the best performers currently used ISO9000/TS16949, while only 28 percent of the average firm did (Figure 7.9). However, best performers use less lean manufacturing and life cycle analysis.

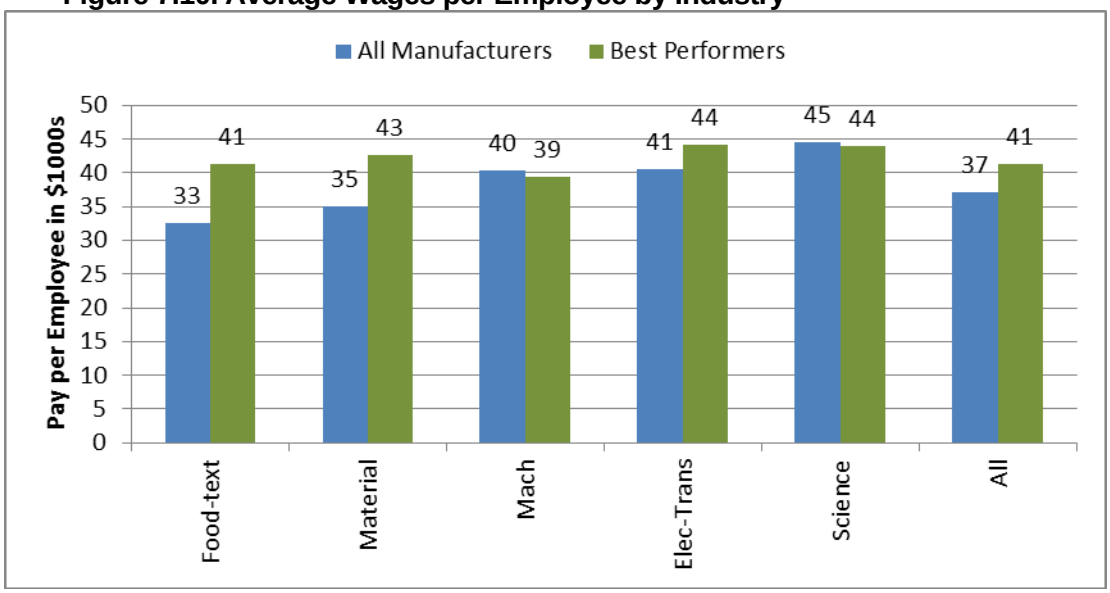
Figure 7.9. Percentage of Firms that Used Selected Quality Management Techniques



Source: Georgia Manufacturing Survey 2012, weighted results of 528 manufacturers

Firms with the most productive and efficient workers and technologies will compensate their employees accordingly. It makes sense the best performing companies are the most productive and efficient companies. Best performers paid higher wages to their employees, and the differences were more pronounced for manufactures in food-text, material, and elec-trans industry groups. At the aggregate level, top firms paid on average $41,000 a year, an 11% higher compared to the average firm at $37,000 (Figure 7.10).

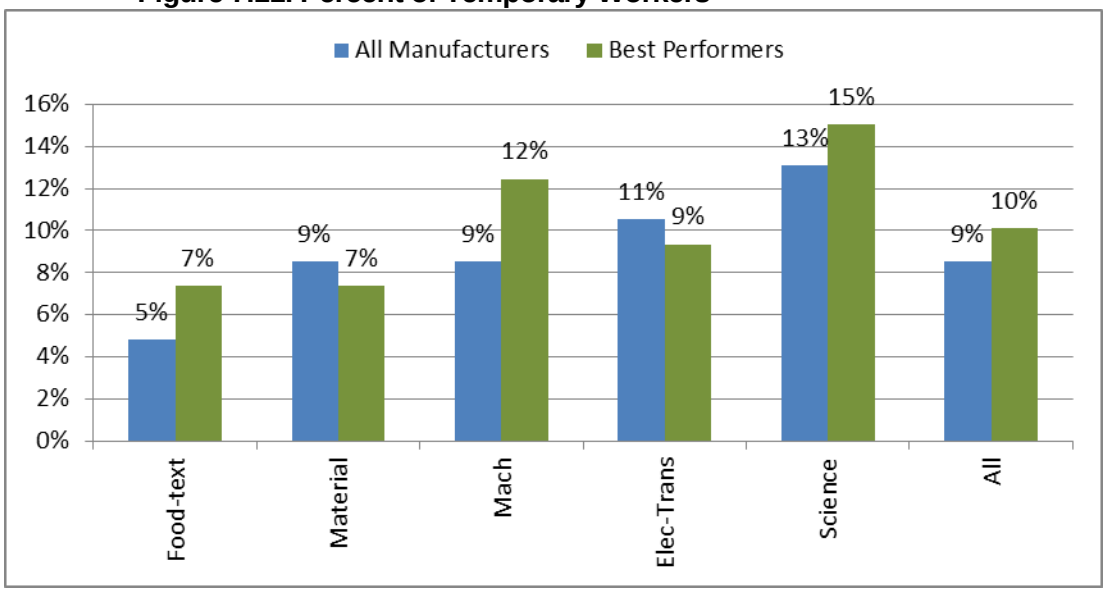
Figure 7.10. Average Wages per Employee by Industry



Source: Georgia Manufacturing Survey 2012, weighted results of 344 manufacturers

The decision to hire temporary versus full time workers is influenced by the overall compensation, benefits, training, flexibility and other costs associated with new hires. Market sustainability and uncertainty may also influence decisions for hiring temporary workers. Manufacturers in the food-text, machinery, and science-based best performer group reported a higher level of temporary workers, which suggests that they consider that hiring temporary workers offers them more of a competitive advantage. In general, the best performers relied more often on temporary labor. The best performers in the food and textiles group for example recorded a temporary workforce average of 7 percent of total workers during 2011, while the group average was only 5 percent (Figure 7.11).

Figure 7.11. Percent of Temporary Workers



Source: Georgia Manufacturing Survey 2012, weighted results of 483 manufacturers

The best performers were more likely to offer incentives to their employees than the average firm (Table 7.6). The best performers may place more value on incentives to improve skill levels of human resources as well as on their techniques of production. Both types of incentives improve productivity, efficiency, and profitability. The table below shows that the percentages of best performers rewarding employees for new skills, productivity increases, and new ideas are consistently higher than the average manufacturer. This finding suggests that the quality of human resources and motivation are critical factors for better performance and productivity. The elect-trans sector reveals the value the best performers place on new skills or education. The science-based group (chemical and lab supplies) reported substantial incentive differences for productivity increases, which suggest substantial value to the best performers for using incentives to improve productivity.

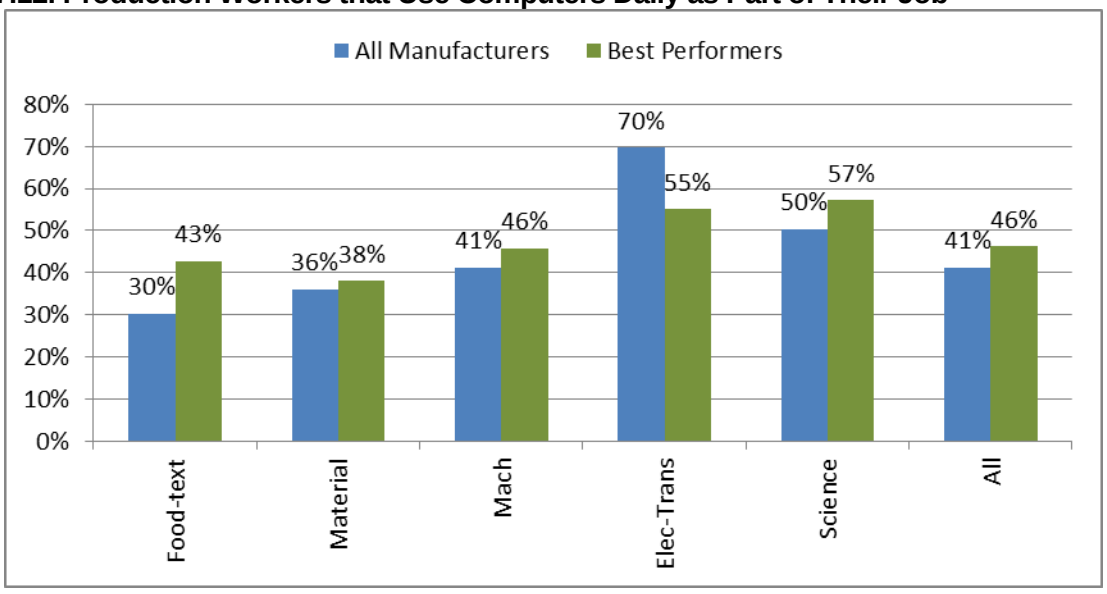
Table 7.6. Percentage of Manufactures Providing Employee Incentives by Industry

	New Skills or Education		Productivity Increases		New Ideas	
	All	Best	All	Best	All	Best
Food-text	8%	12%	46%	48%	20%	24%
Material	8%	12%	38%	37%	17%	8%
Mach	19%	21%	38%	45%	19%	21%
Elec-Trans	16%	33%	33%	33%	27%	40%
Science	18%	23%	47%	65%	25%	27%
Total	12%	19%	40%	45%	20%	21%

Source: Georgia Manufacturing Survey 2012, weighted results of 528 manufacturers

In general, production workers in the best performer group had a greater use of computers as a daily part of their jobs. Forty-three percent of the production workforce at the top companies used computers during 2011, while only 30 percent of workers did at the aggregate level (Figure 7.12).

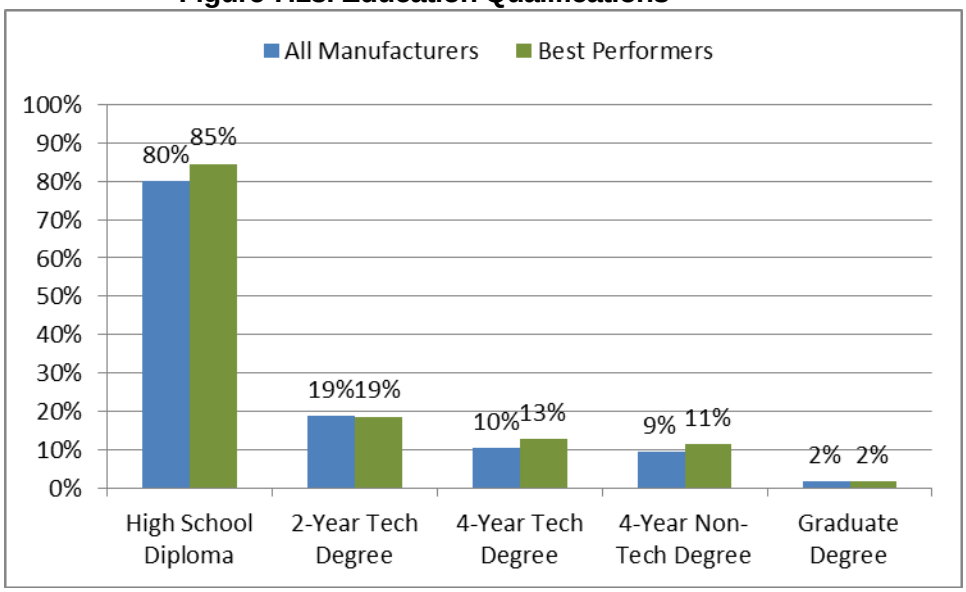
Figure 7.12. Production Workers that Use Computers Daily as Part of Their Job



Source: Georgia Manufacturing Survey 2012, weighted results of 490 manufacturers

Best performers benefit from a more educated and trained workforce. Eighty five percent of top performers' workforce has at least a high school diploma, five points above average firms. While these differences are small, they are consistent with the previous findings with respect to the role of education, higher wages and productivity (Figure 7.13).

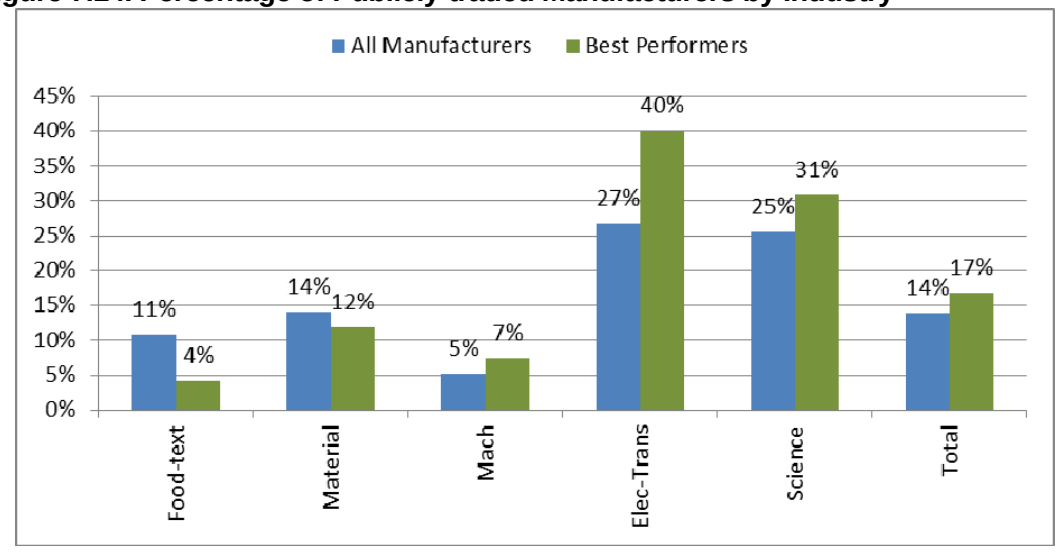
Figure 7.13. Education Qualifications



Source: Georgia Manufacturing Survey 2012, weighted results of 380 manufacturers

Publicly-traded companies have more stockholder scrutiny and must submit more performance information than privately owned companies, which increases the pressure to perform better. Only 14 percent of survey participants were publicly-traded manufacturers, while 17 percent of the firms in the best performers group were public. With the exception of the groups Food-Textiles and Material, best performers of other sectors contain higher shares of publicly-traded firms. These numbers suggest that publicly-traded manufacturers performed better than the average manufacturer in terms of return on sales during this period (Figure 7.14).

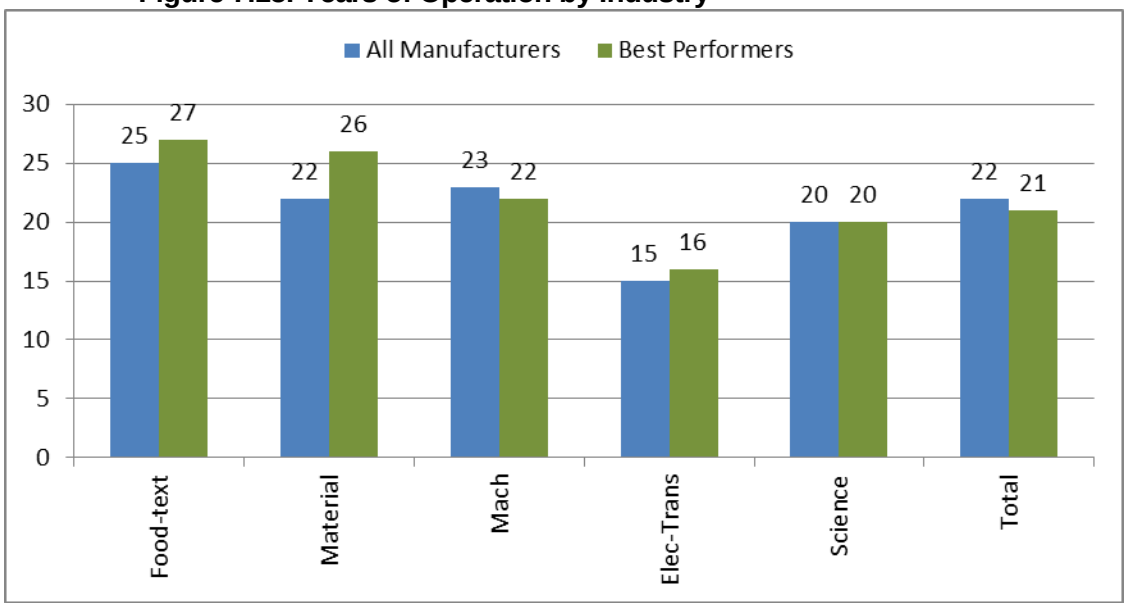
Figure 7.14. Percentage of Publicly-traded Manufacturers by Industry



Source: Georgia Manufacturing Survey 2012, weighted results of 516 manufacturers

The number of years of operation is a very interesting factor. The effect of this factor on performance depends on the type of the industry. Older manufacturers outperformed younger firms in traditional sectors such as food-text and material groups (Figure 7.15).

Figure 7.15. Years of Operation by Industry



Source: Georgia Manufacturing Survey 2012, weighted results of 506 manufacturers

Conclusion

This analysis demonstrated that there was a group of manufacturers that maintained higher levels of profitability than the average establishment during this slow recovery. Companies that use high quality and innovation as their top competitive strategy tend to be more profitable. Best performers exported more, and not necessarily imported more during 2011. In general, levels of outsourcing and in-sourcing were not related to profitability, while there were some differences at the industry level. The best performers were also more familiar with different information technologies, including bar code readers, computer aided design, ERP systems, RFID for inventory tracking, and supply chain management systems. Some quality management techniques were also more popular among top firms, including ISO9000/TS16949 and Quality Systems (Six Sigma). The best performers paid higher wages to their employees, and the differences were more significant for manufactures in foods, textiles, wood, plastic, nonmetal, computers, and electronics. The most profitable manufacturers relied more on temporary workers, with the exception of companies in the wood, plastic, and nonmetal industries. The best performers offered higher rewards to their employees than the average firm,

including incentives for education and training, productivity increases, and generation of new ideas. Production workers at the best performing firms showed a higher use of computers as part of their jobs than workers at the average manufacturing firm. The best performers have a more educated workforce than the average firm. Publicly traded manufacturers performed better than privately owned ones, particularly in the industries computers, electronics, chemical, and lab supplies. Finally, older firms performed better in traditional sectors, such as food, textiles, wood, plastic, and nonmetal.

Chapter
8

Business Assistance Resources

Past Georgia Manufacturing Surveys have found that companies using outside service providers are better off than companies going at it alone. This section takes a further look at assistance source usage. It opens with an examination of the types of companies that seek outside assistance across a range of service providers—from Georgia Tech to other universities and technical colleges, to the Georgia Department of Labor, to private-sector firms, to other manufacturers. It then investigates the type of assistance that manufacturers are interested in seeking. It closes with an analysis of the type of benefits that manufacturers can experience from outside assistance by focusing on the quantitative and qualitative impacts of Georgia Tech assistance. A model that compares the productivity of Georgia Tech clients and non-clients is presented.

Business Assistance Usage

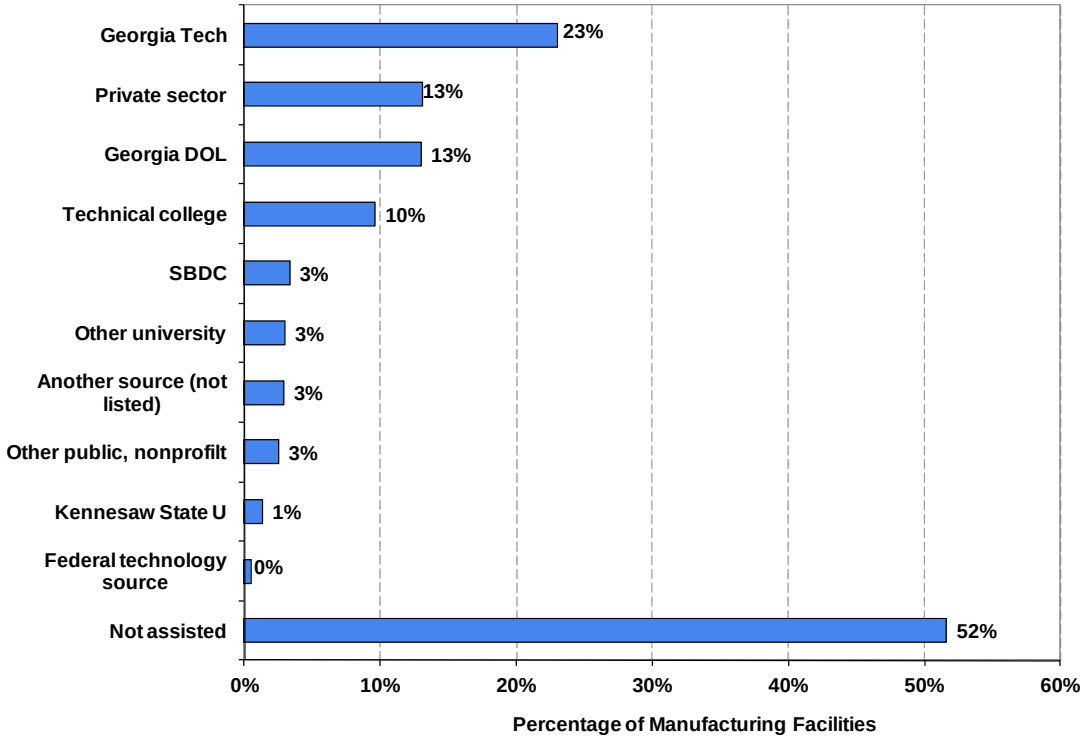
Nearly half of Georgia manufacturers use some type of business assistance provider. Georgia Tech was used by 23 percent of all manufacturing survey respondents, followed by a private-sector consulting firm or vendor and Georgia Department of Labor (13 percent each), and a technical college/Quick Start program (10 percent) (Figure 8.1).

Facility employment size is a major determinant of using outside assistance. In general, the larger the firm, the more apt it is to use outside assistance sources. The exception is the Small Business Development Centers (SBDC) which serves a small, percentage of manufacturing users (3 percent). The technical colleges show a steep slope in use between the large and small and medium sized manufacturers. This elbow appearing line, which suggests an emphasis on serving larger manufacturers, exists for use of technical colleges/QuickStart. Georgia Tech's usage pattern indicates a declining slope between medium-size and large manufacturers, suggesting that the program, while serving larger manufacturers, also has a notable rate of service to small and medium-sized manufacturers as well (Figure 8.2).

The biggest challenge with the smallest companies of 10 to 49 employees is that they are least likely to use any outside assistance source. More than six of 10 manufacturers in this smallest employment size category have not obtained outside business assistance compared with only 40 percent of medium-sized manufacturers and 31 percent of large manufacturers.

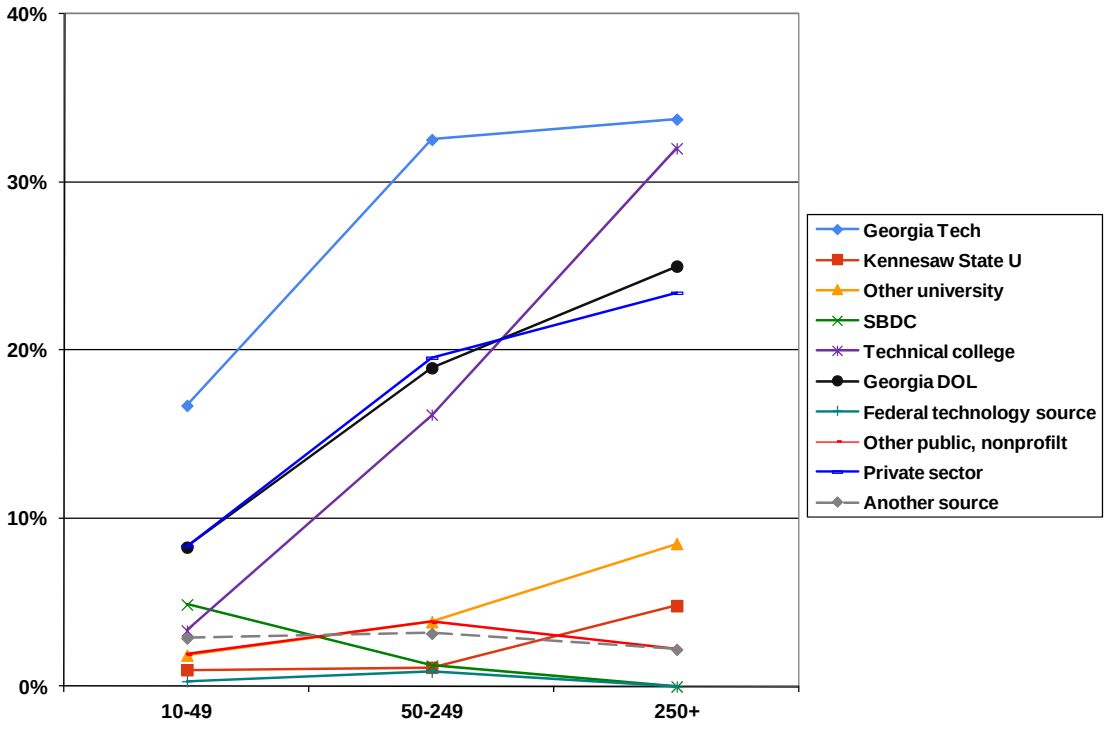
Figure 8.1 Business Assistance Sources Used by Manufacturers

(Percentage of manufacturers using source in last two years)



Source: Georgia Manufacturing Survey 2012, weighted responses of 528 manufacturers.

Figure 8.2 Business Assistance Sources Used by Facility Employment Size
(y-axis represents percentage of manufacturing facilities using source in last two years)



Source: Georgia Manufacturing Survey 2012, weighted responses of 528 manufacturers.

By industry, the science-based and elec-trans groups have the highest percentage of users of business assistance sources, especially Georgia Tech. The technical colleges have the greatest penetration of the elec-trans group. The Georgia Department of Labor and private sector are the most commonly used assistance sources by the food-text group. Manufacturers in the materials group are the least likely to use business assistance sources (Table 8.1).

By region, establishments in the Northwest, South, and Coastal regions are most apt to use outside assistance sources; those in the West and Atlanta regions are the least apt to use outside assistance (Table 8.2). The percentage of respondents using Georgia Tech is highest in the Northwest and Coastal regions. Use of the Georgia Department of Labor is highest in the Northwest and West regions. The technical colleges have the highest penetration rates in the Northwest, Central and South regions.

Table 8.1 Business Assistance Sources Used by Industry
(Percentage of respondents using business assistance source in last two years)

Source	Food-text	Materials	Mach	Elec-Trans	Science
Georgia Tech	16.5%	18.2%	28.2%	31.1%	35.3%
Kennesaw State U	1.7%	0.0%	2.8%	0.0%	3.9%
Other university	4.9%	2.5%	3.1%	2.2%	2.0%
SBDC	5.6%	1.6%	5.7%	2.2%	2.0%
Technical college	7.6%	8.4%	8.5%	22.2%	7.8%
Georgia DOL	17.4%	11.3%	14.3%	13.3%	7.8%
Federal technology source	0.9%	0.0%	1.4%	0.0%	0.0%
Other public, nonprofilt	3.3%	2.5%	1.4%	4.4%	2.0%
Private sector	19.0%	11.5%	7.2%	15.6%	17.7%
Another source (not listed)	2.4%	2.6%	3.8%	2.2%	3.9%
Not assisted	46.3%	59.2%	53.3%	41.7%	39.0%

Source: Georgia Manufacturing Survey 2012, weighted responses of 528 manufacturers.

Table 8.2. Business Assistance Sources Used by Industry
(Percentage of respondents using business assistance source in last two years)

Source	North-west	North-east	Atlan-ta	West	Cen-tral	East	South	Coastal
Georgia Tech	31.0%	17.7%	22.8%	13.9%	20.9%	26.1%	21.9%	29.8%
Kennesaw State U	1.2%	0.0%	2.3%	0.0%	1.6%	4.7%	0.0%	0.0%
Other university	4.3%	3.9%	2.2%	0.0%	1.7%	0.0%	8.2%	0.0%
SBDC	1.4%	4.0%	4.2%	0.0%	1.6%	4.7%	3.0%	6.9%
Technical college	19.8%	7.7%	5.9%	4.4%	13.4%	0.0%	13.8%	6.9%
Georgia DOL	25.4%	7.5%	9.0%	21.1%	13.7%	7.9%	18.2%	7.2%
Federal technology source	0.0%	0.0%	0.8%	0.0%	0.0%	6.9%	0.0%	0.0%
Other public, nonprofilt	2.2%	0.0%	3.9%	0.0%	1.2%	0.0%	0.0%	10.4%
Private sector	14.3%	13.4%	8.7%	19.1%	12.4%	12.5%	24.7%	14.2%
Another source (not listed)	3.8%	0.0%	1.8%	9.1%	2.6%	0.0%	5.0%	8.2%
Not assisted	41.5%	51.9%	58.8%	61.0%	49.6%	53.0%	44.0%	40.3%

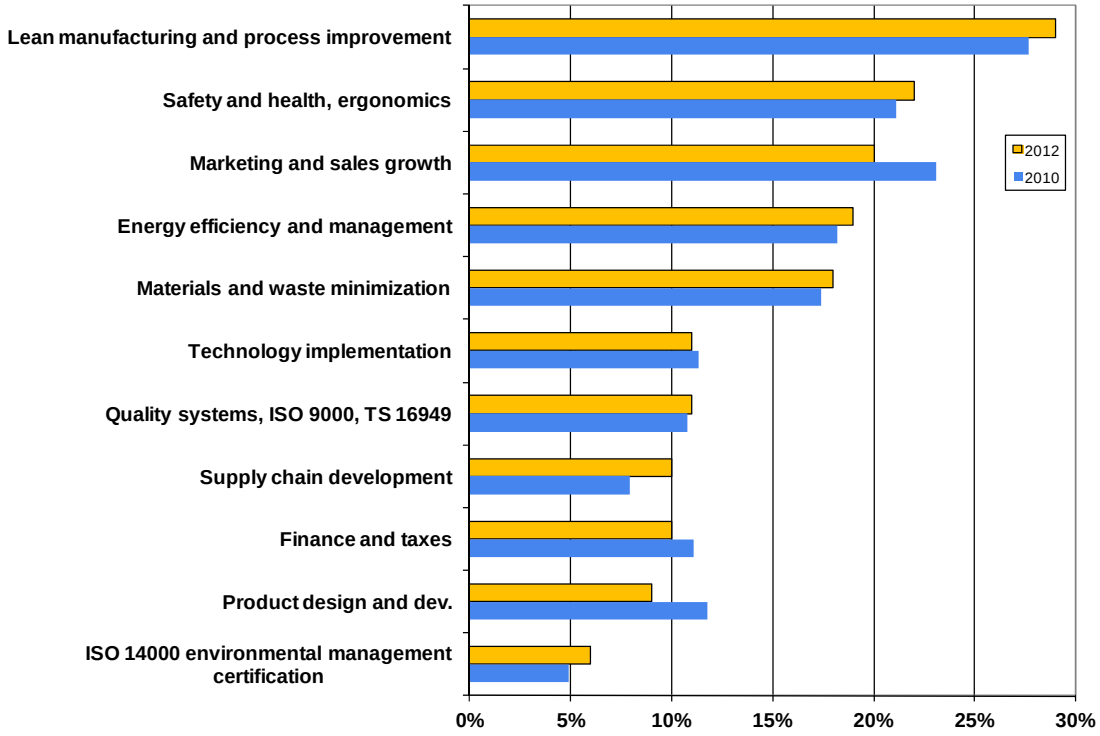
Source: Georgia Manufacturing Survey 2012, weighted responses of 528 manufacturers.

Areas of Interest in Training/Technical Assistance

Half of the companies responding to the Georgia Manufacturing Survey 2012 were interested in receiving training or technical assistance directed toward managers, and the same percentage was also interested in receiving training programs for non-managerial employees. The most frequently mentioned areas of managerial interest were lean manufacturing, safety and health, marketing and sales growth, energy efficiency, and materials and waste minimization. Comparing these percentages to those in the 2008 and 2005 surveys, there is

more emphasis in the 2012 survey on lean manufacturing and less emphasis on marketing and sales growth than was exhibited by respondents to the 2010 survey (Figure 8.3). Lean manufacturing was also the top non-managerial interest area, followed by team and problem-solving skills (Figures 8.3 and 8.4).

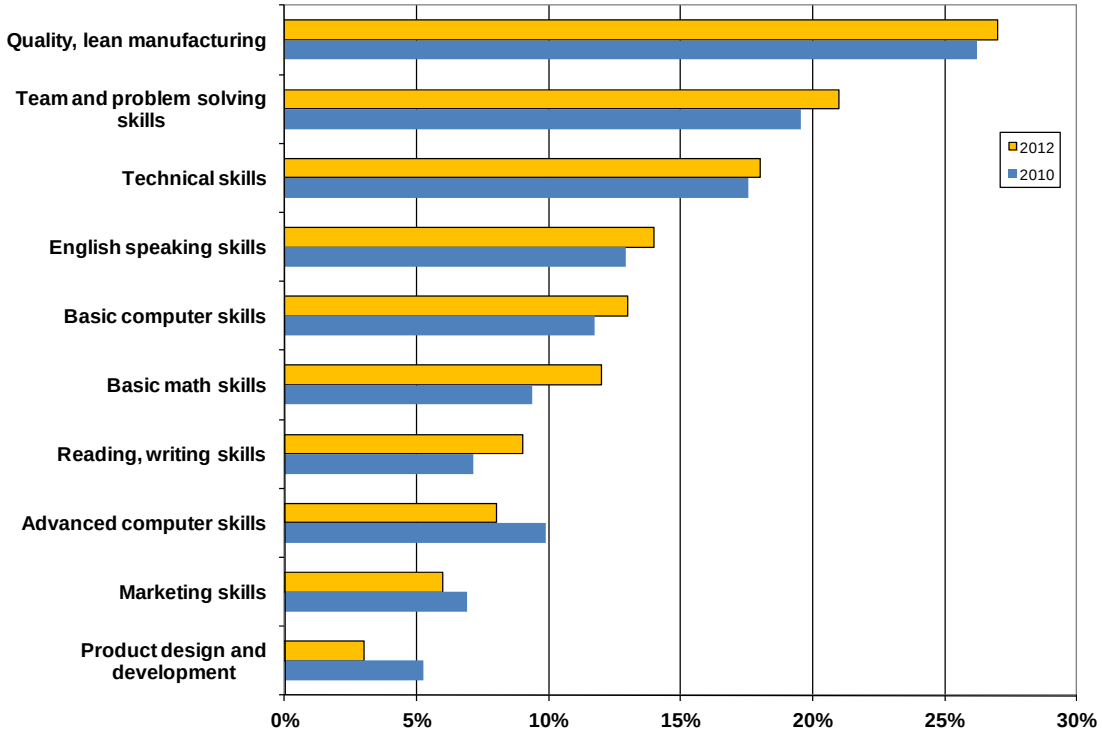
Figure 8.3. Areas of Interest for Training and Technical Assistance: Management
(Percentage of respondents indicating interest in area)



Source: Georgia Manufacturing Survey 2012, weighted responses of 528 manufacturers; Georgia Manufacturing Survey 2010, weighted responses of 407 manufacturers.

Figure 8.3. Areas of Interest for Training and Technical Assistance: Non-managerial Employees

(Percentage of respondents indicating interest in area)



Source: Georgia Manufacturing Survey 2012, weighted responses of 528 manufacturers; Georgia Manufacturing Survey 2010, weighted responses of 407 manufacturers.

Interest in managerial assistance and training was related to facility employment size for some areas, but not for others. Managerial Interest in lean manufacturing was strongest for medium-sized manufacturers. The same is true of interest in safety and health. Energy efficiency and management and materials and waste minimization attracted higher interest among the largest manufacturers. Small manufacturers were most interested in marketing. Interest in marketing, product development, technology assistance, and ISO 9000 was roughly similarly prevalent among respondents regardless of size. By industry, the science-based group was more likely than the other groups to express interest in safety and health and ISO 14000. The electronics/electrical/transportation group was more likely than other groups show interest in lean manufacturing, technology implementation, and product development. Marketing and sales was most prevalent in the machinery group, electronics/electrical/transportation group, and science-based group. The food/textiles/apparel/leather group had the largest number of respondents expressing interest in energy efficiency and management. We also present regional breakdowns of the percentage of manufacturers with interest in assistance these areas. In general, interest is relatively higher in the Northwest region and lower in the West region (Tables 8.3a, 8.3b, 8.3c).

Non-managerial training programs attracted the highest percentage of interest among larger manufacturers in technical skills (such as machinists). Quality,

lean manufacturing resonated to a greater degree to medium-sized manufacturers. By industry, the electronics/electrical/transportation industry group respondents were relatively more interested in programs and the materials group relatively less interested in these programs. Interest in quality and lean training and team and problem solving skills was highest in the electronics/electrical/transportation group. The food/textile/apparel/leather group had a comparatively high percentage of respondents showing interest in English speaking as well as in quality and lean and team and problem solving skills. Regional differences in frequency of interest in non-managerial training programs are also presented. The level of interest in non-managerial training across was highest in respondents in the Northwest region and lowest for respondents in the East and West regions (Tables 8.4a, 8.4b, 8.4c).

Table 8.3a. Interest in Managerial Training and Technical Assistance by Facility Employment Size

(Percentage of respondents indicating interest in area)

Area	10-49	50-249	250+	Total
Lean manufacturing and process improvement	23.0%	40.0%	30.0%	29.0%
Safety and health, ergonomics	17.0%	30.0%	26.0%	22.0%
Marketing and sales growth	23.0%	15.0%	12.0%	20.0%
Energy efficiency and management	16.0%	23.0%	27.0%	19.0%
Materials and waste minimization	17.0%	19.0%	22.0%	18.0%
Technology implementation	9.0%	13.0%	15.0%	11.0%
Quality systems, ISO 9000, TS 16949	11.0%	11.0%	7.0%	11.0%
Supply chain development	7.0%	15.0%	8.0%	10.0%
Finance and taxes	10.0%	12.0%	3.0%	10.0%
Product design and dev.	10.0%	9.0%	10.0%	9.0%
ISO 14000 environmental management certification	5.0%	8.0%	7.0%	6.0%

Source: Georgia Manufacturing Survey 2012, weighted responses of 528 manufacturers.

Table 8.3b. Interest in Managerial Training and Technical Assistance by Industry Group

(Percentage of respondents indicating interest in area)

Area	Food-text	Materials	Mach	Elec-trans	Science
Lean manufacturing and process improvement	25.0%	26.0%	25.0%	44.0%	39.0%
Safety and health, ergonomics	23.0%	23.0%	20.0%	18.0%	25.0%
Marketing and sales growth	18.0%	17.0%	25.0%	20.0%	22.0%
Energy efficiency and management	27.0%	20.0%	13.0%	11.0%	22.0%
Materials and waste minimization	19.0%	20.0%	16.0%	11.0%	20.0%
Technology implementation	8.0%	8.0%	13.0%	22.0%	12.0%
Quality systems, ISO 9000, TS 16949	11.0%	6.0%	19.0%	16.0%	12.0%
Supply chain development	14.0%	7.0%	6.0%	16.0%	16.0%
Finance and taxes	6.0%	11.0%	13.0%	7.0%	14.0%
Product design and dev.	4.0%	8.0%	14.0%	18.0%	8.0%
ISO 14000 environmental management certification	7.0%	4.0%	7.0%	4.0%	16.0%

Source: Georgia Manufacturing Survey 2012, weighted responses of 528 manufacturers.

Table 8.3c. Interest in Managerial Training and Technical Assistance by Region

(Percentage of respondents indicating interest in area)

Area	North-west	North-east	Atlanta	West	Central	East	South	Coastal
Lean manufacturing and process improvement	42.0%	26.0%	30.0%	27.0%	22.0%	14.0%	24.0%	29.0%
Safety and health, ergonomics	31.0%	27.0%	19.0%	11.0%	18.0%	14.0%	26.0%	20.0%
Marketing and sales growth	13.0%	13.0%	26.0%	4.0%	22.0%	5.0%	17.0%	34.0%
Energy efficiency and management	27.0%	21.0%	17.0%	17.0%	17.0%	11.0%	15.0%	27.0%
Materials and waste minimization	28.0%	17.0%	14.0%	13.0%	18.0%	16.0%	23.0%	21.0%
Technology implementation	17.0%	4.0%	15.0%	8.0%	8.0%	0.0%	9.0%	0.0%
Quality systems, ISO 9000, TS 16949	16.0%	13.0%	10.0%	8.0%	15.0%	5.0%	3.0%	13.0%
Supply chain development	15.0%	8.0%	9.0%	17.0%	8.0%	5.0%	8.0%	10.0%
Finance and taxes	9.0%	17.0%	10.0%	8.0%	9.0%	14.0%	9.0%	5.0%
Product design and dev.	10.0%	4.0%	15.0%	2.0%	5.0%	6.0%	7.0%	5.0%
ISO 14000 environmental management certification	10.0%	6.0%	5.0%	3.0%	10.0%	0.0%	4.0%	8.0%

Source: Georgia Manufacturing Survey 2012, weighted responses of 528 manufacturers.

Table 8.4a. Interest in Non-managerial Training and Technical Assistance by Facility Employment Size

(Percentage of respondents indicating interest in area)

Area	10-49	50-249	250+	Total
Quality, lean manufacturing	22.0%	35.0%	30.0%	27.0%
Team and problem solving skills	15.0%	29.0%	31.0%	21.0%
Technical skills	13.0%	24.0%	33.0%	18.0%
English speaking skills	11.0%	22.0%	13.0%	14.0%
Basic computer skills	11.0%	16.0%	17.0%	13.0%
Basic math skills	7.0%	20.0%	10.0%	12.0%
Reading, writing skills	7.0%	14.0%	6.0%	9.0%
Advanced computer skills	8.0%	7.0%	7.0%	8.0%
Marketing skills	8.0%	3.0%	6.0%	6.0%
Product design and development	3.0%	4.0%	2.0%	3.0%

Source: Georgia Manufacturing Survey 2012, weighted responses of 528 manufacturers.

Table 8.4b. Interest in Non-managerial Training and Technical Assistance by Industry Group

(Percentage of respondents indicating interest in area)

Area	Food-text	Materials	Mach	Elec-trans	Science
Quality, lean manufacturing	24.0%	25.0%	24.0%	33.0%	37.0%
Team and problem solving skills	22.0%	19.0%	17.0%	31.0%	24.0%
Technical skills	16.0%	13.0%	27.0%	27.0%	16.0%
English speaking skills	23.0%	12.0%	11.0%	18.0%	14.0%
Basic computer skills	10.0%	13.0%	14.0%	20.0%	14.0%
Basic math skills	14.0%	9.0%	10.0%	18.0%	16.0%
Reading, writing skills	12.0%	5.0%	6.0%	20.0%	16.0%
Advanced computer skills	6.0%	5.0%	10.0%	13.0%	12.0%
Marketing skills	9.0%	5.0%	7.0%	4.0%	4.0%
Product design and development	1.0%	4.0%	3.0%	4.0%	4.0%

Source: Georgia Manufacturing Survey 2012, weighted responses of 528 manufacturers.

Table 8.4c. Interest in Non-managerial Training and Technical Assistance by Region
(percentage of respondents indicating interest in area)

Area	North-west	North-east	Atlanta	West	Central	East	South	Coastal
Quality, lean manufacturing	33.0%	31.0%	27.0%	16.0%	23.0%	8.0%	24.0%	31.0%
Team and problem solving skills	27.0%	25.0%	20.0%	15.0%	16.0%	14.0%	22.0%	17.0%
Technical skills	27.0%	14.0%	18.0%	26.0%	19.0%	10.0%	13.0%	17.0%
English speaking skills	22.0%	21.0%	16.0%	3.0%	6.0%	0.0%	10.0%	11.0%
Basic computer skills	27.0%	19.0%	10.0%	3.0%	9.0%	0.0%	11.0%	14.0%
Basic math skills	23.0%	22.0%	10.0%	0.0%	10.0%	8.0%	3.0%	6.0%
Reading, writing skills	13.0%	13.0%	11.0%	3.0%	3.0%	8.0%	5.0%	8.0%
Advanced computer skills	8.0%	8.0%	10.0%	2.0%	2.0%	0.0%	8.0%	8.0%
Marketing skills	3.0%	5.0%	7.0%	2.0%	11.0%	0.0%	2.0%	15.0%
Product design and development	1.0%	4.0%	6.0%	0.0%	1.0%	0.0%	2.0%	0.0%

Source: Georgia Manufacturing Survey 2012, weighted responses of 528 manufacturers.

Impact of Georgia Tech Assistance on Productivity

How does one assess the impact of assistance on manufacturers? Using Georgia Tech assistance as an example, we could ask Georgia Tech-assisted manufacturers whether or not they received any benefits from this assistance. However, their answers would not necessarily prove that the results are attributable to Georgia Tech services. Unassisted firms could also have experienced these same benefits during the 2009-to-20011 time period. Benefits or lack thereof may have arisen from the general economic conditions of the time rather than the assistance received from Georgia Tech. Georgia Tech-assisted manufacturers may also have been influenced by other companies (for example, vendors and consultants, other manufacturers) or by other public assistance sources (for example, federal laboratories, other state-funded educational or assistance institutions).

To account for these influences, we have developed a model to estimate the impact of Georgia Tech project-related extension services on client productivity. Productivity is measured by value-added per employee, which is calculated as sales less the cost of materials, parts, services, and other purchased inputs divided by the number of employees. Drawing on Jarmin[8], we examined the growth rate in the standard value-added production function from 2009 to 2011, as a function of receiving Georgia Tech services. We controlled for an array of facility characteristics, including:

- change in capital intensity, i.e., the capital/labor ratio 2009-2011

[8]Ronald S. Jarmin, 1999. "Evaluating the Impact of Manufacturing Extension on Productivity Growth," *Journal of Policy Analysis and Management* 18 (1): 99-119. We employ a similar model which estimates the logged change in value-added per employee as a function of changes in labor and capital (logged), along with control variables representing manufacturing characteristics (e.g., employment size, industry, location, and status as a branch plant).

- facility employment size (dummy variables)
- industry classification (dummy variables)

This model was estimated using ordinary least squares. We did not log value-added per employee because the difference in value-added per employee from 2009 to 2011 approximated a normal distribution (based on a review of a histogram of this variable). Georgia Tech assistance is positively and significantly linked to productivity growth (Table 8.5). Over the study period, Georgia Tech clients had $15,000 higher value-added per employee than non-clients.

Table 8.5. Productivity is Significantly Higher for Georgia Tech Clients than for Non-clients.

(Ordinary Least Squares – Value-Added per Employee Change 2009-2011)

Variables	OLS
Received assistance from Georgia Tech	$15,234 (5971)**
Change in capital/labor 2009-11	2.7 (0.09)***
1-10 employees, 2011	2,893 (8528)
	-36,694 (8334)***
Industry dummies	Mixed
Constant	26,886 (13650)**
Observations	300
R-squared	0.46

Dependent variable is the difference between value-added per employee in 2009 and 2011.
Standard errors in parentheses
* Significant at 10%; ** Significant at 5%; *** Significant at 1%

Source: Georgia Manufacturing Survey 2012, weighted responses of 300 manufacturers.

As pointed by Jarmin (1998, p.108) companies with higher than average productivity growth may self-select into the group of Georgia Tech clients. If this is the case, the impact of MEP programs is likely to be overstated. To correct for selection biases, an instrumental variable model is applied. In the 2008 and 2010 survey, interest in training or technical assistance for managers was found to be a good instrument, in that is can be a precursor to use of Georgia Tech for assistance.[9] The instrumental variable regression results are not markedly different from the OLS model. We also ran a two-step Heckman model which did not find that the selection bias was significant (inverse mills ratio > 0.10) so we conclude that the OLS model is sufficient for this analysis.

[9]We did not use location of the manufacturer in a metropolitan area with a center office, as Jarmin did, given that the concept of physical offices in around the Georgia has been changed beyond the notion of "bricks and mortar."

Appendix
1

Survey Framework, Questionnaire Design, and Administration

The section will describe our methodology for analyzing industries, developing the sampling frame for the survey, designing the questionnaire, and administering the survey.

Industry Groupings

Our industry groupings were inspired by Pavitt's[10] taxonomy of industries because of its basis in innovation and technology adoption. We utilized several indicators from the survey to verify Pavitt's classifications. These indicators are shown below. For example, we were able to confirm that chemicals and medical supply firms both have an intensive use of scientists and engineers and thus belong in a science-based classification. However, automotive and transportation establishments in Georgia were not found to have a high use of engineers, so we decided that we could not develop a "scale intensive" grouping around this industry. While we saw a notable level of engineers and scientists in the electrical and electronics industries, it was not as high as was the case with the science-based (i.e., medical supply) group, so we set them into their own segment.

We also wanted to balance our numbers of respondents within each industry group. For example, putting all the supplier-dominated industries together would have meant that most of our respondents would have been in this grouping. The table below shows that these NAICS-based groups vary widely by size and use of scientists and engineers. We therefore made the decision based on the NAICS classification system, dividing this grouping into the non-durables (or "food-text") and the natural resource goods industries (or "material"). We also determined to classify that automotive group into the electrical and electronics industries rather than the metals and machinery group because the automotive industry had higher median employment levels that were more akin to the electrical and electronic industries in our sample.

[10] Keith Pavitt. (1984) 'Sectoral patterns of technical change: towards a taxonomy and a theory', Research Policy, Vol. 13, pp. 343–373

NAICS-Based Industries	# respon dents	Modified Pavitt Taxonomy	GMS 2010 grouping	Median Employ-ment	Mean # Scientists, Engineers
Food – 311,2	37	Supplier dominated	Food-text	56	20
Textiles – 313,4	34	Supplier dominated	Food-text	60	7
Apparel – 315,6	10	Supplier dominated	Food-text	25	3
Wood – 321	52	Supplier dominated	Materials	25	1
Furniture – 337	17	Supplier dominated	Materials	21	1
Paper – 322	17	Supplier dominated	Materials	70	12
Printing – 323	17	Supplier dominated	Materials	19	4
Chemicals – 324,5	39	Science-based	Science	34	5
Plastics – 326	57	Supplier dominated	Materials	41	6
Nonmetallic– 327	26	Scale intensive	Materials	28	6
Prim. Metals–331	10	Multiple	Mach.	34	5
Fab. Metals–332	109	Specialized suppliers	Mach.	25	5
Machinery–333	46	Specialized suppliers	Mach.	20	5
Computer–334	9	Science-based	Elec-trans	21	10
Electrical–335	23	Science-based	Elec-trans	51	9
Transportation–336	13	Scale intensive	Elec-trans	95	17
Medical supply–3391	12	Science-based	Science	36	13

Survey Framework

The population for the survey was all manufacturing establishments with 10 or more employees in the state of Georgia. An establishment is defined by the U.S. Census Bureau as "a single physical location where business is conducted or where services or industrial operations are performed."

To identify all manufacturing establishments/facilities, we compiled a list of Georgia establishments various internal Georgia Tech lists and respondents to past surveys. This list of companies was cleaned of duplicates, out-of-state companies, and insufficient addresses. Further refinement was provided by a process of contacting these companies that took place through Georgia Tech Industry Services. Companies that had moved or had an undeliverable address were removed from the list. This process resulted in 4,4573 companies.

Questionnaire Design

The questionnaire was designed to approximate previous Georgia Manufacturing Surveys to enable comparisons and determine trends. Themes addressed in the questionnaire included manufacturers' problems and needs,

changes in business structure and practices, product and process development, constraints to development, use of information technology, manufacturing productivity and performance, workforce costs and training, and interest in technical assistance.

The 2012 survey specifically focused on three areas: (1) innovation, (2) adoption of information technologies, quality management and continuous improvement, and manufacturing production technologies, and (3) sustainable manufacturing.

Once a draft questionnaire and cover letter had been designed, a pilot test was conducted to get feedback on the survey's format, wording, and design. Comments from manufacturers and Industry Services management were incorporated into a final version presented in Appendix 2.

Administration

The survey was conducted from February to May 2012 using two waves of mailings and follow-up. A packet containing a questionnaire, a cover letter from the Georgia Department of Labor, and a self-addressed, postage-paid envelope was mailed to 4,572manufacturing establishments. Similar second follow-up mailing was sent. This entire process yielded a total response of 604 surveys.[11]

The response to the survey was as follows:

Companies in initial database	4,572
Wrong address/undeliverable, out of business, not a manufacturer	114
Total surveys delivered to active manufacturers	4,458
Declared refusals	22
Non-respondents	4,436
Total surveys received	604
Respondents with less than 10 employees	76
Complete surveys with manufacturers having 10+ employees	528
Response rate	

The response rate was calculated by eliminating all the wrong addresses, non-manufacturers, and companies that were out of business from the list of Georgia manufacturers. Then, the number of completed survey forms of manufacturers (604) was divided by the total number of manufacturing establishments, established as legitimate, in the target population (4,458). The response rate was 12 percent. Our analysis focuses only in those establishments with 10 or more employees (528).

[11] The process yielded additional surveys not included in this summary due to late response of the respondents. These surveys are included in other analyses that draw on the data provided by this survey.

To evaluate the representativeness of the survey responses, Table 1.1 compares them to Georgia Department of Labor information. All manufacturing NAICS codes were grouped into five categories: food/apparel/textiles/leather, other materials related manufacturing (e.g., lumber, furniture, paper, stone, clay, glass and concrete), Machinery (metals, industrial machinery), Electronics (electronics, electrical, transportation), and Science-based (e.g., chemicals, medical supplies). Smaller establishments and those in the materials group are most noticeably underrepresented in the sample. Because of the importance of scale and product characteristics in determining firm behavior such as technology use, the sample was stratified by industry and establishment size and an expansion weight was applied.[12] The Georgia Department of Labor database of 3,744 establishments was used to calculate these weights. Note that Table 1.1 has a total survey response of 528. This total excludes survey forms from companies with fewer than 10 employees, and companies with missing employment and industry information.

Table A.1: Number of Establishments by Industry and Employment Size
Georgia Department of Labor (2010) vs. Survey Respondents

	GA Dept. of Labor		Georgia Survey	
	# estab.	% estab.	# estab.	% estab.
Industry Group				
Food-text	724	19%	81	15%
Materials	1,463	39%	186	35%
Mach	803	21%	165	31%
IT-Trans	377	10%	45	9%
Science	377	10%	51	10%
Employment				
10-19	1,277	34%	126	24%
20-99	1,728	46%	266	50%
100+	739	20%	136	26%

Failure to participate in the study is not the only type of non-response. Some respondents preferred not to answer one or more of the items on the questionnaire. Inter-item response rates are presented on each table. In many cases, the response rates neared or exceeded 90 percent, but for a few questions, response rates were below 70 percent. What these item response rates mean is unclear. For example, the 75 percent rate for return on sales may reflect a preference not to disclose this information, whereas the 76 percent rate for money spent on training may mean that the company did not collect the information. (Inter-item response rates are shown in Appendix 3)

Another step in the analysis involved verification of the accuracy of responses to certain questions. The project team ran checks on answers to the performance measure questions. For items that fell outside generally accepted

[12] See Terance Rephann and Philip Shapira, *Survey of Technology Use in West Virginia Manufacturing*, Morgantown, WV: West Virginia University Regional Research Institute, December 1, 1993, p. 8. Non-respondent surveys were not conducted. However, a few non-respondents told us that they did not understand, use, or feel that the technologies mentioned in the survey were applicable to their business. It is possible that the survey respondents are more advanced in technology use than the non-respondents.

ranges (e.g., payroll per employee or average wages of more than $100,000), the team sought to obtain correct information. Responses were also checked for internal consistency. For example, the number of employees with high school diplomas or their equivalent was checked against the total number of employees in the facility to ensure that these two items were consistent (i.e., there were not more employees with high school diplomas than the total number that worked in the facility).

Appendix 3 contains a breakdown of survey responses for every question on the survey form. Percentages of general managers answering each question and of item response rates are available. For questions that ask for quantitative information, percentile breakdowns, means, and standard error of the means are presented.

Appendix
2

Questionnaire

The 2012 Georgia Manufacturing Survey

Investing in the future

This survey is conducted to develop benchmark information to help Georgia manufacturers be more competitive and improve state business and technology services to industry. Prior Georgia Manufacturing Surveys were completed in 1994, 1996, 1999, 2002, 2005, 2008, and 2010. We appreciate your cooperation in making the 2012 survey a success.

- **In return for completing your survey, we will send a summary and customized report comparing your data with industry statistics.**
- **All company information will be kept confidential**. All individual firm and facility information will be kept in a secured, limited access location. Results will only be presented in an aggregated form. Your firm or facility's identity will not be revealed in any publication or presentation of the results of this survey.
- We understand you do not always keep exact records of all activities – estimates and rounding are fine.
- This is the only copy sent to this facility. If there is another person at your location who can complete the survey, please forward this mailing to him or her.
- Survey questions refer to this facility or plant.

Web-based survey is available at http://www.gms-ei2.org/2012/01/2012-survey-2/

Please return this survey in the enclosed postage-paid envelope within 10 days to:

Kennesaw State University
Econometric Center
Atn: 2010 Georgia Manufacturing Survey, Project Number [ID]
1000 Chastain Road
MD 0403, BB, Bldg. 4, Rm 322
Kennesaw, GA 30144-9732

Questions about the survey?

Contact: Dimitri Dodonova
Telephone: (770) 499-3390 Fax: (770) 423-6144
e-mail: dcamargo@kennesaw.edu http://www.gms-ei2.org/2012/01/2012-survey-2

Please confirm your name and address and make any changes if necessary.

[Contact Name]
[Company Name]
[Address]
[City], [State] [Zip]
[Phone]

THANK YOU FOR YOUR HELP

Georgia Tech
Enterprise Innovation Institute
School of Public Policy

Georgia Department of Labor
Kennesaw State University
Habif, Arogeti, and Wynne

1. FACILTY - INDUSTRY AND NEEDS

1.1. Is this facility a single-establishment enterprise not affiliated with any other enterprises?

- ❑ **Yes** (*skip to Question 1.2)*
- ❑ **No** — this facility is part of a company or group with two or more separate facilities.

  ➥ If part of a multi-facility company or group, is the **head office** located in Georgia?

  - ❑ **Yes**
  - ❑ **No**, head office is located in _____(U.S. state) or _____ (country outside of the U.S.)

1.2. Is this business:

- ❑ Publicly traded (registered securities are available for sale to general public)
- ❑ Privately owned

  ➥ If privately owned, is this a **family-owned** business?

  - ❑ Yes
  - ❑ No

1.3. In what year did you begin manufacturing at this facility? Year: ☐

1.4. Your facility's **main product** or manufacturing activity is: *(Please check one.)*

❑ Food, beverages, feed	❑ Stone, clay, glass, or concrete products
❑ Textiles	❑ Primary metals (iron, steel, nonferrous)
❑ Apparel, leather	❑ Fabricated metal products
❑ Lumber and wood products, except furniture	❑ Machinery (industrial, nonindustrial)
❑ Furniture (wood or metal)	❑ Computer and electronic products, instruments
❑ Pulp, paper, or paper products	❑ Electrical equipment, appliances, or components
❑ Printing, publishing	❑ Transportation equipment
❑ Chemical, petroleum, coal & allied products	❑ Medical or laboratory supplies
❑ Plastics or rubber	❑ Other (please describe) _____

1.5. For the plant's main product(s), please **RANK** the order of importance of the following factors according to how your facility competes in the marketplace for sales. 1=most important, 6=least important. (*Please do not give the same ranking to more than one factor.)*

☐	Low price
☐	High quality
☐	Innovation/new technology
☐	Quick delivery
☐	Adapting product to customer needs
☐	Sustainable or green manufacturing

1.6. Did any of the following significant changes occur to this facility in the last 2 years?

- ❑ Facility expanded due to acquisition or merger with another business or part of it
- ❑ Facility downsized due to sale or closure of part of the business
- ❑ No major change
- ❑ Other major change (please describe): _____

1.7. In which of the following areas does your facility have the most significant problems or needs? (*Please check all that apply.*)

- ❑ Expansion planning, facility layout
- ❑ Lean manufacturing and workflow improvement
- ❑ Quality assurance (e.g., ISO 9000, QS-9000, Six Sigma)
- ❑ Product development/design
- ❑ Marketing and sales
- ❑ Information systems and hardware
- ❑ Business strategy, financial analysis, competitiveness planning
- ❑ Basic workforce skills (e.g., reading, writing, math, keyboard skills)
- ❑ Technical skills (e.g., machining, electrical work)
- ❑ Management and leadership
- ❑ Energy cost management
- ❑ Environmental, health, safety, and workforce compliance and improvement
- ❑ Other (please describe):_____

2. PRODUCT, PROCESS AND ORGANIZATIONAL INNOVATION

A **product innovation** is the introduction of a **new or significantly improved good or service**. *The innovation must be new to your facility, but does not need to be new to your sector or market.* Resale of goods purchased elsewhere or changes to color or look are excluded.

2.1. During the period 2009-20011, did your facility introduce **new or significantly improved**: *(Please check if yes.)*

- ❑ Goods
- ❑ Services

*If you **do not check any option**, skip to Question 2.4.*

If ANY of the boxes above (from 2.1.) are checked, please continue, otherwise skip to Question 2.4.

2.2. Were any of your goods and service innovations during 2009-2011: *(Check all that apply.)*

- ❑ New to one of your markets (introduced before your competitors)
- ❑ New only to your facility (already available from your competitors)

2.3. Using the definitions above, please, indicate what percentage of your total sales from goods and services introduced during the period 2009-2011 were:

Sales of new or significantly improved goods and services that were **new to one of your markets** (introduced earlier than competitors)	%
Sales of new or significantly improved goods and services that were **new to your firm**, but NOT to your market	%
Sales from existing products	%
Total sales	100 %

A **process innovation** is the implementation of a **new or significantly improved production process or method of providing services**. *The innovation must be new to your facility, but it does not need to be new to your sector or market.*

2.4. During the period 2009-2011, did your facility introduce **new or significantly improved:** *(Please check if yes.)*

- ❑ Processes or manufacturing technologies
- ❑ Logistics, delivery, or distribution methods
- ❑ Support activities for the processes not covered above, such as improved purchasing, accounting, or maintenance processes
- ❑ Higher performing materials

An **organizational innovation** involves **new or significant changes in firm structure**, management methods, or information exchange systems.

2.5. During the period 2009-2011, did your facility introduce **new or significant changes** in: *(Please check if yes.)*

- ❑ Corporate strategy
- ❑ Management systems to better use or exchange information, knowledge and skills
- ❑ Work organization, such as changes in management or departmental structure
- ❑ Relations with other firms, such as alliances, partnerships, outsourcing, or subcontracting

A **marketing innovation** covers **new or significant changes in marketing methods** to increase the appeal of your goods or services or enter new markets. Routine or seasonal changes are excluded.

2.6. During the period 2009-2011, did your facility introduce **new or significant changes** in: *(Please check if yes.)*

- ❑ Design or packaging of goods or services
- ❑ Sales methods or distribution channels, such as Facebook/Twitter/other social media, franchising, direct sales or distribution licenses

2.7. Did your facility engage in any of the following activities to achieve **any of the types of innovation mentioned in Questions 2.1 to 2.6**? *(Please check if yes for all those that apply.)*

- ❑ In-house R&D (to increase knowledge or devise innovations, including software research)
- ❑ Purchase of R&D from research organizations or other branches of your company
- ❑ Purchase of machinery, equipment, computers or software to implement innovations
- ❑ Planning, engineering, design, or other development work to implement an innovation
- ❑ Purchase or license patents, inventions, know-how, or other types of knowledge to implement an innovation
- ❑ Training of staff to develop or introduce innovations
- ❑ Market research, advertising, and other marketing activities linked to implementing an innovation

2.8. Please indicate the **facility's expenditures** for the following innovation activities **over the last 12 months**, including personnel and related costs. (*Please insert zero in categories with no expenditures.)*

In-house R&D (including personnel costs & capital expenditures on buildings & equipment)	$
Acquisition of external R&D	$
Acquisition of machinery, equipment and software (excluding R&D-related expenditures)	$
Other development work for innovation and all other innovation-related expenditures	$
Total (sum of above 4 categories)	$

2.9. During the period 2009-2011, check if your facility:

- ❑ Ever worked with <u>customers</u> to create or design a product, process or other innovation
- ❑ Ever worked with <u>suppliers</u> to create or design a product, process or other innovation
- ❑ Applied for a patent or registered an industrial design
- ❑ Registered a trademark or assumed a copyright
- ❑ Signed a confidentiality agreement
- ❑ Published one or more papers or technical articles (in journals or conference proceedings)

2.10. During the period 2009-2011, did your facility **receive financial support** from any of these public or private sources for any of the <u>innovation activities</u> indicated in this section? *(Please check if yes.)*

- ❑ Public support through the U.S. Small Business Innovation Research program (SBIR or STTR)
- ❑ Other public support (loans or grants from the national, state, or local government, not the SBIR program)
- ❑ Venture capital, angel funding, or other private equity investment
- ❑ Bank loan or other private debt instrument

3. SUSTAINABLE MANUFACTURING

Sustainable manufacturing involves minimizing use of natural resources, toxic materials, waste emissions and production materials over the life cycle of the product or part to achieve cost savings, environmental, and social benefits.

3.1. Which of the following sustainable manufacturing goals are currently put into practice (or planned to be put into practice) at your facility? (*Check one option for each item.*)

	Practiced Now	*Plan to practice in next 2 years*	*No plan to practice*	*Not applicable*
Elimination of waste materials sent to landfills	❑	❑	❑	❑
No smokestacks, effluent, or waste to atmosphere, ground, water, or sewer	❑	❑	❑	❑
Operation of facilities with renewable energy sources (e.g., solar, wind, landfill gas, biomass)	❑	❑	❑	❑
Recovery and reuse of discarded products and manufactured materials (closed loop)	❑	❑	❑	❑
Reduce energy use and emissions in shipping (e.g. transport of input materials or finished products)	❑	❑	❑	❑
Reduce energy use and emissions associated with employee commuting or business travel)	❑	❑	❑	❑
Other (please describe):	❑	❑	❑	❑

3.2. A carbon footprint is an estimate of carbon dioxide (CO2) and other greenhouse gases produced by a business, individual or geographic area. Has your facility produced any estimate of its carbon footprint in the last 3 years?

- ❑ Don't know
- ❑ No → *(Skip to Question 4.1.)*
- ❑ Yes → What is the rounded approximate total carbon footprint in metric tons of CO2 equivalent terms for the most recent year available (*Check one option*)?
  - ❑ Less than 10,000 metric tons per year
  - ❑ 10,000 to 24,999 metric tons per year
  - ❑ 25,000 metric tons per year or more

4. MANUFACTURING PRODUCTION AND PERFORMANCE

4.1. Please, answer for the fiscal years 2007 and 2009 using rounded approximate numbers or estimates **for this facility**.

	2011	**2009**
What were your **total annual sales or gross value** of shipments?	$	$
What was the total purchase of materials, parts, and services (i.e., **cost of goods**)?	$	$
What were your **energy expenditures** (e.g., heat, electricity)?	$	$
What was the total **new capital investment**, including facility, equipment, machinery, and information systems?	$	$

	2011	**2009**
What was the percentage of sales **exported** outside the U.S. (by value)?	%	%
What was the percentage of purchases of materials, parts, and services **imported** or acquired from outside the U.S. (by value)?	%	%
What was the percentage of finished goods **imported** or acquired from outside the U.S. (by value)?	%	%

4.2. What was the average annual return on sales (pre-tax) for this facility **over the last 3 years**? [(Gross Sales-Cost of Goods)/Gross Sales] *(Please circle the closest number.)*

← Negative return **Positive return →**

-25% or more	-15%	-9%	-6%	-3%	**0%**	+3%	+6%	+9%	+15%	+25% or more

4.3. Has any work that was formerly performed at this facility been **moved outside of Georgia** within the last 2 years? ▶ Yes ❑ No ❑

*If **YES**, this work was transferred outside of Georgia to:*	❑Elsewhere in USA	❑Mexico, other Central or South America	❑Asia (including China, India)	❑Europe	❑Elsewhere in world

4.4. Has any work been **transferred back to this facility in Georgia** from outside the state within the last 2 years? ▶ Yes ❑ No ❑

*If **YES**, this work was transferred back to Georgia from:*	❑Elsewhere in USA	❑Mexico, other Central or South America	❑Asia (including China, India)	❑Europe	❑Elsewhere in world

4.5. Which of the following **information technologies** are currently used (or planned to be used) at your facility? (*Check one option for each item.*)

	Practiced Now	*Plan to practice in next 2 years*	*No plan to practice*	*Not applicable*
Bar code readers for data collection	❑	❑	❑	❑
Computer aided design	❑	❑	❑	❑
Software for scheduling, inventory control, or purchasing (e.g., ERP)	❑	❑	❑	❑
RFID for inventory and warehouse tracking	❑	❑	❑	❑
Supply chain management systems	❑	❑	❑	❑
Mass customization systems	❑	❑	❑	❑

4.6. Which of the following **quality management and continuous improvement techniques** are currently used (or planned to be used) at your facility? (*Check one option for each item.*)

	Practiced Now	*Plan to practice in next 2 years*	*No plan to practice*	*Not applicable*
ISO 9000, TS16949 certification	❑	❑	❑	❑
ISO 14000 environmental management certification	❑	❑	❑	❑
ISO 50001, Energy Management System	❑	❑	❑	❑
Quality systems (e.g., Six Sigma)	❑	❑	❑	❑
Lean manufacturing	❑	❑	❑	❑
Preventive/predictive machine maintenance program	❑	❑	❑	❑
Life cycle analysis	❑	❑	❑	❑

4.7. Which of the following **manufacturing production technologies** are currently used (or planned to be used) at your facility? (*Check one option for each item.*)

	Practiced Now	*Plan to practice in next 2 years*	*No plan to practice*	*Not applicable*
Computer-integrated manufacturing (CIM)	❑	❑	❑	❑
Rapid prototyping	❑	❑	❑	❑
Additive manufacturing, printed manufacturing	❑	❑	❑	❑
Robots	❑	❑	❑	❑
Advanced materials (e.g., nano-materials, bio-materials, composites)	❑	❑	❑	❑

4.8. Which of the following state or federal government benefits does your company use? (*Check all that apply.*)

- ❑ R&D tax credit
- ❑ Investment tax credit
- ❑ Job credit
- ❑ Retraining tax credit
- ❑ Import/export credit
- ❑ Energy tax credit

5. WORKFORCE AND TRAINING

5.1. Please, answer for the years 2007 and 2009 about your workforce using exact numbers or estimates, **for this facility**.

	2011	**2009**
On average, how many employees worked at this location? (Include temporary workers and convert part-time and contract labor to full-time equivalents.)	Full-Time Equivalent Employees	Full-Time Equivalent Employees
Of your full-time equivalent employees listed above, how many are temporary workers?	Temporary Employees	Temporary Employees
What was your total payroll? (Please include direct payroll plus indirect fringe benefit payroll expenses. Include payments to agencies for temporary workers.)	Payroll $	Payroll $

5.2. Does the facility provide bonuses or other incentives to employees based on the following? *(Check if yes.)*

- ❑ New skills or education acquired
- ❑ Productivity increases
- ❑ New ideas suggested or implemented

5.3. On average in 2011, what percentage of your production workers used, at least once a day, as part of their job:

a. A computer or programmable controller?	%
b. The Internet?	%

5.4. In 2011, how many employees at this facility had at least the following training or educational qualifications:

	Number of Employees
a. High school graduate or GED?	
b. Two or more years of industrial-related training, through technical college, vocational school, or apprenticeship?	
c. Four-year college degrees (e.g., B.A., B.S.) with majors in science, engineering or information technology?	
d. Four-year college degrees (e.g., B.A., B.S.) with majors in other subjects (**not** science, engineering, or information technology)?	
e. Master's, Ph.D., or other graduate degrees with majors in science, engineering or information technology?	

5.5. How much did your company spend on all training activities in fiscal year 2011?

	$
Of this, approximately what percentage was related to new activities and tasks (i.e., not routine training)?	%

5.6. What percentage of employees in production work are in teams (e.g., quality team, work cell)? *(If none, enter zero.)*

%

6. BUSINESS ASSISTANCE RESOURCES

6.1. In the past 2 years, has your facility **received business assistance** from: *(Check all that apply.)*

- ❑ Georgia Tech (main campus or regional office)
- ❑ Kennesaw State University
- ❑ Other university (not Georgia Tech or Kennesaw State University))
- ❑ Small Business Development Centers (SBDC, provided by University of Georgia)
- ❑ Technical college (Technical College System of Georgia, Quick Start)
- ❑ Georgia Department of Labor's recruitment, labor market information, or welfare-to-work services
- ❑ Federal laboratory, NASA, or other federal technology program
- ❑ Other public or nonprofit business assistant source
- ❑ A private-sector business assistance source, such as a private consultant or vendor
- ❑ Another source not included in the above
- ❑ **Facility has not received outside business assistance**

6.2. Would **you or your managers** be interested in receiving training or technical assistance in any of the following areas? *(Check all that apply.)*

- ❑ Product design and development
- ❑ Technology implementation
- ❑ Marketing and sales growth
- ❑ Lean manufacturing and process improvement
- ❑ Supply chain development
- ❑ Quality systems, ISO 9000, TS 16949
- ❑ ISO 14000 environmental management certification
- ❑ Finance and taxes
- ❑ Safety and health, ergonomics
- ❑ Energy efficiency and management
- ❑ Materials and waste minimization
- ❑ Other topics *(please describe)*

_____

6.3. What new training programs would you like to have available to **non-managerial employees** at this facility? *(Check box if your company would benefit from training in a category even if is not currently available or provided.)*

- ❑ English speaking skills
- ❑ Reading, writing skills
- ❑ Basic math skills
- ❑ Technical skills (e.g., machinist)
- ❑ Product design and development
- ❑ Marketing skills
- ❑ Team and problem solving skills
- ❑ Quality, lean manufacturing
- ❑ Basic computer skills (e.g., keyboarding, word processing, e-mail)
- ❑ Advanced computer skills (e.g., database, Web design)
- ❑ Other topics *(please describe)*

_____

- ❑ Check here if facility does not need/would not use non-managerial training

Please check any of the following boxes if you would like to receive information about:

- ❑ Georgia Tech's industrial services, seminars, and workshops
- ❑ Kennesaw State University's services, seminars, and workshops
- ❑ Georgia Department of Labor's services, information, training
- ❑ Federal and state manufacturing tax incentives and credits
- ❑ Reducing indirect costs in the manufacturing and distribution process

(No individual information besides contact information for the company will be transmitted.)

Appendix
3

Manufacturer Responses by Survey Question

(Total respondents as of 6/01/2010 is 528)

1. Facility-Industry and Needs

1.1. This facility is	
Single establishment enterprise	60.74%
A multi-facility, company or group, head office	12.32%
An affiliate of a parent group or holding company	26.94%
	100.00%
Total respondents	528

1.1a. Is your company's head office located in Georgia	
Yes	73.06%
No	26.94%
	100.00%
Total respondents	528

1.2. Is this business:	
Publicly traded	15.00%
Privately owned, family business	59.26%
Privately owned, not a family business	25.75%
Total respondents	528

1.3. In what year did you begin manufacturing at this facility	
Mean year	1984
Std. deviation year	20
10th Percentile	1956
25th Percentile	1975
50th Percentile	1988
75th Percentile	1998
90th Percentile	2005
Total respondents	504

1.4. Your facility's main product or manufacturing activity is:

Food beverages, feed	8.53%
Textiles	8.17%
Apparel, leather	2.64%
Lumber and wood, except furniture	11.22%
Furniture (wood or metal)	3.97%
Pulp Paper and paper products	3.32%
Printing and publishing	4.04%
Chemical, petroleum, coal & allied products	7.70%
Plastics or Rubber	10.86%
Stone, clay, glass or concrete	5.67%
Primary metals (iron, steel, nonferrous)	1.02%
Fabricated metals	14.04%
Machinery (industry, nonindustrial)	6.38%
Computer and electronic products, Instruments	2.01%
Electrical equipment, appliances, or components	5.15%
Transportation equipment	2.91%
Medical or laboratory supplies	2.37%
Other (please describe)	100.00%
Total respondents	528

1.5. Rank order of importance of the following factors facility competition for sales (percent ranking factor #1)

Low price	17.09%
High quality	56.14%
Innovation/new technology	8.54%
Quick delivery	12.68%
Adapting product to customer needs	16.33%
Sustainable or green manufacturing	2.69%
Total respondents	528

1.6. Did any of the following significant changes occur?

Merger with another business	5.96%
Sale or closure of part of business	10.32%
No major change	69.64%
Other (e.g., reduction of employees, production, new customers)	14.69%
Total respondents	526

1.7. In which of the following areas does your facility have the most significant problems or needs?

Expansion planning, facility layout	13.79%
Lean manufacturing and workflow improvement	31.62%
Quality assurance (e.g., ISO 9000, QS-9000, Six Sigma)	13.62%
Product development/design	11.44%
Marketing and sales	36.02%
Information systems and hardware	12.17%
Business strategy, financial analysis, competitiveness planning	11.39%
Basic workforce skills (e.g., reading, writing, math, keyboard skills)	16.36%
Technical skills (e.g., machining, electrical work)	23.50%
Management and leadership	12.24%
Energy cost management	21.40%
Environmental, health, safety, and workforce compliance and improvement	13.52%
Other (please describe)	8.93%
Total respondents	528

2. Product, Process and Organizational Innovation

2.1. During the period 2009-20011, did your facility introduce:

New or significantly improved goods	46.0%
New or significantly improved services	14.0%
Total respondents	528

2.2. Were any of your goods and service innovations during 2009-2011

New to one of your markets? (introduced before your competitors)	28.4%
New only to your facility? (already available from your competitors)	23.3%
Total respondents	528

2.3. Please give the percentage of your total sales from goods and services introduced during the period 2009 to 2011.

2.3a Sales from goods and services that were **new to one of your markets**

Mean percentage	15.31%
Std. deviation percentage	17.75%
10th Percentile	0.00%
25th Percentile	5.00%
50th Percentile	10.00%
75th Percentile	20.00%
90th Percentile	35.00%

Total respondents	215

2.3b Sales from goods and services that were **new to your firm**, but NOT to your market	
Mean percentage	16.69%
Std. deviation percentage	19.82%
10th Percentile	0.00%
25th Percentile	5.00%
50th Percentile	10.00%
75th Percentile	20.00%
90th Percentile	40.00%
Total respondents	252

2.3c Sales from existing products	
Mean percentage	77.44%
Std. deviation percentage	20.18%
10th Percentile	50.00%
25th Percentile	70.00%
50th Percentile	80.00%
75th Percentile	90.00%
90th Percentile	95.88%
Total respondents	252

2.5. During the period 2009-2011, did your facility engage in any of the following organizational innovation activities?

Corporate strategy	22.76%
Implement new or significantly improved management systems to better use or exchange information, knowledge and skills	22.69%
Make a major change to the organization of work, such as changes in management or departmental structure	31.96%
New or significant changes in your relations with other firms, such as alliances, partnerships, outsourcing, or subcontracting	22.08%
Total respondents	528

2.6. During the period 2009-2011, did your facility engage in any of the following activities? (please check if yes)

Make significant changes to the design or packaging of a good or service (exclude routine or seasonal changes)	15.60%
New or significant changes to sales methods or distribution channels, such as Internet sales, franchising, direct sales or distribution licenses	100.00%
Total respondents	528

2.7. During the period 2009-2011, did your facility engage in any of the following innovation-related activities?

In-house R&D (to increase knowledge or devise innovations, including software research)	32.63%
Purchase R&D from research organizations or other branches of your company	5.17%
Purchase machinery, equipment, computers or software to implement innovations	45.09%
Planning, engineering, design, or other development work to implement an innovation	28.45%
Purchase or license patents, inventions, know-how, or other types of knowledge to implement an innovation	8.66%
Training staff to develop or introduce innovations	29.29%
Market research, advertising, and other marketing activities linked to implementing an innovation	18.34%
Total respondents	528

2.8. Please estimate your expenditures for the following innovation activities over the last 12 months. (Include personnel and related costs).

2.8a In-house R&D (including personnel costs & capital expenditures on buildings & equipment)

Mean In-house R&D	$246,760
Std. deviation In-house R&D	$682,446
10th Percentile	$0
25th Percentile	$0
50th Percentile	$30,000
75th Percentile	$150,000
90th Percentile	$600,000
Total respondents	281

2.8b Acquisition of external R&D

Mean external R&D	$29,385
Std. deviation external R&D	$196,127
10th Percentile	$0
25th Percentile	$0
50th Percentile	$0
75th Percentile	$0
90th Percentile	$15,000
Total respondents	188

2.8c Acquisition of machinery, equipment and software (excluding R&D-related expenditures)

Mean acquisition of machinery, equipment and software	$589,292
Std. deviation acquisition of machinery, equipment and software	$2,556,310
10th Percentile	$0

25th Percentile	$5,000
50th Percentile	$50,000
75th Percentile	$223,296
90th Percentile	$1,000,000
Total respondents	306

2.8d Other development work for innovation and all other innovation-related expenditures

Mean other development work	$112,114
Std. deviation other development work	$1,084,186
10th Percentile	$0
25th Percentile	$0
50th Percentile	$0
75th Percentile	$20,000
90th Percentile	$100,000
Total respondents	202

2.8e Total (sum of above 4 categories)

Mean Total	$673,923
Std. deviation Total	$2,484,199
10th Percentile	$0
25th Percentile	$15,000
50th Percentile	$72,000
75th Percentile	$411,000
90th Percentile	$1,800,000
Total respondents	299

2.9. During the period 2009-2011, check if your facility

Ever worked with customers to create or design a product, process or other innovation	64.55%
Ever worked with suppliers to create or design a product, process or other innovation	43.21%
Applied for a patent or registered an industrial design	11.43%
Registered a trademark or assumed a copyright	12.88%
Signed a confidentiality agreement	
Staff published one or more papers or technical articles (in journals or conference proceedings)	
Total respondents	528

2.10. During the period 2007-2009, did you receive for innovation activities from

Public support through the SBIR or STTR programs	1.15%
Other public support (loans or grants from the national, state, or local government)	2.72%
Venture capital, angel funding, or other private equity investment	2.93%
Bank loan or other private debt instrument	29.44%

Total respondents	517

3. Sustainable manufacturing

3.1. Indicate whether you use or plan to use any of the following technologies or techniques at this facility

3.1a. Eliminate waste materials sent to landfills

Practice now	68.86%
Plan to practice in next 2 years	7.29%
No Plan to practice	12.33%
Not applicable	11.52%
	100.00%
Total Respondents	478

3.1b. Reduce air or water pollutants

Practice now	54.86%
Plan to practice in next 2 years	3.30%
No Plan to practice	8.96%
Not applicable	32.89%
	100.00%
Total Respondents	458

3.1c. Use renewable energy sources

Practice now	7.12%
Plan to practice in next 2 years	7.95%
No Plan to practice	53.04%
Not applicable	31.89%
	100.00%
Total Respondents	456

3.1d. Recovery and reuse of discarded products and manufactured materials (closed loop)

Practice now	52.33%
Plan to practice in next 2 years	8.38%
No Plan to practice	20.64%
Not applicable	18.65%
	100.00%
Total Respondents	475

3.1e. Reduce energy use and emissions in shipping

Practice now	25.40%

Plan to practice in next 2 years	12.58%
No Plan to practice	35.53%
Not applicable	26.50%
	100.00%
Total Respondents	454

3.1f. Reduce energy use and emissions associated with employee commuting or business travel

Practice now	16.73%
Plan to practice in next 2 years	6.59%
No Plan to practice	54.97%
Not applicable	21.72%
	100.00%
Total Respondents	458

3.1g. Other sustainable goal

Practice now	27.99%
Plan to practice in next 2 years	9.28%
No Plan to practice	26.25%
Not applicable	36.48%
Total Respondents	43

3.2. Has your facility produced any estimate of its carbon footprint in the last 3 years?

Don't know	18.92%
Yes	8.04%
No	91.96%
Total respondents	127

3.2a. What is the carbon footprint in CO2 equivalent terms

Less than 10,000 metric tons per year	65.77%
10,000 to 24,999 metric tons per year	17.65%
25,000 metric tons per year or more	16.58%
Total respondents	35

4. Manufacturing Production and Performance

4.1a. What were your total annual sales or gross value of shipments at this plant?

	2011	2009
Mean sales	$25,660,951	$21,663,411
Std. deviation sales	$81,553,956	$80,948,750
10th Percentile	$1,066,644	$987,000
25th Percentile	$2,200,000	$1,900,000
50th Percentile	$6,685,000	$5,100,000
75th Percentile	$22,500,000	$18,000,000
90th Percentile	$58,100,000	$50,300,000
Total Respondents		418

4.1b. How much did you spend on materials, parts and services?

	2011	2009
Mean spending on direct inputs	$16,549,708	$14,996,909
Std. deviation spending on direct inputs	$64,278,403	$67,651,242
10th Percentile	$400,000	$350,000
25th Percentile	$1,000,000	$830,000
50th Percentile	$3,500,000	$2,800,000
75th Percentile	$13,500,000	$11,000,000
90th Percentile	$39,834,000	$32,800,000
Total respondents		382

4.1c. How much did you spend in energy at this location?

	2011	2009
Mean energy expenditure	$721,777	$684,629
Std. deviation energy expenditure	$6,153,575	$6,128,841
10th Percentile	$10,500	$12,000
25th Percentile	$24,180	$24,000
50th Percentile	$66,609	$60,000
75th Percentile	$260,000	$250,000
90th Percentile	$930,000	$740,000
Total respondents		381

4.1d. How much new capital investment was made at this location?

	2011	2009
Mean new capital investment	$1,067,671	$627,615
Std. deviation new capital investment	$5,474,782	$2,871,690
10th Percentile	$0	$0
25th Percentile	$2,136	$0
50th Percentile	$60,000	$32,304
75th Percentile	$450,000	$250,000
90th Percentile	$2,000,000	$1,421,387
Total respondents		386

4.1e. What percentage of sales was exported outside the U.S.

	2011	2009
Mean percentage of sales outside the U.S.	7.75%	6.68%
Std. deviation percentage of sales outside the U.S.	15.90%	14.83%
10th Percentile	0.00%	0.00%
25th Percentile	0.00%	0.00%
50th Percentile	1.00%	0.00%
75th Percentile	8.50%	5.00%
90th Percentile	23.00%	20.00%
Total respondents		431

4.1f. Approximate percentage of your facility's purchases of materials, parts, and services imported or acquired from sources outside of the United States (by value)

	2011	2009
Mean percentage of purchases outside the U.S.	11.94%	11.06%
Std. deviation percentage of purchases outside the U.S.	20.66%	19.94%
10th Percentile	0.00%	0.00%
25th Percentile	0.00%	0.00%
50th Percentile	1.00%	0.05%
75th Percentile	15.00%	12.00%
90th Percentile	47.00%	40.00%
Total respondents		416

4.1g. Approximate percentage of your facility's purchases of final goods imported or acquired from sources outside of the United States (by value)

	2011	2009
Mean percentage of purchases outside the U.S.	5.26%	4.66%
Std. deviation percentage of purchases outside the U.S.	16.73%	15.60%
10th Percentile	0.00%	0.00%
25th Percentile	0.00%	0.00%
50th Percentile	0.00%	0.00%
75th Percentile	1.00%	0.00%
90th Percentile	10.00%	10.00%
Total respondents		410

4.2. What was the average annual return on sales (pre-tax) over the last 3 years?

-25% or less	2.80%
-15%	1.30%
-9%	1.29%
-6%	1.72%

-3%	5.92%
0%	5.19%
3%	17.55%
6%	14.41%
9%	11.36%
15%	16.56%
+25% or more	18.94%
Average return on sales - mean	8.60%
Average return on sales - Std. deviation	11.08%
Total respondents	396

4.3. Has any work that was formerly performed at this facility been moved outside of Georgia within the last 2 years?

Yes	14.40%
No	85.60%
Total Respondents	503

4.3a to 4.3e. If YES, this work was moved from Georgia to:

Elsewhere in USA	8.12%
Mexico, other Central or South America	4.20%
Asia (including China, India)	5.13%
Europe	0.68%
Elsewhere in world	0.82%

4.4. Has any work been transferred back to this facility in Georgia from outside the state within the last 2 years?

Yes	15.61%
No	84.39%
Total Respondents	466

4.4b to 4.4e. If YES, this work was transferred back to Georgia from:

Elsewhere in USA	9.92%
Mexico, other Central or South America	1.27%
Asia (including China, India)	4.35%
Europe	0.41%
Elsewhere in world	0.68%

4.5.Which of the following information technologies are currently used (or planned to be used) at your facility?
4.5a. Bar code readers for data collection

Practiced now	39.09%
Plan to practice in next 2 years	20.48%

No Plan to practice	24.69%
Not applicable	15.74%

4.5b. Computer aided design

Practiced now	39.09%
Plan to practice in next 2 years	4.41%
No Plan to practice	16.52%
Not applicable	14.14%

4.5c. Software for scheduling, inventory control, or purchasing (e.g., ERP)

Practiced now	71.24%
Plan to practice in next 2 years	12.48%
No Plan to practice	11.46%
Not applicable	4.82%

4.5d. RFID for inventory and warehouse tracking

Practiced now	16.04%
Plan to practice in next 2 years	17.89%
No Plan to practice	48.56%
Not applicable	17.51%

4.5e. Supply chain management systems

Practiced now	34.12%
Plan to practice in next 2 years	11.98%
No Plan to practice	35.49%
Not applicable	18.41%

4.5f. Mass customization systems

Practiced now	11.18%
Plan to practice in next 2 years	6.13%
No Plan to practice	50.15%
Not applicable	32.54%

4.6.Which of the following quality management and continuous improvement techniques are currently used (or planned to be used) at your facility?
4.6a. ISO 9000, TS16949 certification

Practiced now	27.63%

Plan to practice in next 2 years	9.60%
No Plan to practice	42.18%
Not applicable	20.60%

4.6b. 14000 environmental management certification

Practiced now	9.40%
Plan to practice in next 2 years	7.44%
No Plan to practice	56.39%
Not applicable	26.77%

4.6c. ISO 50001, Energy Management System

Practiced now	1.63%
Plan to practice in next 2 years	4.66%
No Plan to practice	66.03%
Not applicable	27.67%

4.6d. Quality systems (e.g., Six Sigma)

Practiced now	32.78%
Plan to practice in next 2 years	13.56%
No Plan to practice	36.01%
Not applicable	17.65%

4.6e. Lean manufacturing

Practiced now	49.92%
Plan to practice in next 2 years	14.56%
No Plan to practice	21.00%
Not applicable	14.53%

4.6f. Preventive/predictive machine maintenance program

Practiced now	60.27%
Plan to practice in next 2 years	10.84%
No Plan to practice	15.89%
Not applicable	13.00%

4.6g. Life cycle analysis

Practiced now	18.39%
Plan to practice in next 2 years	12.68%

No Plan to practice	45.40%
Not applicable	23.53%

4.7.Which of the following manufacturing production technologies are currently used (or planned to be used) at your facility?
4.7a. Computer-integrated manufacturing (CIM)

Practiced now	24.89%
Plan to practice in next 2 years	7.85%
No Plan to practice	41.53%
Not applicable	25.74%

4.7b. Rapid prototyping

Practiced now	12.90%
Plan to practice in next 2 years	4.54%
No Plan to practice	51.08%
Not applicable	31.48%

4.7c. Additive manufacturing, printed manufacturing

Practiced now	6.42%
Plan to practice in next 2 years	3.34%
No Plan to practice	54.03%
Not applicable	36.21%

4.7d. Robots

Practiced now	13.13%
Plan to practice in next 2 years	5.04%
No Plan to practice	48.89%
Not applicable	32.94%

4.7e. Advanced materials (e.g., nano-materials, bio-materials, composites)

Practiced now	9.19%
Plan to practice in next 2 years	4.71%
No Plan to practice	50.26%
Not applicable	35.84%

4.8. Which of the following state or federal government benefits does your company use?

R&D tax credit	17.79%

Investment tax credit	16.63%
Job credit	17.69%
Retraining tax credit	7.50%
Import/export credit	5.37%
Energy tax credit	8.23%
Total Respondents	528

5. Workforce and Training

5.1a. How many employees worked at this location?

	2011	2009
Mean number of employees	78	75
Std. deviation number of employees	122	122
10th Percentile	12	12
25th Percentile	16	17
50th Percentile	34	32
75th Percentile	80	80
90th Percentile	180	161
Total respondents	528	528

5.1b. Of your full-time equivalent employees listed above, how many are temporary workers?

	2011	2009
Mean payroll	8	6
Std. deviation payroll	22	17
10th Percentile	0	0
25th Percentile	0	0
50th Percentile	1	0
75th Percentile	5	4
90th Percentile	20	15
Total respondents	528	528

5.1c. What was total payroll?

	2011	2009
Mean payroll	$2,951,235	$2,705,144
Std. deviation payroll	$4,584,501	$4,162,116
10th Percentile	$351,001	$360,306
25th Percentile	$545,000	$560,000
50th Percentile	$1,200,000	$1,100,000
75th Percentile	$3,000,000	$2,905,237

90th Percentile	$7,000,000	$6,335,980
Total respondents	339	328

5.2. Does the facility provide bonuses or other incentives to employees based on the following?

New skills or education acquired	12.20%
Productivity increases	39.90%
New ideas suggested or implemented	19.70%

Total respondents

5.3a. On average in 2011, what percentage of your workers used a computer or programmable controller at least once a week as part of their job?

Mean percentage of workers using computers	41.14%
Std. deviation percentage of workers using computers	59.45%
10th Percentile	0.00%
25th Percentile	5.00%
50th Percentile	25.00%
75th Percentile	75.00%
90th Percentile	100.00%
Total respondents	490

5.4a. How many persons were high school graduate or GED?

Mean number of workers graduated in high school	60
Std. deviation number of workers graduated in high school	103
10th Percentile	9
25th Percentile	13
50th Percentile	22
75th Percentile	60
90th Percentile	125
Total respondents	430

5.4b. How many persons had two or more years of industrial-related training?

Mean number of workers with 4 year of industrial training	11
Std. deviation number of workers with 4 year of industrial training	25
10th Percentile	0
25th Percentile	2
50th Percentile	4
75th Percentile	10
90th Percentile	25
Total respondents	391

5.4c. How many persons had a 4 year college degree or higher with majors in science, engineering or information technology?

Mean number of workers with 4 year college degrees	6
Std. deviation number of workers with 4 year college degrees	21
10th Percentile	0
25th Percentile	1
50th Percentile	2
75th Percentile	5
90th Percentile	12
Total respondents	397

5.4d. How many persons had a 4 year college degree or higher with majors in other subjects ?

Mean number of workers with 4 year college degrees	7
Std. deviation number of workers with 4 year college degrees	18
10th Percentile	0
25th Percentile	1
50th Percentile	2
75th Percentile	5
90th Percentile	15
Total respondents	383

5.4e. How many persons had master's, Ph.D., or other graduate degrees with majors in science, engineering or information technology?

Mean number of workers with science or engineering degrees	1
Std. deviation numbers of workers with science or engineering degrees	2
10th Percentile	0
25th Percentile	0
50th Percentile	0
75th Percentile	1
90th Percentile	2
Total respondents	341

5.5a. How much did the company spend on all training activities in 2011?

Mean spending on training	$45,131
Std. deviation spending on training	$323,937
10th Percentile	$0
25th Percentile	$0
50th Percentile	$5,000
75th Percentile	$15,000
90th Percentile	$50,000
Total respondents	393

5.5b. Of this, approximately what percentage was related to new activities and tasks?

Mean percentage training related to new activities	28.95%

Std. deviation percentage training related to new activities	35.81%
10th Percentile	0.00%
25th Percentile	0.00%
50th Percentile	10.00%
75th Percentile	50.00%
90th Percentile	100.00%
Total respondents	330

5.6. What percentage of employees in production work are in teams?

Mean percentage of employees in teams	31.91%
Std. deviation percentage of employees in teams	40.79%
10th Percentile	0.00%
25th Percentile	0.00%
50th Percentile	0.00%
75th Percentile	80.00%
90th Percentile	100.00%
Total respondents	438

6. Business Assistance Resources

6.1. Have you received business assistance from:

Georgia Tech (main campus or regional office)	23.05%
Kennesaw State University	1.34%
Other university (not Georgia Tech or Kennesaw State University))	3.00%
Small Business Development Centers (SBDC, provided by University of Georgia)	3.35%
Technical college (Technical College System of Georgia, Quick Start)	9.60%
Georgia Department of Labor's recruitment, labor market information, or welfare-to-work services	12.96%
Federal laboratory, NASA, or other federal technology program	0.47%
Other public or nonprofit business assistant source	2.55%
A private-sector business assistance source, such as a private consultant or vendor	13.07%
Another source not included in the above	2.92%
Facility has not received outside business assistance	51.61%
Total Respondents	426

6.2. Would you or your managers be interested in receiving training or technical assistance in:

Product design and development	9.45%
Technology implementation	10.91%
Marketing and sales growth	19.77%

Lean manufacturing and process improvement	29.05%
Supply chain development	9.64%
Quality systems, ISO 9000, TS 16949	11.08%
ISO 14000 environmental management certification	6.43%
Finance and taxes	10.26%
Safety and health, ergonomics	21.91%
Energy efficiency and management	19.10%
Materials and waste minimization	18.24%
Other topics	2.38%
Total Respondents	528

6.3. What new training programs would you like to have available to <u>non-managerial employees</u> at this facility?

English speaking skills	14.44%
Reading, writing skills	9.32%
Basic math skills	11.81%
Technical skills (e.g., machinist)	18.24%
Product design and development	3.23%
Marketing skills	6.12%
Team and problem solving skills	20.92%
Quality, lean manufacturing	26.90%
Basic computer skills (e.g., keyboarding, word processing, email)	13.24%
Advanced computer skills (e.g., database, ERP, Web design)	7.81%
Other topics	1.43%
Total Respondents	528