Innovation in Manufacturing: Needs, Practices, and Performance in Georgia 2005-2008

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INNOVATION AND SUSTAINABILITY: THE 2008 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 2008 is Innovation and Sustainability in Manufacturing.

New Business, Energy Efficiency Concerns in 2008

Compared with previous years, marketing and sales and energy costs have risen in importance to Georgia manufacturers in 2008. Lean manufacturing priorities are still uppermost among Georgia manufacturers while the need for technical skills and basic capabilities are also important. Yet, fewer manufacturers expressed concerns about these areas in 2008 compared to 2005 levels. In addition, computing technologies continue to decline in importance.

Sustainability is Prevalent in Manufacturing Set up

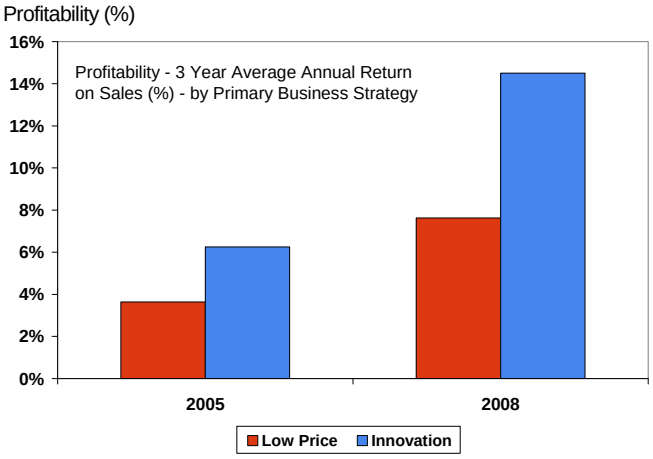
Three in four manufacturers use sustainability practices in production. They are most common in front end functions such as process design and supplier and raw material selection and least common in marketing via green branding or eco labeling. Energy resource reduction activities are appearing activities ranging from using high efficiency lighting (by nearly half the respondents) to setting energy targets (by 18%). In addition, one in five manufacturers has environmental stewardship programs. Suppliers and online sources play a major role in helping with these practices.

Innovation and Sustainability Links

Manufacturers that introduced technologically new or significantly improved processes were more apt to use green processes. New or improved organizational practices are likely to be tied to employee training in sustainability. And new marketing innovations are most likely to be associated with green marketing or eco labeling.

Profitability Gap Between Innovation and Low Price Strategies Widens

Twenty 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. Profits grew generally between 2005 and 2008, but grew much more for manufacturers competing primarily through innovation than through low price.



Outsourcing Continues Apace

Fifteen percent of manufacturers were impacted by outsourcing in 2008, similar to 2005 survey levels. At the same time, 12 percent of manufacturers benefitted from in-sourcing. In-sourcing was most prevalent among manufacturers in chemicals, medical devices and other science-based industries and those in electronics and electrical industries.

Performance Tied to Innovation, Use of Public Knowledge Sources

Product and process innovators had 11% and 15% higher productivity growth than non-innovators in the 2005-to-2007 time period. Use of public knowledge sources such as Georgia Tech was also associated with 15% higher productivity growth. Lack of qualified personnel and funding are considered the biggest barriers to innovation. However, fewer than one in four manufacturers train for innovation and only 5% use tax credits, loans/grants or other financial support.

About the Survey

- Mail surveys were sent to more than 4,000 manufacturers with 10 or more employees from May to August 2008. Completed surveys from 804 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.cherry.gatech.edu/survey

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Introduction: The 2008 Georgia Manufacturing Survey

The Georgia Manufacturing Survey 2008 is the sixth 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 2008 survey focuses on current and planned use of sustainable manufacturing techniques; trends in product, process, and organizational innovation; operational performance; and the impact and effectiveness of Georgia's manufacturing assistance programs.

The 2008 survey went to all Georgia manufacturing firms with 10 or more employees. Of the 804 responses received, 738 surveys met the criteria of manufacturers with 10 or more employees. These 738 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 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 2008. 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—Northwest (Dalton, Rome, Cartersville), Northeast (Gainesville, Athens), Atlanta, West (Columbus, LaGrange), East (Augusta), Central (Macon, Dublin, Warner

[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.

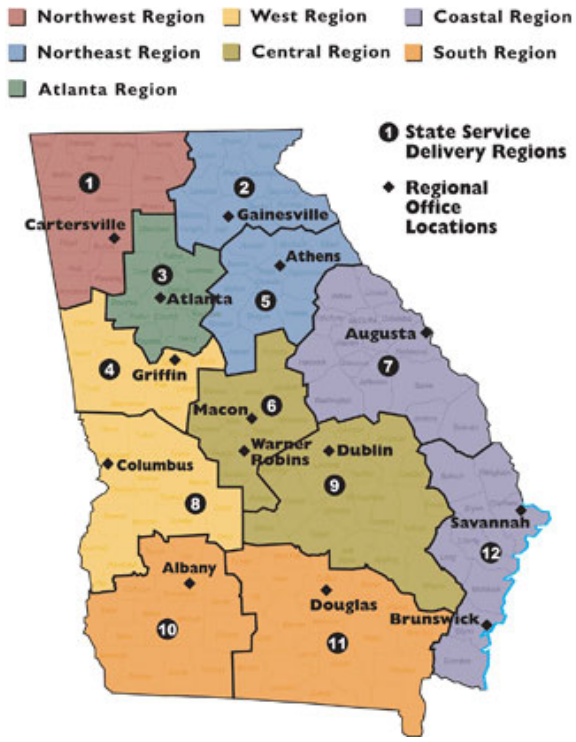
[2] Keith Pavitt. (1984) 'Sectoral patterns of technical change: towards a taxonomy and a theory', Research Policy, Vol. 13, pp. 343–373

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
		339	Miscellaneous (caskets, musical instrum., sporting goods)
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 2008 asked a question that has been posed in all six manufacturing surveys, including those conducted in 1994, 1996, 1999, 2002, and 2005: "In which of the following areas does your facility have the most significant problems or needs?" There were several modifications to this question from the 2005 survey:

- Material failure, wear patterns, and other material-related issues was deleted
- Marketing and sales was rephrased from marketing, niche marketing, market planning, exporting
- Information systems and hardware was rephrased from computer equipment and systems (either hardware or software)
- Management and leadership was rephrased from management, team, and problem-solving skills
- Energy cost management was rephrased from energy costs, conservation
- A new response choice category – water resource management – was added in light of Georgia's drought
- Environmental compliance and improvement was rephrased from waste products, pollution prevention

Nearly all of the respondents (90 percent) indicated that they had at least one significant problem or need at their facility. The average respondent checked 2.5 problem areas. Although 23 percent noted only one problem, a handful reported seven to eleven problems.

Manufacturers' Problems – Search for Sales, Energy Resources

Although manufacturer's priorities have maintained marked stability over time, the 2008 survey underscores several important changes. (See Table 2.1) First, marketing and sales were a significant need of nearly one-third of respondents. This is well above the percentage for 2005 and approaching 2002 levels, which was the high point of the search for sales and markets in the 14 year history of conducting this survey.

Second, lean manufacturing continues to rank high among manufacturer's concerns, with 32 percent indicating a need in this area. However, the percentage of respondents

reporting a need for lean manufacturing and workflow improvement is lower than 2005 levels.

Third, human resource problems are still at the forefront of manufacturers' issues. Forty percent of manufacturers have one or more human resource needs. Needs for workers with technical and basic skills are equally important, with about 20 percent of manufacturers indicating problems with each of these areas. The percentage of manufacturers with basic skills needs – which rose from 2002 to 2005 – declined in 2008. Management skill needs also are somewhat less prevalent, with 13 percent reporting problems in this area compared to 16 percent in 2005.

Fourth, 2008 has seen an increase in manufacturing worries about energy cost management. Twenty-three percent of Georgia manufacturers reported a significant problem with energy cost management. This area has consistently risen in prominence since 1999 when only 10 percent of Georgia manufacturers were worried about energy costs.

The 2008 survey also highlighted an increase in the percentage of manufacturers indicating problems with quality assurance and product development and design. Seventeen percent of manufacturers had a quality-related problem or need and 16 percent registered a need in the product development and design area.

The percentage of manufacturers with a need for expansion planning dropped to 18 percent in the 2008 compared to 21 percent in 2005. Also somewhat less prevalent in the 2008 survey than the 2005 survey were problems with safety compliance, business strategy and financial analysis, information technology, environmental and waste management. Although water resources were a statewide consideration, only 5 percent of respondents said they had a significant problem with water resource management.

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

Problems/Needs	2008	2005	2002	1999	1996	1994	Diff. 2008-2005
Manufacturing process/lean	32.3%	38.9%	34.4%	29.0%	27.0%	37.0%	-6.6%
Marketing and sales	32.9%	25.2%	36.9%	25.0%	17.0%	15.0%	7.7%
Technical skills	23.8%	23.3%	26.6%	25.0%	31.0%	n/a	0.5%
Energy costs management	23.2%	19.1%	15.3%	10.0%	13.0%	16.0%	4.1%
Basic skills	21.9%	25.6%	10.6%	13.0%	16.0%	n/a	-3.7%
Expansion planning, facility layout	17.6%	20.6%	24.0%	22.0%	22.0%	25.0%	-3.0%
Quality assurance	17.1%	14.7%	17.2%	17.0%	19.0%	22.0%	2.4%
Product development, design	15.5%	12.5%	19.0%	13.0%	13.0%	12.0%	3.0%
Safety compliance, health, workplace	13.3%	15.0%	17.6%	15.0%	17.0%	29.0%	-1.7%
Business, Finance	13.0%	15.8%	19.7%	n/a	n/a	n/a	-2.8%
General business analysis	n/a	n/a	16.3%	11.0%	n/a	n/a	
Financial planning	n/a	n/a	5.6%	n/a	12.0%	12.0%	
Supervisory, team skills	12.6%	15.6%	26.2%	21.0%	33.0%	n/a	-3.0%
Information systems & hardware	10.7%	14.3%	20.1%	27.0%	17.0%	13.0%	-3.6%
Computer software/packages	n/a	n/a	15.9%	19.0%	23.0%	26.0%	
Computer hardware/systems	n/a	n/a	10.3%	16.0%	n/a	n/a	
Automation	n/a	n/a	n/a	n/a	15.0%	8.0%	

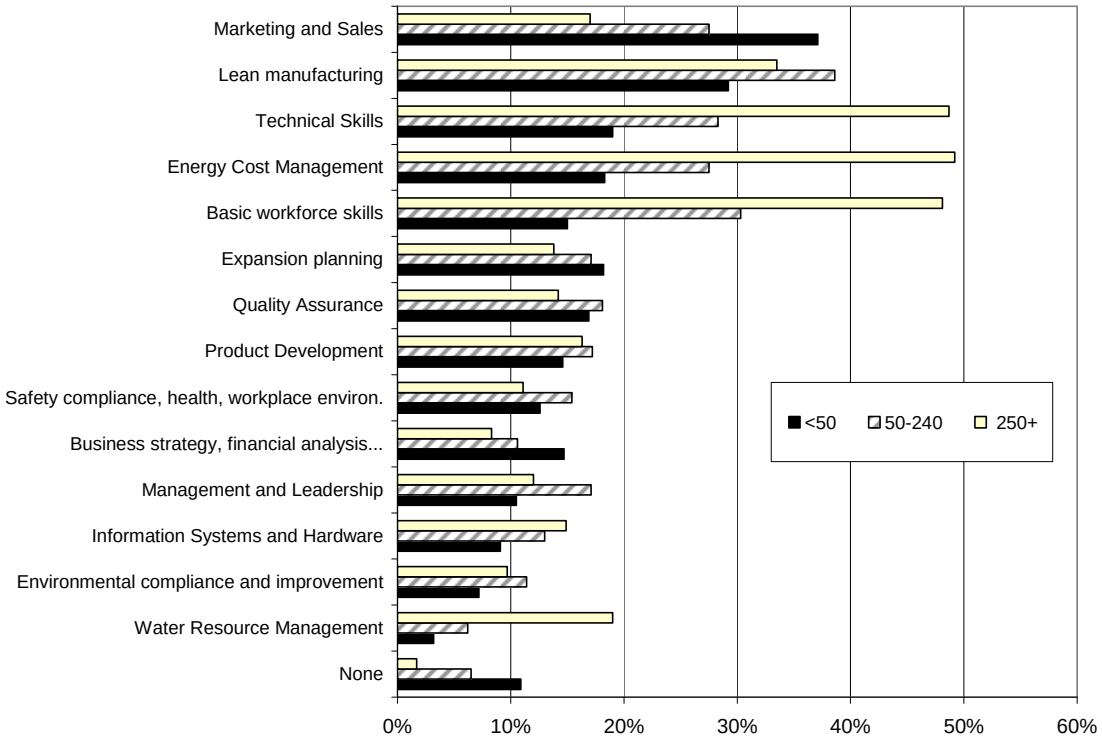
Environmental/waste management	8.7%	10.3%	15.7%	11.0%	n/a	n/a	-1.6%
Material-related	n/a	5.7%	8.8%	5.0%	5.0%	10.0%	
Water resource management	5.1%						

Source: 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 basic and technical skills than were smaller manufacturers (refer to Figure 2.1, yellow bar). They were also most likely to be concerned about energy costs and water resource management. 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 management skills and placed more emphasis on worries about quality assurance, product development, and environmental compliance issues. Small businesses with 10 to 49 employees were more apt to indicate marketing was a great need compared to their larger-firm counterparts. They were also comparatively more interested in financial planning. (See Figure 2.1)

Figure 2.1. Manufacturing Needs and Problems by Facility Employment Size



Source: Georgia Manufacturing Survey 2008, weighted responses of 677 manufacturers.

The emphasis given to specific problems differed by industry groups. Marketing and sales was the top interest for the food/textile/apparel/leather group and the materials group. Lean manufacturing was most prominent in the metals and machinery group. The food/textile/apparel/leather group indicated more concern with problems such as energy cost management and water resource management. Manufacturers in the materials group tended to follow the overall needs patterns. Metals and machinery industries often mentioned problems with finding technically-skilled workers and workers with basic workforce skills. Electrical, electronics, and transportation manufacturers also were more acutely focused on technical skills; in addition, they were the most likely to have needs for expansion planning. Science-based industries had the greatest need for energy cost management. (See Table 2.2)

Table 2.2. Manufacturing Problems and Needs by Industry

Problems/Needs	Food-Text	Materials	Mach	Elec-Trans	Science
Marketing and Sales	30.5%	36.4%	31.7%	25.1%	28.9%
Lean manufacturing	28.1%	34.7%	37.0%	27.7%	25.4%
Technical Skills	19.8%	20.9%	34.0%	27.4%	21.8%
Energy Cost Management	30.0%	24.6%	10.1%	20.5%	36.4%
Basic workforce skills	18.5%	21.3%	24.1%	23.6%	23.1%
Expansion planning	13.3%	17.2%	18.3%	25.3%	14.6%
Quality Assurance	13.9%	19.1%	17.6%	12.8%	18.4%
Product Development	14.0%	15.2%	15.0%	18.6%	16.2%
Safety compliance, health, workplace environ.	10.2%	13.1%	17.3%	9.6%	17.4%
Business strategy, financial analysis...	15.2%	11.2%	15.0%	14.2%	7.8%
Management and Leadership	9.6%	11.5%	21.5%	8.6%	9.5%
Information Systems and Hardware	14.0%	10.4%	10.2%	6.4%	12.1%
Environmental compliance and improvement	7.0%	10.1%	4.8%	6.4%	17.3%
Water Resource Management	12.8%	3.1%	2.6%	1.6%	9.5%

Source: Georgia Manufacturing Survey 2008, weighted responses of 677 manufacturers.

Marketing and sales needs were the most widespread concern for manufacturers in the Augusta and Central regions. Lean manufacturing needs were most commonly expressed by respondents in the Coastal regions. These two were equally prevalent in the Atlanta, Northeast, Northwest, and South regions. The most common concern among respondents in the West region was technical skill needs, followed by energy cost management. Technical skill needs were also frequently mentioned by manufacturers in the Augusta region. Basic skills needs were particularly prominent among manufacturers in the Coastal, South, Central, and West regions. Expansion planning needs were most evident for firms in the regions east of metro Atlanta (i.e., Northeast and Augusta). The highest proportion of firms with safety issues were found in the Central and South regions. (See Table 2.3)

Table 2.3. Manufacturing Problems and Needs by Region

Problems/Needs	Atlanta	Augusta	Central	Coastal	North-east	North-west	South
Marketing and Sales	34.9%	32.6%	30.2%	24.6%	35.5%	35.6%	33.8%
Lean manufacturing	36.2%	23.8%	25.5%	29.5%	31.7%	34.7%	30.7%
Technical Skills	21.1%	34.0%	27.6%	25.9%	18.5%	18.9%	29.8%
Energy Cost Management	17.9%	22.0%	24.3%	17.5%	26.5%	26.0%	27.7%
Basic workforce skills	15.3%	22.1%	29.8%	32.4%	22.3%	20.0%	29.5%
Expansion planning	16.9%	22.5%	18.6%	10.7%	21.5%	17.2%	15.3%
Quality Assurance	21.1%	10.1%	18.9%	18.1%	12.0%	16.3%	18.2%
Product Development	17.2%	14.8%	17.0%	11.2%	18.7%	11.0%	12.2%
Safety compliance, health, workplace environ.	10.6%	11.8%	25.6%	5.1%	11.1%	12.2%	24.4%
Business strategy, financial analysis...	10.7%	10.0%	17.1%	7.0%	19.8%	16.1%	9.7%
Management and Leadership	12.2%	6.6%	9.2%	7.7%	15.7%	13.1%	18.0%
Information Systems and Hardware	10.5%	5.0%	4.1%	12.5%	11.1%	15.8%	11.4%
Environmental compliance and improvement	6.7%	14.8%	11.0%	9.8%	10.3%	7.9%	6.4%
Water Resource Management	4.9%	2.2%	1.2%	1.4%	8.5%	6.6%	5.8%

Source: Georgia Manufacturing Survey 2008, weighted responses of 677 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 value-added customer and product services. The results represent the percentage of manufacturers that chose each strategy as their highest choice. This series of questions was also asked in the 1999, 2002, and 2005 which facilitates exploration of changes in primary manufacturing strategies over time.

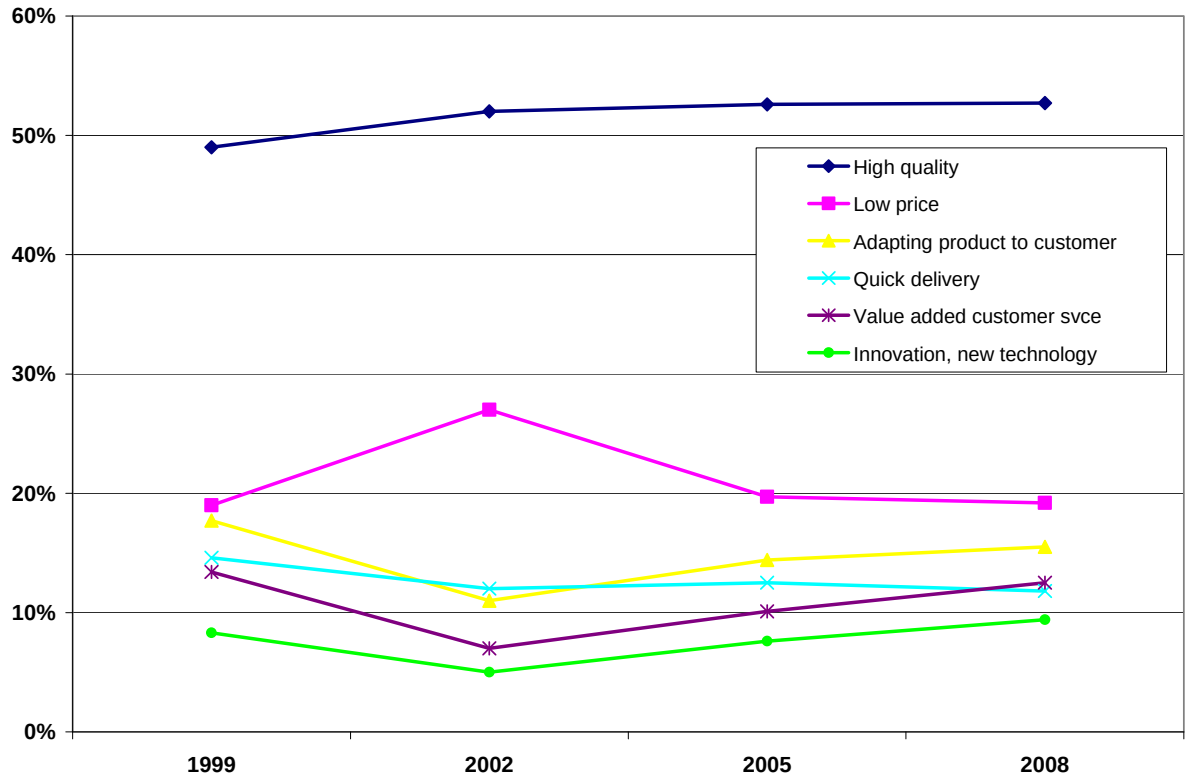
As in 2005 (and previous years), the 2008 survey found that more than half of Georgia manufacturers chose quality of service as their primary strategy in competing for customer sales. Low price was a primary strategy for just under 20 percent of Georgia manufacturers. Adapting to customers' needs was cited by 16 percent of the manufacturers, followed by value-added services at 13 percent and quick delivery at 12 percent and percent. Innovation/new techniques constituted a top strategy for the fewest manufacturers at less than 10 percent.

Since 2005, the percentage of respondents competing for sales primarily based on quality, low price, and quick delivery has remained constant, if not declined slightly. The percentage of firms competing for sales through adapting to customer needs, value-added services, and innovation has increased slightly from 2005 levels. (See Figure 3.1)

Strategies by Firm Characteristics

By employment size, the largest and the smallest firms were more apt to compete for sales primarily through high quality than were medium-sized companies. Medium-sized and large manufacturers were slightly more likely to compete for sales through low price than were small firms. Small manufacturers also were more apt to say that adapting product to customer needs was a primary strategy for them than were the largest companies. Value-added services and innovation strategies were more likely to be priorities for the largest firms. (See Table 3.1)

Figure 3.1. Top Manufacturing Strategies: 1999-2008
(Percentage of Firms Ranking Strategy as the Most Important)



Source: 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. Food / textile / apparel / leather establishments were the most apt to respond that low price was their primary strategy for competing for sales in the market. Manufacturers in the electronics / electrical / transportation group were similarly highly likely to prioritize low price strategies but also to prioritize innovation strategies, suggesting diversity within this broad industry group. Science-based industries also had a higher percentage of manufacturers primarily competing on innovation than was the case for the average survey respondent (15 percent vs. 10 percent, respectively). Respondents in the materials and metals / machinery groups followed the average firm in terms of their distribution of primary strategies, though with slightly higher prevalence of strategies prioritizing quick delivery. (See 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 and South regions (68 percent each). Low price strategies are most prominent in the Augusta region, with nearly one-third of manufacturers prioritizing this strategy. The

Central region had the highest percentage of firms that compete based on quick delivery (23 percent) and adapting to customer needs (21 percent). Innovation-oriented strategies accounted for the highest percentage of respondents in the Atlanta region. (See 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	55.4%	47.2%	52.9%
Low price	16.7%	24.2%	20.6%
Adapting product to customer needs	17.1%	13.0%	12.2%
Quick delivery	13.0%	9.5%	11.4%
Value-added customer service	12.0%	12.3%	18.0%
Innovation, new technology	8.5%	10.7%	12.4%

Source: Georgia Manufacturing Survey 2008, weighted responses of 738 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	57.4%	49.9%	52.2%	56.8%	50.3%
Low price	23.5%	17.6%	18.2%	23.5%	17.6%
Adapting product to customer needs	16.6%	16.4%	14.7%	11.3%	16.0%
Quick delivery	13.3%	10.3%	14.6%	11.9%	10.6%
Value-added customer service	12.2%	14.3%	11.0%	8.7%	12.3%
Innovation, new technology	9.0%	7.7%	8.7%	16.5%	13.7%

Source: Georgia Manufacturing Survey 2008, weighted responses of 738 surveys

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

Strategy	Atlanta	Augusta	Central	Coastal	North-east	North-west	South	West
High quality	45.5%	52.7%	51.3%	68.2%	57.3%	54.1%	67.5%	44.0%
Low price	16.1%	31.8%	15.3%	15.5%	27.0%	15.4%	20.6%	22.3%
Adapting product to customer needs	18.9%	13.8%	21.2%	4.7%	15.8%	15.9%	9.9%	7.8%
Quick delivery	10.3%	16.6%	23.0%	9.9%	11.5%	10.2%	10.8%	9.9%
Value-added customer service	14.2%	16.5%	11.4%	10.5%	11.9%	10.4%	16.4%	4.0%
Innovation, new technology	13.2%	8.9%	10.8%	10.1%	6.7%	5.7%	4.9%	9.7%

Source: Georgia Manufacturing Survey 2008, weighted responses of 738 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 average return-on-sales has risen since 2005. In 2005, the mean (average) return on sales was 5.3 percent and the median (50^{th} percentile) was 6 percent. By 2008, these figures were 9.8 percent and 9 percent, respectively.

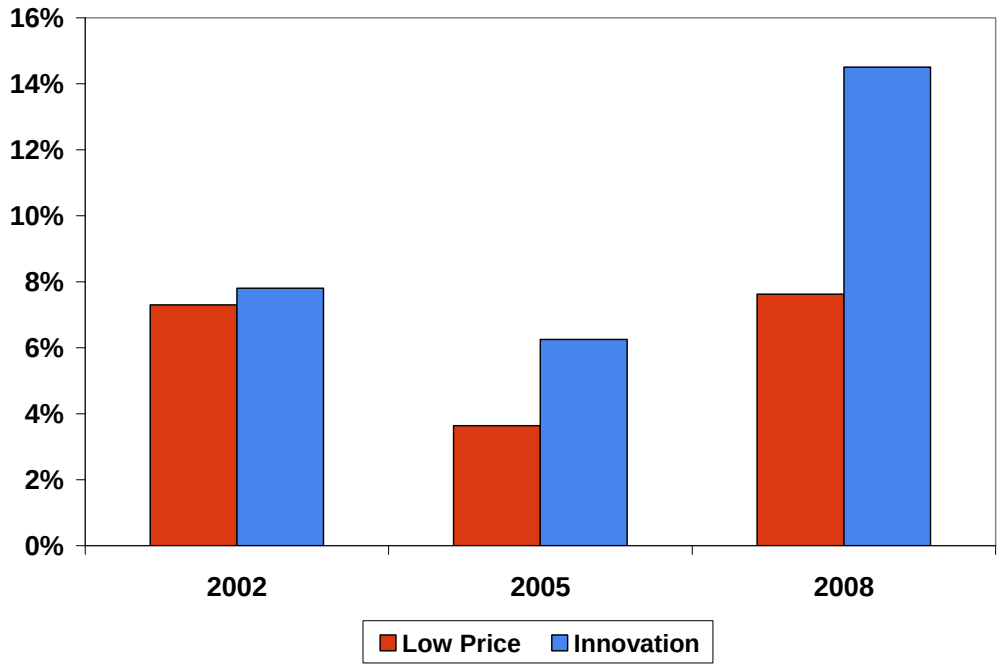
We found that the average return on sales for establishments that compete primarily on low price were pretty close to those of firms competing on innovation in 2002; only a half of a percentage point separated the two strategies. By 2005, these margins had widened. Establishments competing primarily 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. Figure 3.2 illustrates these differences.

Across all strategies, we found that high quality and innovation strategies had the highest mean return on sales (well over 6 percent). Low price and customization strategies had the lowest mean return on sales of less than 4 percent. Quick delivery and value-added services strategies were associated with margins in the 5 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 $33,000 to $37,000 for all but innovation strategies, which were associated with an average wage of nearly $42,000.

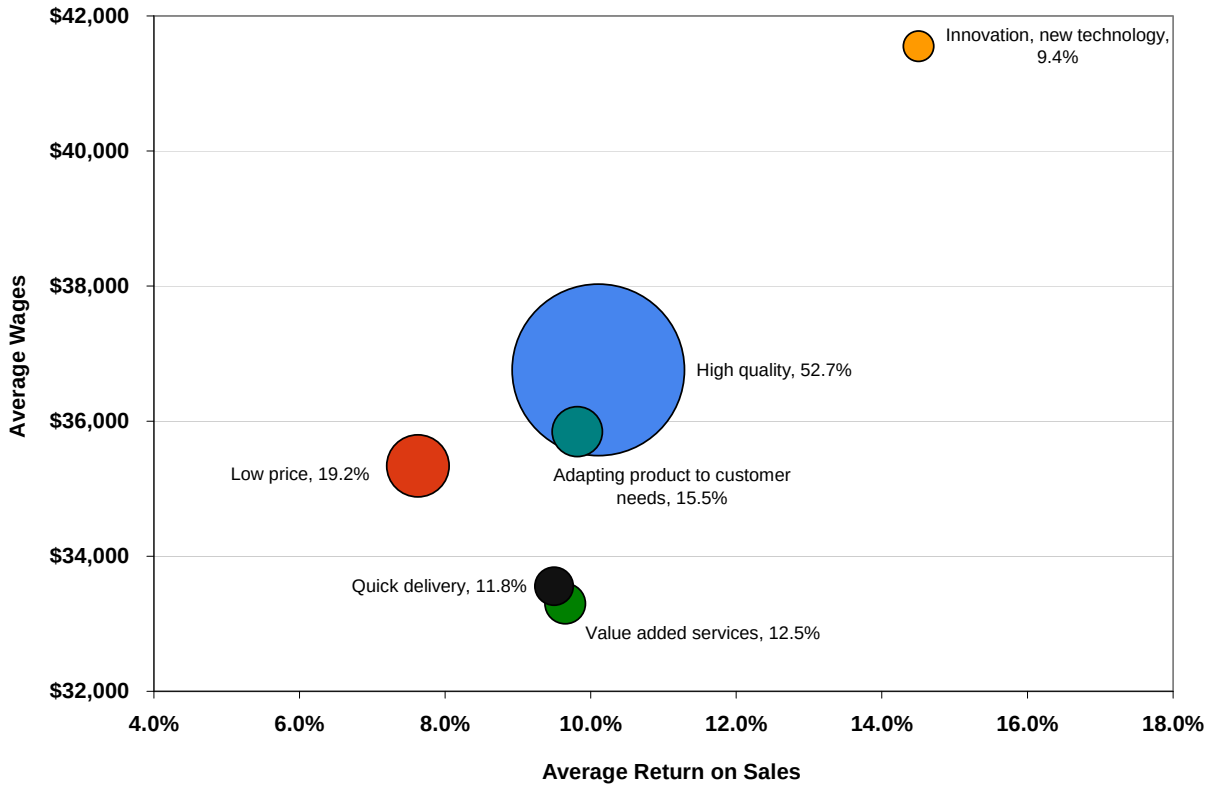
We can look at the relationship between the number of manufacturers that adopt various strategies to compete for customers, the "profitability" of these establishments, and the average wages they pay. The bubble chart in Figure 3.3 illustrates these findings graphically. The sizes of the bubbles represent the percentages of Georgia manufacturers that compete primarily through the various strategies. The vertical axis shows the average 2007 wages associated with these strategies. The horizontal axis shows average return on sales from 2005-2007 associated with these strategies. Manufacturers who compete primarily through innovation strategies have relatively high returns on sales and higher employee wages. However, most Georgia manufacturers use strategies that are associated with lower wages.

Figure 3.2. Average Return on Sales for Manufacturers Competing Primarily Through Low Price vs. Innovation: 2002, 2005, and 2008



Source: 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 2008



Source: Georgia Manufacturing Survey 2008, weighted responses of 738 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 prior surveys. Innovation strategies continue to be associated with higher profitability, particularly relative to low price strategies, and higher wages.

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.

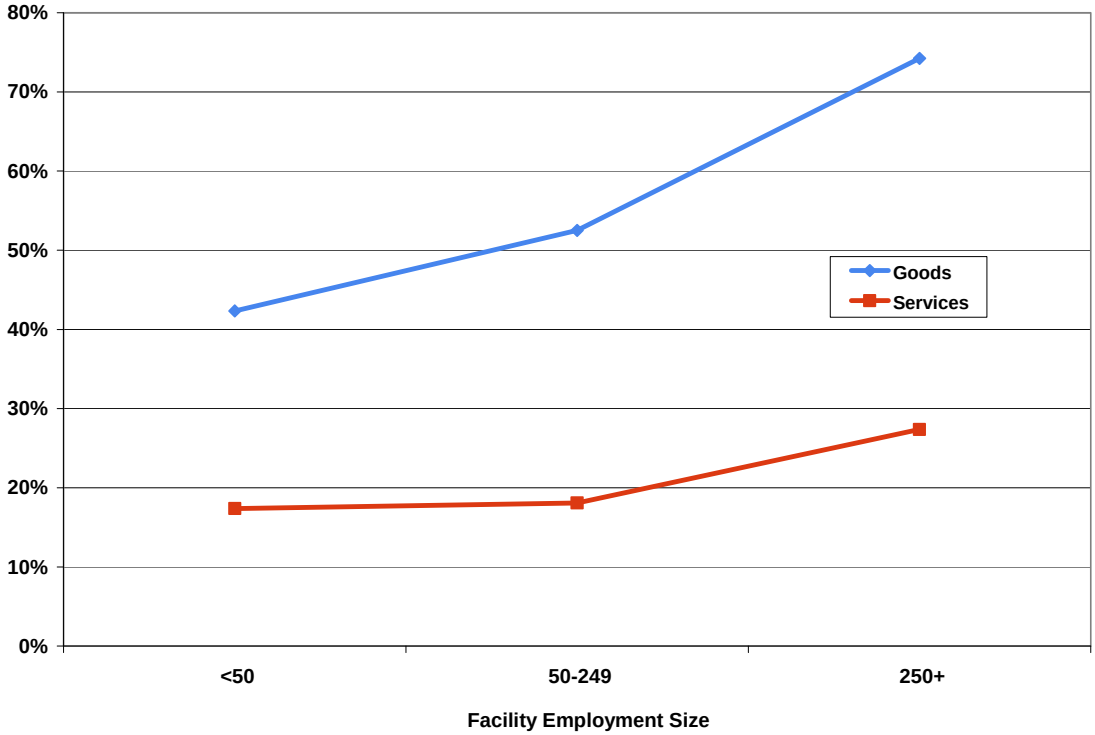
Innovation Types in Georgia Manufacturing

Product Innovation

We asked survey respondents to tell us whether their facility introduced any new or significantly improved goods or services during the period 2005 to 2007. Excluded were small changes to the color or look or resale of goods purchased elsewhere. Nearly half of the respondents had introduced a new or significantly improved good. Eighteen percent of the establishments had introduced a new or significantly improved service.

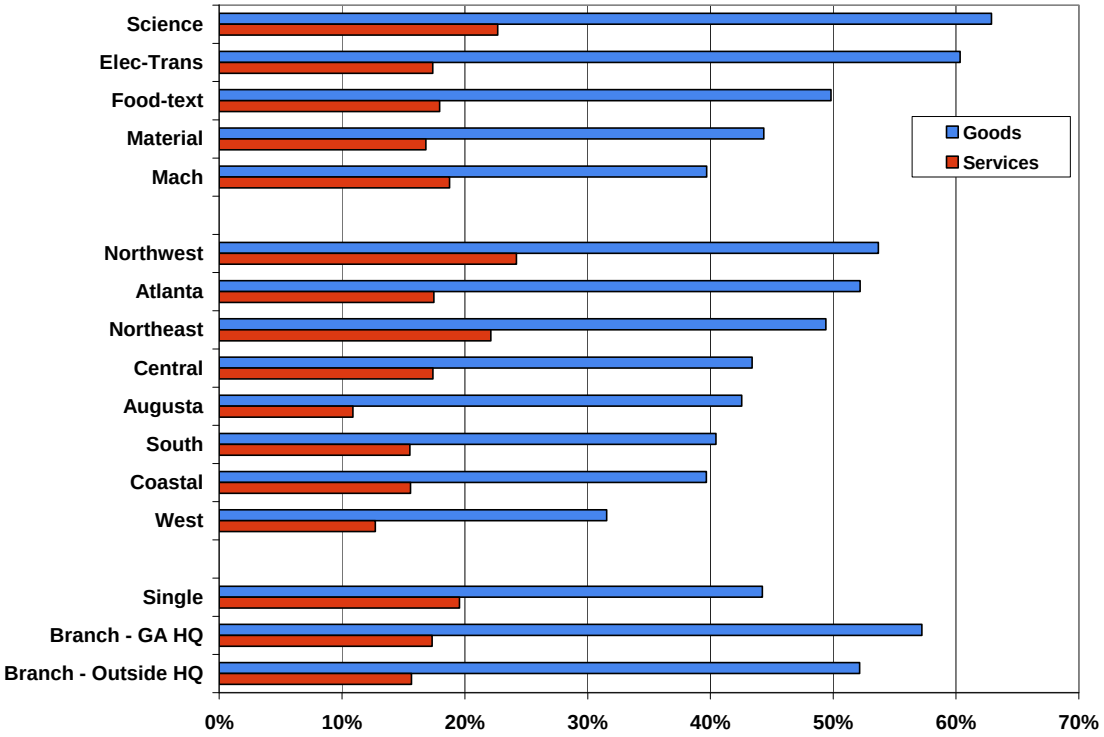
Introduction of new goods was most likely among larger manufacturing establishments. Unlike the 2005 survey, this year's survey found that large manufacturing establishments were also more likely to have introduced new services. However, smaller establishments with less than 50 employees were equally as likely to have introduced a new service as were medium-sized establishments with 50 to 249 employees. (See 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 group. By region, the Atlanta, Northwest, and Northeast regions had the highest percentage of establishments that introduced new goods (around 50 percent), with the West coming in at the lowest percentage (just over 30 percent). New services were more prominent among establishments in the Northwest and Northeast regions, with more than 20 percent of manufacturers in these regions having introduced new services; the Augusta and West regions have a relatively lower percentage. Branch plants are more likely to have introduced new products and services than are single establishment firms. (See Figure 4.2)

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 2005-2007)



Source: Georgia Manufacturing Survey 2008, weighted responses of 738 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 2005-2007)



Source: Georgia Manufacturing Survey 2008, weighted responses of 738 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 2005 to 2007 timeframe. This percentage is slightly below 2005 levels but still up from the 22 percent reported in 2002. The percentage of establishments introducing new-to-the-market innovations increased markedly with the facility employment size class. There was also a size-based effect evident in the percentage of establishments with new-to-the-facility innovations by facility employment size, but it was not as pronounced. By industry, establishments in the food-text and science categories had the highest percentage of respondents reporting introducing of new-to-the-market innovations. One would expect the elec-trans group to have a high percentage of establishments introducing new-to-the-market innovations; however, the elec-trans group had among the lowest percentages, along with the materials industry group. By region, the Northeast region had the highest percentage of establishments introducing new-to-the-market innovations, and the Augusta and West regions had the lowest. (See Table 4.1)

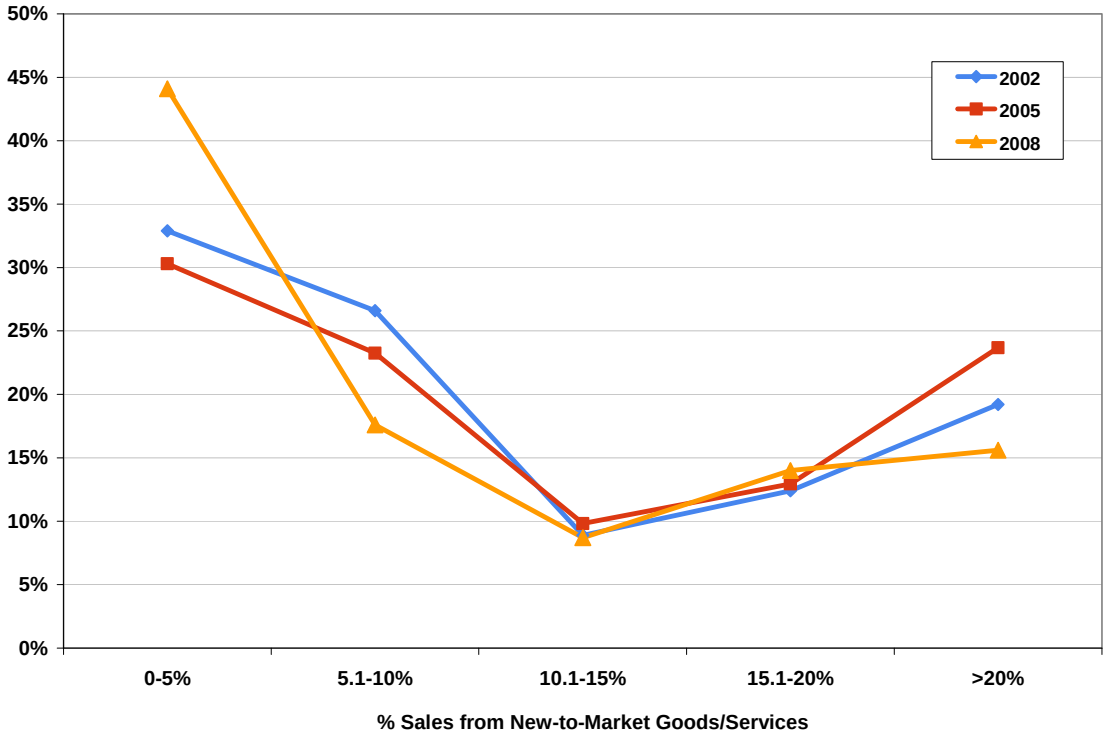
Table 4.1. New to Market vs. New to Facility Innovations
(Percentage of Establishments that Introduced the Innovations)

	New to Market	New to Facility
Total	29.6%	28.7%
Employment		
10-49	26.2%	26.5%
50-249	32.7%	31.3%
250+	46.3%	38.0%
Industry		
Food-text	26.8%	33.2%
Material	28.4%	25.8%
Mach	21.9%	29.4%
Elec-Trans	38.2%	26.0%
Science	44.2%	31.8%
Region		
Atlanta	32.3%	27.9%
Augusta	29.7%	22.5%
Central	26.6%	28.6%
Coastal	39.6%	24.4%
Northeast	29.2%	34.8%
Northwest	33.7%	30.9%
South	17.3%	29.6%
West	21.5%	21.7%

Source: Georgia Manufacturing Survey 2008, weighted responses of 738 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 14 percent of the facility's sales. However, for almost 6 percent of the respondents with new-to-the-market products or services, these offerings comprised half or more of their sales, although this percentage is down from 12 percent in the 2005 survey. 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 2002 except that the number of establishments reporting that more than one-fifth of sales came from new-to-the-market products was higher in the 2005 survey than in the 2002 survey.

Figure 4.3. Percentage of Sales from New-to-the-Market Goods/Services: 2002, 2005, 2008
(Y-axis represents percentage of firms)



Source: Georgia Manufacturing Survey 2008, weighted responses of 326 manufacturers.

Process Innovation

Over the last three years, 49 percent of the respondents introduced processes that were new to or significantly improved the firm. Of these processes, new manufacturing technologies and techniques on the shop floor were most common, introduced by 39 percent of respondents. Logistics and distribution innovations were introduced by 10 percent of respondents. Purchasing, accounting, maintenance, or other similar processes were introduced by about 11 percent of respondents. Smaller establishments lagged larger ones in shop floor and office innovation introduction, but logistics process innovations were introduced at comparable rates among small and medium-sized manufacturers. Shop floor innovations (i.e., techniques and technologies) were most common in science-based firms and metals and machinery. Process innovations were least common among electrical / electronics / transportation manufacturers, especially in shop floor and logistics-related innovations. Office innovations (i.e., purchasing and accounting) were most common among science-based manufacturers and least common in food-text and materials industry groups. By region, establishments in the Atlanta, Northeast, and Northwest areas had the highest rates of process innovation introduction, while the establishments in the West had the lowest rates. (See Table 4.2)

Table 4.2. Process Innovations Introduced from 2005 to 2007
(Percentage of Establishments that Introduced the Innovations)

	Techniques, Technologies	Logistics, Distribution	Purchasing, Accounting	Any Process
Total	39.2%	9.7%	10.6%	49.3%
Employment				
10-49	30.9%	7.7%	8.2%	41.2%
50-249	48.3%	11.1%	13.8%	59.2%
250+	75.3%	21.9%	19.8%	81.5%
Industry				
Food-text	39.0%	10.9%	7.7%	48.6%
Material	38.0%	8.3%	7.5%	47.3%
Mach	41.5%	11.3%	15.9%	55.4%
Elec-Trans	31.5%	3.1%	11.8%	37.0%
Science	46.1%	15.1%	20.3%	59.6%
Region				
Atlanta	42.4%	10.2%	11.5%	51.9%
Augusta	35.2%	8.6%	9.4%	41.7%
Coastal	37.7%	15.9%	6.7%	54.4%
Central	36.5%	13.5%	4.8%	45.3%
Northeast	41.8%	6.7%	14.5%	55.7%
Northwest	41.9%	9.7%	7.7%	49.8%
South	36.2%	6.5%	11.8%	41.3%
West	21.9%	9.5%	13.0%	36.5%

Source: Georgia Manufacturing Survey 2008, weighted responses of 738 manufacturers.

Organizational Innovations

Respondents were asked whether their facility had introduced any organizational innovation activities that involved improved 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 reported that they introduced at least one of these organizational activities. (See Table 4.3) Restructuring of management or departments was the most common organizational introduction, reported by nearly one-third of respondents. New management systems were reported by 23 percent of the respondents, and new relationships with other firms by 20 percent. Organizational innovations were much more common among large manufacturing establishments with at least 250 employees. This is particularly the case with alliances, partnerships, outsourcing, or subcontracting, which was roughly twice as likely among large manufacturers as among small or medium-sized ones. By industry, science-based firms were most apt to report management system introductions, and firms in the elec-trans group most prone to having restructurings and new relationships with other firms. Regional

differences highlighted Atlanta and Augusta for restructuring, and the Coastal and Central areas for new inter-firm relationships. Overall introduction of organizational innovations was lowest in the South and West.

Table 4.3. Organizational Innovations Introduced from 2002 to 2004
(Percentage of Establishments that Introduced the Innovations)

	Improved Management System	Internal Restructuring	Relations with other Firms	Any Organizational Innovation
Total	27.1%	33.8%	16.2%	51.7%
Employment				
10-49	16.3%	25.9%	17.3%	44.1%
50-249	33.2%	36.9%	20.6%	61.4%
250+	40.3%	59.1%	40.4%	78.8%
Industry				
Food-text	26.3%	29.4%	23.0%	51.8%
Material	18.2%	31.6%	17.4%	49.0%
Mach	24.3%	30.4%	17.7%	48.8%
Elec-Trans	20.7%	41.6%	26.6%	61.2%
Science	40.5%	27.1%	18.5%	57.7%
Region				
Atlanta	23.8%	35.6%	19.1%	53.9%
Augusta	19.0%	36.3%	18.4%	50.5%
Coastal	25.4%	28.3%	25.9%	52.6%
Central	22.1%	22.2%	28.8%	58.9%
Northwest	24.1%	28.9%	20.3%	53.3%
Northeast	26.0%	30.4%	20.6%	52.3%
South	15.9%	28.2%	14.3%	40.7%
West	21.5%	30.0%	16.6%	46.8%

Source: Georgia Manufacturing Survey 2008, weighted responses of 738 manufacturers.

Marketing Innovations

Nearly 30 percent of the manufacturers participating in the survey introduced at least one marketing innovation during the 2005 to 2007 time period. This suggests that marketing innovations are the least common improvement in manufacturing. Introduction of new sales and distribution channels was more common than introduction of new designs or packaging – 19 percent versus 13 percent respectively. Differences by size, industry, and region were less pronounced in the marketing area than in the product, process, or organizational areas. Large establishments were more apt to introduce new packaging designs, but the difference in rate of introduction of new sales and distribution methods did not vary by size. Food / textile / apparel / leather firms were most likely to have introduced new designs or packaging. There was not much difference among

industry groups in the percentage of manufacturers introducing new sales and distribution channels. Regional differences were also less conspicuous.

Table 4.4. Marketing Innovations Introduced from 2005 to 2007
(Percentage of Establishments that Introduced the Innovations)

	Packaging	Sales	Any Marketing Innovation
Total	13.1%	19.0%	28.3%
Employment			
10-49	13.0%	20.1%	29.4%
50-249	10.1%	16.1%	23.4%
250+	26.7%	21.2%	39.2%
Industry			
Food-text	19.8%	17.9%	29.4%
Material	12.5%	19.5%	30.1%
Mach	7.7%	18.5%	24.1%
Elec-Trans	13.2%	18.1%	25.1%
Science	13.3%	17.6%	26.8%
Region			
Atlanta	14.7%	19.3%	30.0%
Augusta	11.1%	19.1%	28.0%
Coastal	11.3%	19.0%	24.3%
Central	15.9%	25.3%	31.0%
Northwest	13.5%	16.0%	26.8%
Northeast	11.5%	18.0%	26.4%
South	15.6%	19.3%	30.4%
West	5.6%	21.1%	26.7%

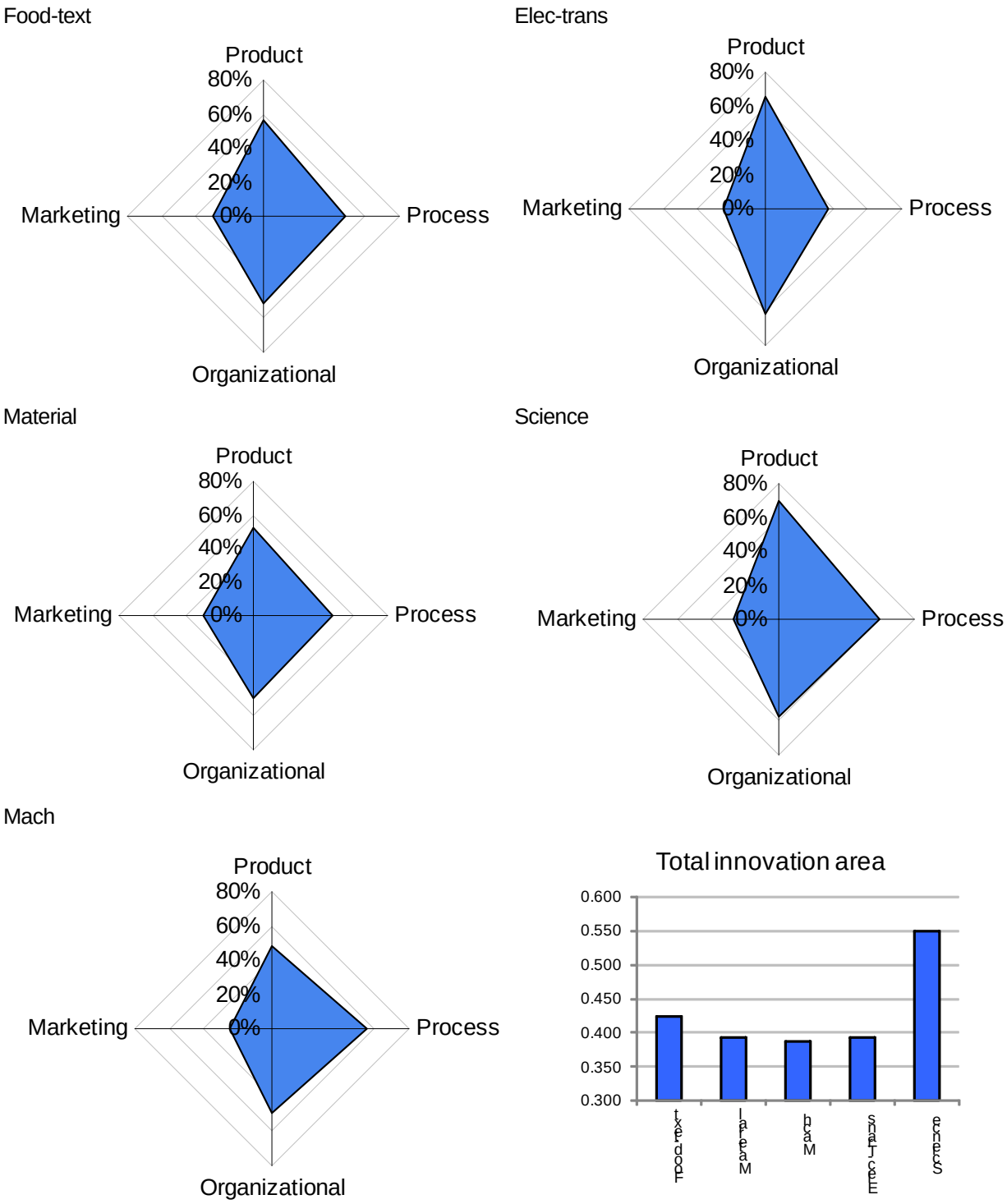
Source: Georgia Manufacturing Survey 2008, weighted responses of 738 manufacturers.

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 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 (see 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 although marketing is more prominent in this group. The elec-trans group looks like a narrow diamond, with relatively higher levels of product and organizational innovation and lower levels of process and marketing innovation. The metals and machinery and materials groups have the smallest visual innovation profiles, with process innovation being more prevalent in the machinery group.

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,[5] 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 2005-to-2007 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 – 68 percent,
- Purchasing machinery, equipment, computers, or software to implement innovations – 50 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) – 3.9 percent.
- Publishing papers or technical articles – 5.5 percent.
- Purchasing or licensing patents, inventions, know-how, or other types of knowledge – 7.6 percent.

Several of these activities were particularly impacted by facility employment size. Larger establishments were much more likely than medium-sized firms and especially than smaller firms to work with customers, sign a confidentiality agreement, engage in planning / engineering / design / development, train staff to introduce innovations, and publish papers. Less difference by size was evidenced

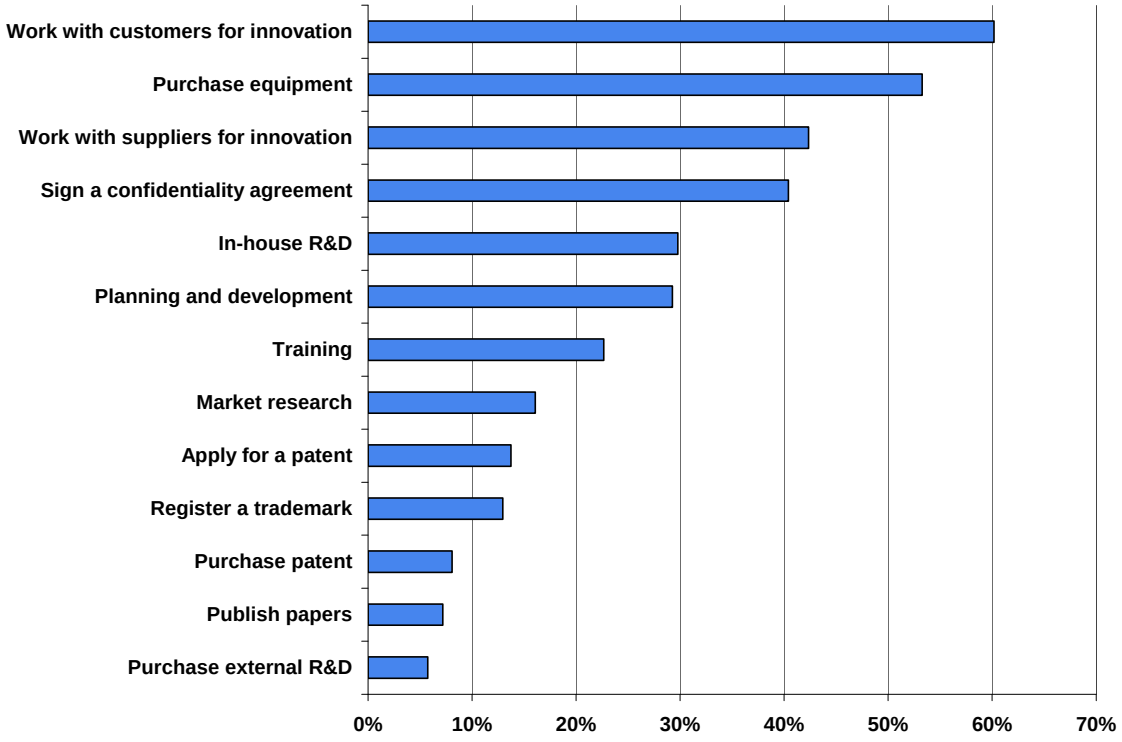
[5] The patenting information is based on manufacturers' survey responses and has not been verified against patent database information.

for engaging in in-house R&D, market research, purchasing intellectual property, and purchasing external R&D.

By industry, the elec-trans industry has the highest take up rate for seven of the 13 activities and is very close to the top in two others. Science-based industries have the highest incidence of using confidentiality agreements, in-house R&D, planning/engineering/design/development, and training. Metals and machinery are most likely to purchase machinery or equipment to implement innovations.

Working with customers to create an innovation is most prevalent among manufacturers in Atlanta, Northeast, and Northwest regions. Manufacturers in the Augusta and Northwest regions have the highest percentage of manufacturers working with suppliers to create an innovation. Planning / engineering / design / development are especially common among manufacturers in Augusta.

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



Source: Georgia Manufacturing Survey 2008, weighted responses of 738 manufacturers.

Table 4.5. Adoption of Specialized Innovation Activities from 2005 to 2007 by Facility Employment Size
(Percentage of Establishments Engaged in Innovation Activities)

Innovation Activity	10-49	50-249	250+
Work with customers for innovation	58.2%	61.1%	74.2%
Purchase equipment	48.9%	59.3%	66.8%
Work with suppliers for innovation	37.8%	46.9%	64.4%
Sign a confidentiality agreement	36.1%	43.8%	65.5%
In-house R&D	26.0%	36.0%	37.8%
Planning and development	23.7%	33.7%	61.4%
Training	19.5%	24.1%	45.8%
Market research	15.4%	15.3%	25.4%
Register a trademark	11.2%	15.7%	28.5%
Apply for a patent	12.5%	11.7%	23.2%
Purchase patent	7.6%	7.7%	13.9%
Purchase external R&D	5.5%	6.1%	27.1%
Publish papers	3.9%	8.2%	12.2%
Mean # Innovation Activities	3.1	3.7	5.5

Source: Georgia Manufacturing Survey 2008, weighted responses of 738 manufacturers.

Table 4.6. Adoption of Specialized Innovation Activities from 2005 to 2007 by Industry Group
(Percentage of Establishments Engaged in Innovation Activities)

Innovation Activity	Food-text	Material	Mach	Elec-Trans	Science
Work with customers for innovation	57.4%	60.7%	59.0%	64.6%	61.7%
Purchase equipment	50.3%	52.6%	59.6%	50.4%	50.8%
Work with suppliers for innovation	48.4%	42.7%	33.2%	51.7%	39.3%
Sign a confidentiality agreement	37.7%	34.5%	43.6%	53.6%	55.1%
In-house R&D	29.4%	26.3%	25.9%	34.5%	55.0%
Planning and development	22.4%	28.2%	29.9%	37.4%	36.6%
Training	20.6%	17.4%	25.5%	31.4%	34.7%
Market research	20.4%	12.2%	15.6%	22.6%	19.0%
Register a trademark	16.0%	11.0%	7.7%	20.3%	18.6%
Apply for a patent	12.8%	10.4%	12.0%	29.7%	17.5%
Purchase patent	6.4%	7.1%	7.3%	17.1%	9.2%
Purchase external R&D	5.2%	4.4%	2.1%	17.1%	10.7%
Publish papers	8.3%	4.1%	6.0%	20.6%	9.3%
Mean # Innovation Activities	3.4	3.1	3.3	4.5	4.2

Source: Georgia Manufacturing Survey 2008, weighted responses of 738 manufacturers.

Table 4.5. Innovations Introduced from 2005 to 2007 by Region
(Percentage of Establishments Engaged in Innovation Activities)

Innovation Activity	Atlanta	Augusta	Central	Coastal	North-east	North-west	South	West
Work with customers for innovation	65.2%	45.3%	50.5%	54.3%	66.2%	58.7%	51.7%	65.2%
Purchase equipment	53.0%	58.1%	58.2%	40.6%	56.5%	53.4%	53.1%	47.3%
Work with suppliers for innovation	43.4%	57.7%	39.7%	29.5%	34.5%	57.6%	32.3%	34.8%
Sign a confidentiality agreement	51.0%	29.5%	28.9%	33.6%	40.2%	40.7%	27.8%	33.2%
In-house R&D	32.8%	34.0%	17.3%	28.6%	31.2%	36.7%	21.1%	21.2%
Planning and development	29.7%	41.3%	28.5%	31.5%	35.6%	27.9%	22.2%	16.8%
Training	26.7%	24.3%	14.8%	23.2%	19.0%	20.7%	26.3%	16.9%
Market research	19.8%	13.7%	13.2%	9.5%	15.0%	19.6%	12.2%	7.7%
Register a trademark	15.4%	15.9%	8.2%	15.7%	12.2%	14.9%	6.3%	9.4%
Apply for a patent	18.6%	8.3%	8.4%	17.2%	10.0%	17.2%	8.1%	5.9%
Purchase patent	10.1%	9.4%	5.0%	16.4%	5.2%	9.0%	5.1%	3.1%
Purchase external R&D	7.7%	11.1%	4.2%	8.5%	4.6%	4.4%	3.7%	0.0%
Publish papers	10.0%	7.2%	4.1%	7.9%	9.1%	6.2%	2.3%	1.8%
Mean # Innovation Activities	3.8	3.6	2.8	3.2	3.4	3.7	2.7	2.6

Source: Georgia Manufacturing Survey 2008, weighted responses of 738 manufacturers.

Sectoral Innovation Gaps Between Small and Large Firms

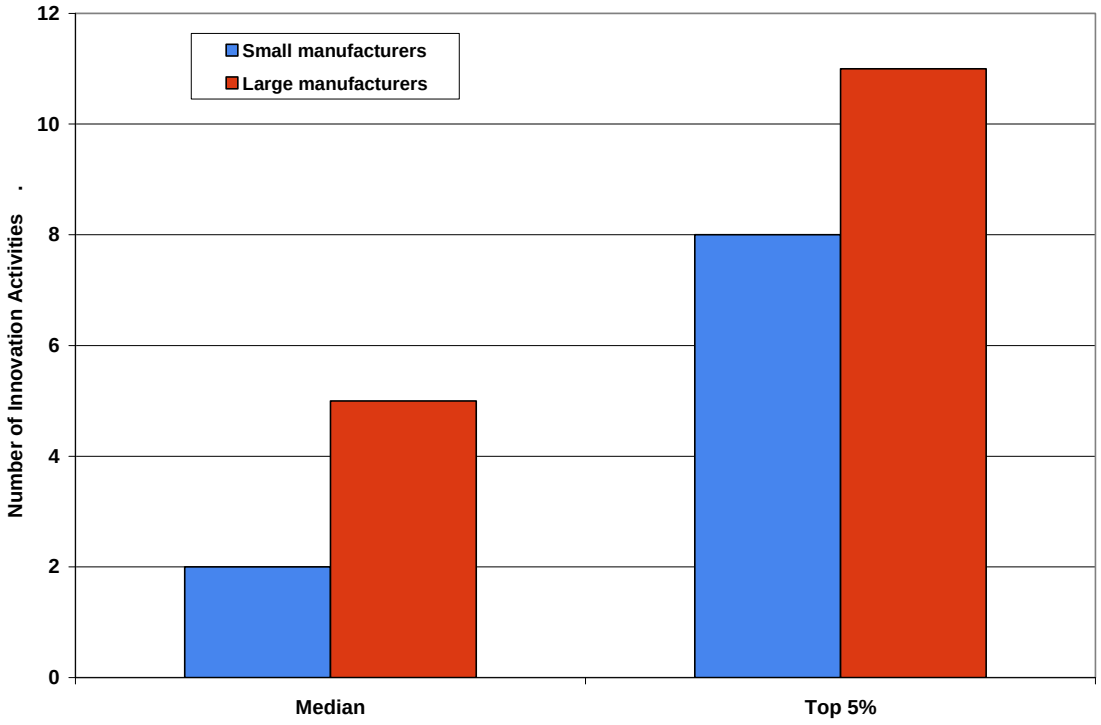
To further probe the patterns of industry group innovation, this section looks more closely at variations by establishment employment size. In general, our analysis shows that large establishments achieve higher levels of innovation activity than smaller ones. We find that median-sector innovation activity 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. (See 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

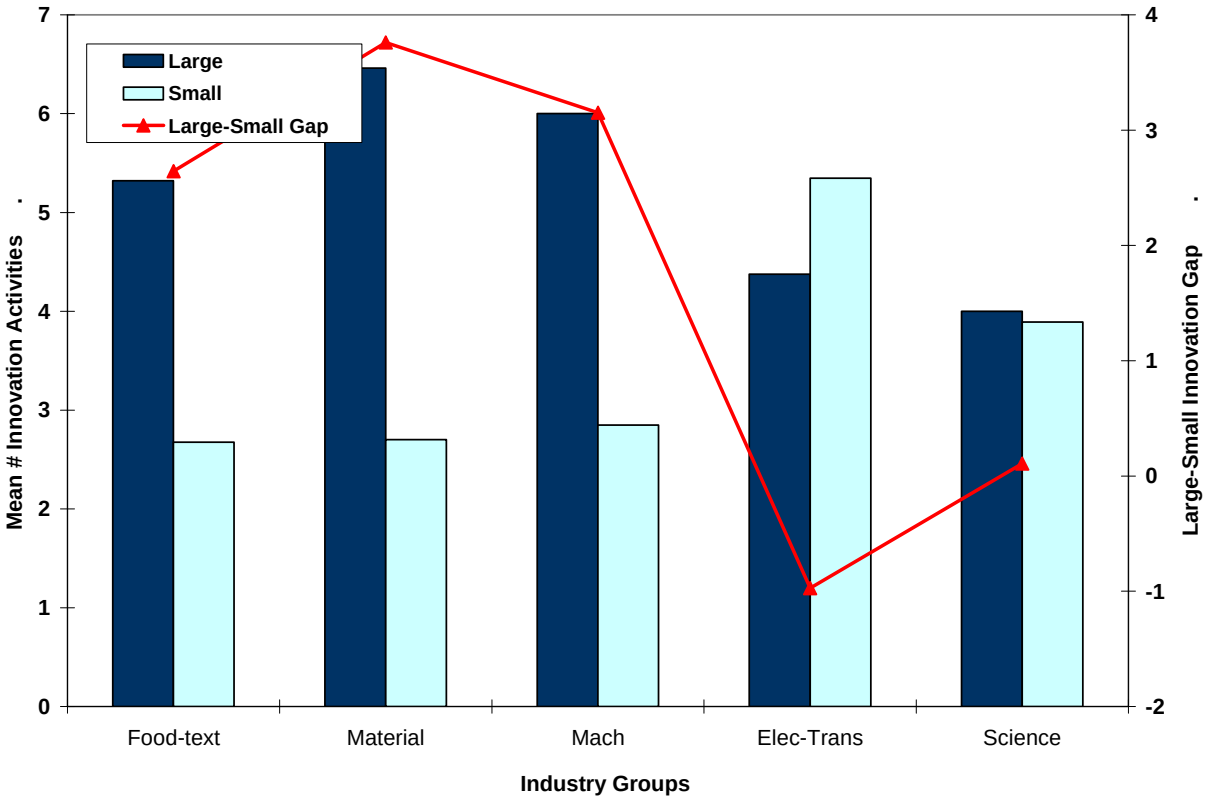
activities by employment size. In this analysis, Figure 4.7 presents the mean sector innovation measures for SMEs and large establishments (the bars of the graph) and then calculates the difference between these two measures (the line on the graph). It is interesting that most technology intensive industries – electrical / electronics / science – have the smallest gap between large and small establishments. The SME-large establishment innovation gap is greatest for materials and metals / machinery establishments, followed to a lesser degree by food-text groups. 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 science-based and food-text sectors. Strategies to assist SMEs in metals / machinery, materials, and food-text groups with many less well-performing SMEs to catch up with the leading edge of innovation practices in their sectors could be helpful. (See Figure 4.7)

Figure 4.6. Number of Innovation Activities Used by Establishment Size



Source: Georgia Manufacturing Survey 2008, weighted responses of 477 manufacturers.

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



Source: Georgia Manufacturing Survey 2008, weighted responses of 477 manufacturers.

Innovation Expenditures and Investments

Sixty 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, are shown in Table 4.6, which shows that the median establishment that made an investment in innovation spent only $2,305 per employee in innovation, mostly in R&D capital investments. 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 4.6: Average Innovation Expenditures and Investments Per Employee
(medians and trimmed means are reported)

	Mean	Mean (trimmed)*	Median
In-house R&D	$3,816	$1,165	$500
Purchased R&D (from external sources)	$341	$24	$1,258
R&D capital investments	$7,415	$2,183	$0
Other R&D	$745	$156	$0
All R&D Expenditures	$10,113	$4,790	$2,305

*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 2008, weighted responses of 294 manufacturers.

Large manufacturers with 250 or more employees have higher average expenditures than their small and medium-sized counterparts. This size differential is especially prominent in R&D capital investments. Electrical / electronics / transportation and science-based establishments had higher values for non-capital innovation expenditures than establishments in the other industry groups. However, innovation-related capital investments on average were highest for the metals and machinery group and nearly as high for the food-text and materials industry groups as for science-based manufacturers. By region, the Northeast and Augusta regions had the highest average R&D expenditures. (See Table 4.7)

Table 4.7: Average Innovation Expenditures and Investments Per Employee
(Trimmed means are reported)

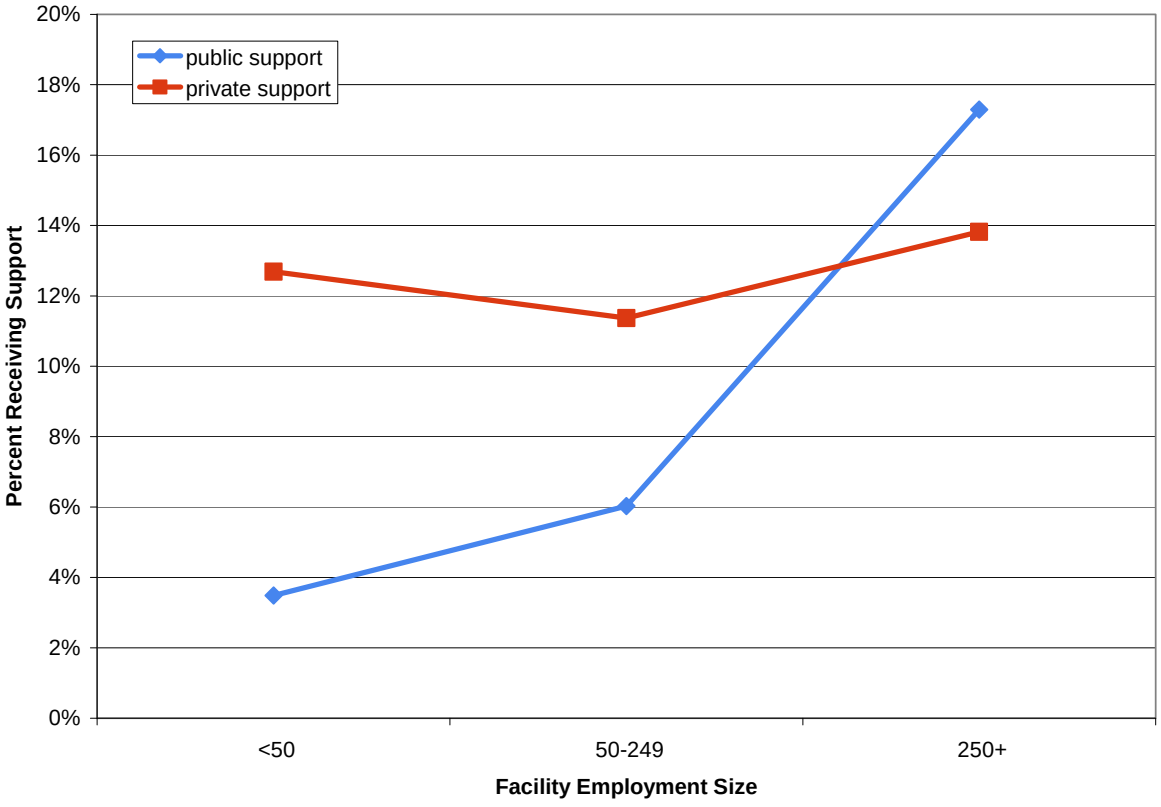
	In-house R&D	Purchased R&D	R&D Capital Investments	Other R&D	All R&D Expenditures
Total	$1,165	$24	$2,183	$156	$4,790
Employment					
10-49	1,251	38	1,401	157	4,141
50-249	765	6	3,267	43	4,813
250+	1,385	87	6,830	343	9,346
Industry					
Food-text	810	7	2,358	240	3,686
Material	648	5	2,355	54	3,480
Mach	803	0	2,619	83	4,679
Elec-Trans	12,329	345	1,576	350	15,388
Science	1,400	61	2,435	335	5,228
Region					
Atlanta	2,014	55	1,440	123	4,649
Augusta	1,184	101	4,627	535	7,641
Central	1,157	18	2,011	109	4,208
Coastal	432	6	4,874	18	5,547

Northeast	1,837	97	2,965	499	8,010
Northwest	487	1	1,660	67	2,517
South	179	0	5,164	141	5,593
West	602	2	2,639	0	3,715

Source: Georgia Manufacturing Survey 2008, weighted responses of 294 manufacturers.

Manufacturers were also asked if their facility received public or private financial support for innovation activities in the 2005 to 2007 time period. Only 5 percent of manufacturers said they received public support such as tax credits, loans, or government grants (local, state, or national level). Private support was more common, with 12 percent of respondents reporting receiving private support such as venture capital, angel funding, or bank loans to support their innovation activities. Large manufacturers with 250 or more employees were much more likely than small manufacturers to have received public support: 17 percent versus 3 percent, while there was not much difference receipt of private support by facility employment size (See Figure 4.8).

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



Source: Georgia Manufacturing Survey 2008, weighted responses of 738 manufacturers.

Benefits of Innovation

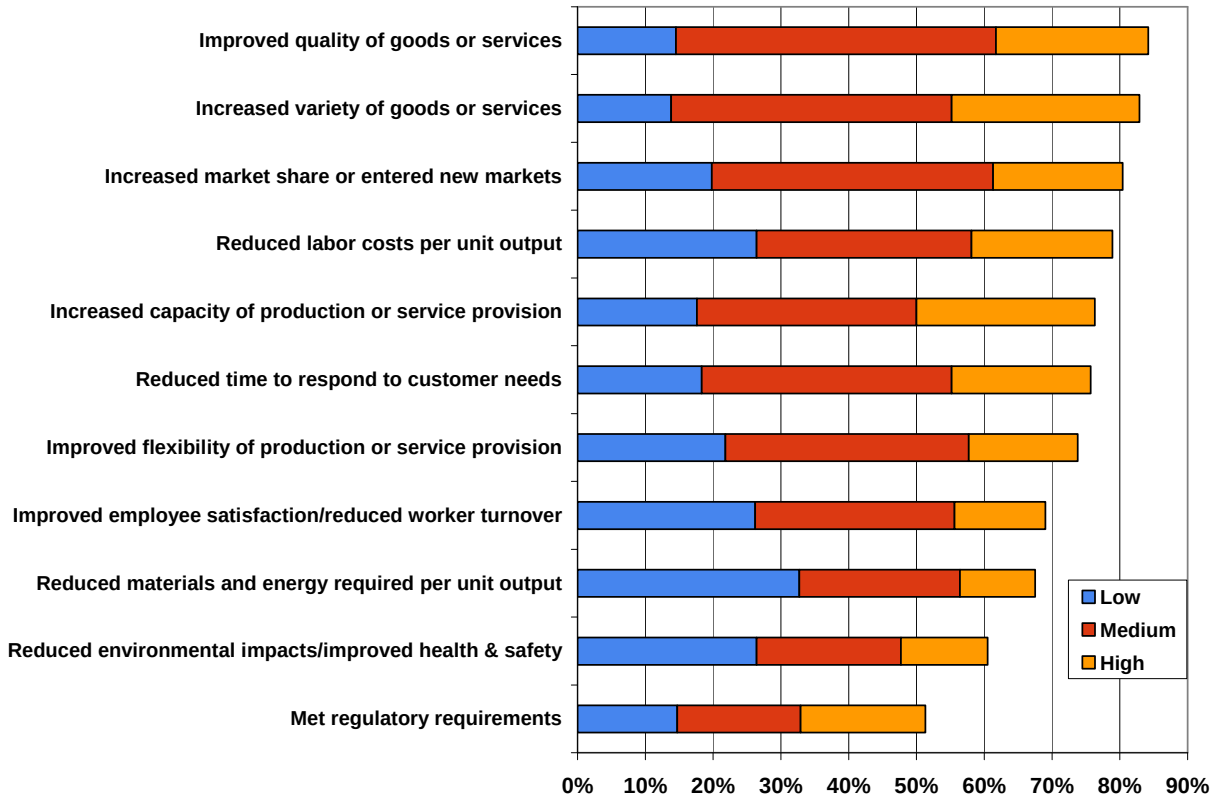
We asked respondents that undertook an innovation in the 2005 to 2007 timeframe to indicate the degree of impact they received from this innovation in several areas. Ratings of low, medium, or high were possible, as well as the ability to indicate if the impact area was not relevant. Figure 4.9 presents these results. The length of the bar reflects all relevant ratings (i.e., the "not relevant" ratings were excluded). More than 80 percent of respondents indicated that improved quality, increased variety of products and services, and increased market share were relevant impacts from the introduction of innovation. Ability to meet regulatory requirements and reduced environmental impact were least often mentioned as being relevant to innovation, although the majority of responses still say that these types of impacts were relevant to the innovations they undertook. The percentage of respondents rating an impact of innovation as high was greatest in the following areas:

- Increased variety of goods and services – 28 percent
- Increased production capacity – 26 percent
- Improved quality – 23 percent

The benefit area which received the lowest percentage of "high impact" ratings was reduced materials and energy required per unit output; only 11 percent of respondents rated this area as having a high degree of impact from innovation.

Large manufacturers were most likely to report that innovation had a high degree of impact on reducing labor costs per unit of output. Small manufacturers were more likely to report high impacts from innovation on reducing time to respond to customer needs and improving flexibility of production or service provision. The latter finding suggests that some impacts of innovation may to be available to any facility no matter its size. (See Table 4.8)

Figure 4.9 Impact of Innovation on Various Areas in the Facility
(percentage of respondents rating type of innovation impact low, medium, or high)



Source: Georgia Manufacturing Survey 2008, weighted responses of 232 manufacturers.

Table 4.8. Percentage of Respondents Rating Innovation Impact High by Facility Employment Size

Innovation Impact	Total	10-49	50-249	250+
Increased variety of goods or services	27.7%	25.7%	31.7%	26.5%
Increased capacity of production or service provision	26.3%	24.1%	28.8%	31.9%
Improved quality of goods or services	22.5%	24.3%	20.8%	16.6%
Reduced labor costs per unit output	20.9%	15.9%	27.8%	29.6%
Reduced time to respond to customer needs	20.5%	20.6%	23.3%	9.5%
Increased market share or entered new markets	19.1%	18.4%	21.3%	16.5%
Met regulatory requirements	18.4%	19.7%	16.5%	16.8%
Improved flexibility of production or service provision	16.1%	15.5%	20.5%	5.2%
Improved employee satisfaction/reduced worker turnover	13.4%	14.6%	12.4%	8.9%
Reduced environmental impacts/improved health & safety	12.8%	11.8%	12.4%	20.9%
Reduced materials and energy required per unit output	11.1%	10.2%	11.6%	15.1%

Source: Georgia Manufacturing Survey 2008, weighted responses of 232 manufacturers.

Wide variability across industry groups and regions is observed. (See Table 4.9) The impacts most commonly rated high by industry were:

- Food-text: Increased production capacity, increased variety of goods and services, improved quality, reduced labor costs
- Material: Increased variety of goods or services, increased capacity of production or service provision
- Mach: Reduced time required to respond to customer needs, improved quality, increased production capacity
- Elec-trans: Increased production capacity, increased variety of goods and services, increased market share
- Science-based: Increased variety of goods and services, increased market share

By region, increased variety of goods and services and increased capacity of production were the two most prevalent benefits for Atlanta and Central regions. Increased capacity and reduced labor costs were the most common benefits for Augusta and Northeast regions. Increased variety of goods and services as improved quality was the most common benefit for the Coastal region. The Northwest region had a wide range of benefits for which respondents indicated high impacts from innovation including increased variety of goods and services, improved quality of goods and services, and increased market share. The South region also had a wide range of benefits indicated by respondents including reduced labor costs, increased variety of goods, and abiding by regulatory requirement. Abiding by regulatory requirements also was prominent in the West region, followed by increased variety of goods and services. (See Table 4.10)

Table 4.9. Percentage of Respondents Rating Innovation Impact High by Industry

Innovation Impact	Food-text	Material	Mach	Elec-Trans	Science
Increased variety of goods or services	28.9%	26.3%	22.9%	35.4%	34.8%
Increased capacity of production or service provision	29.9%	23.7%	24.0%	37.5%	21.3%
Improved quality of goods or services	24.2%	20.3%	26.5%	26.1%	12.1%
Reduced time to respond to customer needs	20.4%	15.9%	28.7%	26.7%	15.9%
Reduced labor costs per unit output	23.8%	18.3%	21.1%	23.7%	20.0%
Increased market share or entered new markets	17.8%	15.8%	17.9%	30.5%	27.9%
Met regulatory requirements	16.7%	18.8%	18.1%	16.0%	20.6%
Improved flexibility of production or service provision	15.6%	13.5%	22.1%	19.4%	12.6%
Improved employee satisfaction/reduced worker turnover	8.4%	13.6%	12.1%	16.3%	16.6%
Reduced environmental impacts/improved health & safety	21.5%	10.1%	10.9%	11.2%	12.5%
Reduced materials and energy required per unit output	17.4%	8.2%	8.3%	16.9%	10.6%

Source: Georgia Manufacturing Survey 2008, weighted responses of 232 manufacturers.

Table 4.10. Percentage of Respondents Rating Innovation Impact High by Region

Innovation Impact	Atlanta	Augusta	Central	Coastal	North-east	North-west	South	West
Increased variety of goods or services	28.5%	19.0%	26.9%	32.5%	21.6%	32.0%	34.2%	23.7%
Increased capacity of production or service provision	28.8%	34.3%	25.5%	17.1%	26.2%	21.7%	30.3%	18.9%
Improved quality of goods or services	24.4%	26.0%	23.2%	24.3%	16.3%	26.5%	21.4%	14.6%
Reduced labor costs per unit output	17.4%	31.9%	13.5%	11.3%	23.4%	22.8%	35.8%	17.6%
Reduced time to respond to customer needs	22.1%	21.0%	17.3%	6.8%	19.0%	23.6%	26.9%	11.5%
Increased market share or entered new markets	25.0%	0.0%	19.7%	16.9%	10.3%	26.6%	19.7%	6.0%
Met regulatory requirements	15.7%	21.4%	23.6%	17.2%	11.1%	17.8%	33.4%	27.2%
Improved flexibility of production or service provision	17.9%	17.9%	12.6%	6.1%	18.1%	14.0%	20.5%	10.9%
Improved employee satisfaction/reduced worker turnover	14.3%	14.5%	14.0%	4.1%	6.4%	16.6%	19.7%	15.2%
Reduced environmental impacts/improved health & safety	10.7%	18.9%	16.1%	4.2%	4.3%	18.9%	31.7%	5.2%
Reduced materials and energy required per unit output	9.6%	19.4%	2.0%	13.4%	6.8%	13.9%	21.5%	11.7%

Source: Georgia Manufacturing Survey 2008, weighted responses of 232 manufacturers.

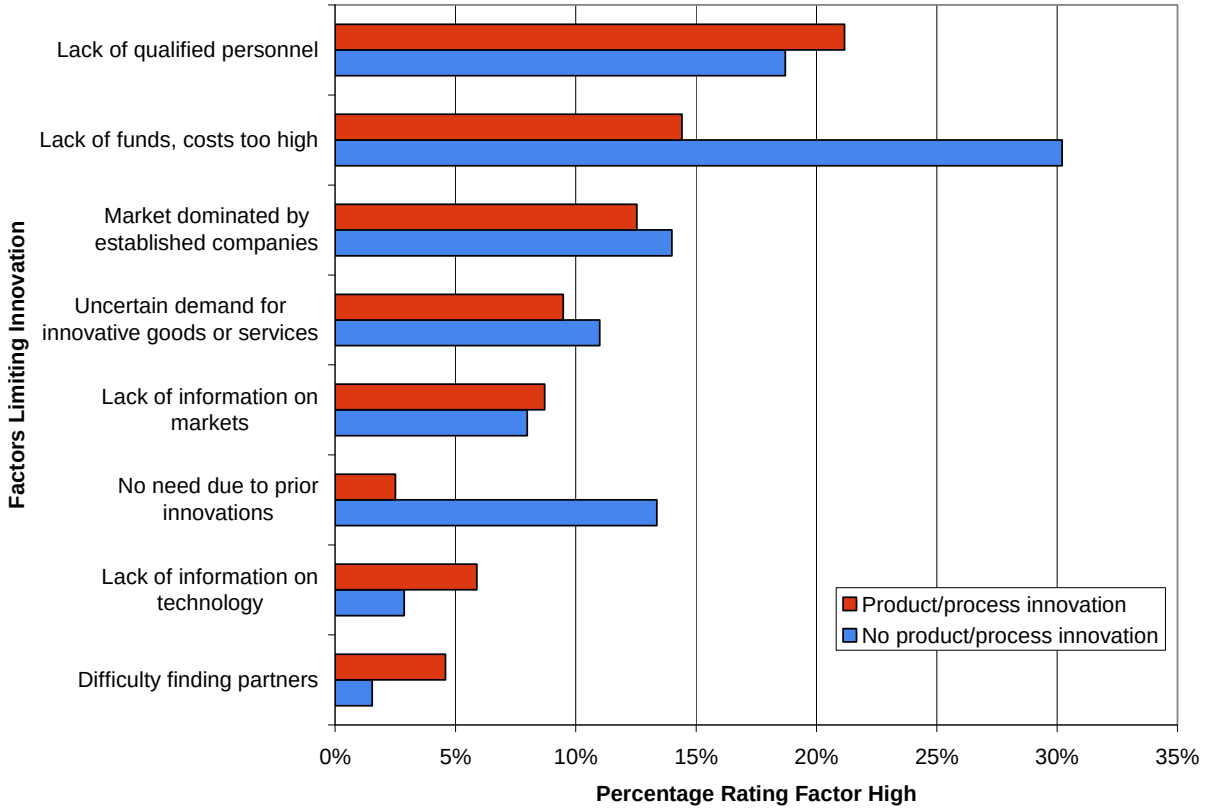
Constraints on Innovation

The introduction of innovation activities in the Georgia manufacturing base appears mixed, according to the Georgia Manufacturing Survey. On the one hand, 60 percent of Georgia manufacturers have worked with customers to design or develop new products or processes. On the other hand, fewer than 10 percent of Georgia manufacturers were engaged in specialized innovation activities such as purchasing patents, publishing papers, or acquiring external R&D. Similarly small firms lag large manufacturers in their engagement in innovation, and there are gaps by industry and region.

To further probe these disparities, we asked manufacturers to indicate the importance of a list of factors that may or may not have limited or influenced a decision not to innovate using a scale of low, medium, and high. In 2002, we found that innovation was limited mostly by financial considerations. In 2005, financial considerations still ranked high, but this barrier was joined by lack of qualified personnel. More than 20 percent of respondents rated lack of funds and lack of qualified personnel of high importance in deterring them from innovating. A somewhat distant third was the concern that markets were dominated by established industries, mentioned as a highly important factor by about 14 percent of respondents. In the 2008 survey, the top three constraints were the same as in 2005. However, lack of qualified personnel edged slightly ahead of lack of funds/high costs in term of the percentage of respondents rating the factors as high barriers. Lack of qualified personnel was rated a high limitation by 21 percent of respondents compared to 18 percent of respondents so rating lack of funds/high costs. Market domination by established companies was rated a highly important barrier by 13 percent of respondents. The least important constraint on innovation was difficulty finding partners; fewer than 4 percent of respondents rated this factor as a highly important barrier.

Comparing establishments that have engaged in a product or process innovation with those that have not, Figure 4.10 shows that the top three barriers for manufacturing facilities that have introduced product or process innovations are not the same as for those that have not. Lack of qualified personnel, lack of funds, and market dominated by established suppliers are the top three limitations for product and process innovators. However, non-innovators are much more apt to rate lack of funds/high costs to be a highly important limitation, with 30 percent of respondents awarding this ranking. The next most common limitation among non-innovators was lack of qualified personnel and no need rated as having a high degree of importance by 19 percent and 13 percent respectively.

Figure 4.10. Limitations on Innovation: Product or Process Innovators vs. Establishments without Innovation Activity
(% rating limitation of high degree of importance)



Source: Georgia Manufacturing Survey 2008, weighted responses of 738 manufacturers.

We have taken the top three barriers to innovation across the entire set of respondents and further divided them by employment size, industry, and region. Employment size is a factor in all three factors as small and medium-sized manufacturers are more likely to experience them than are large manufacturers. By industry, lack of qualified personnel was the most common barrier for manufacturers in the elec-trans group and for metals and machinery establishments. Costs and competition from established firms were prominent barriers for all but the science group. Qualified personnel was an especially highly rated innovation barrier for the Central, Coastal, South, and Northeast regions. Cost was most common for the West region.

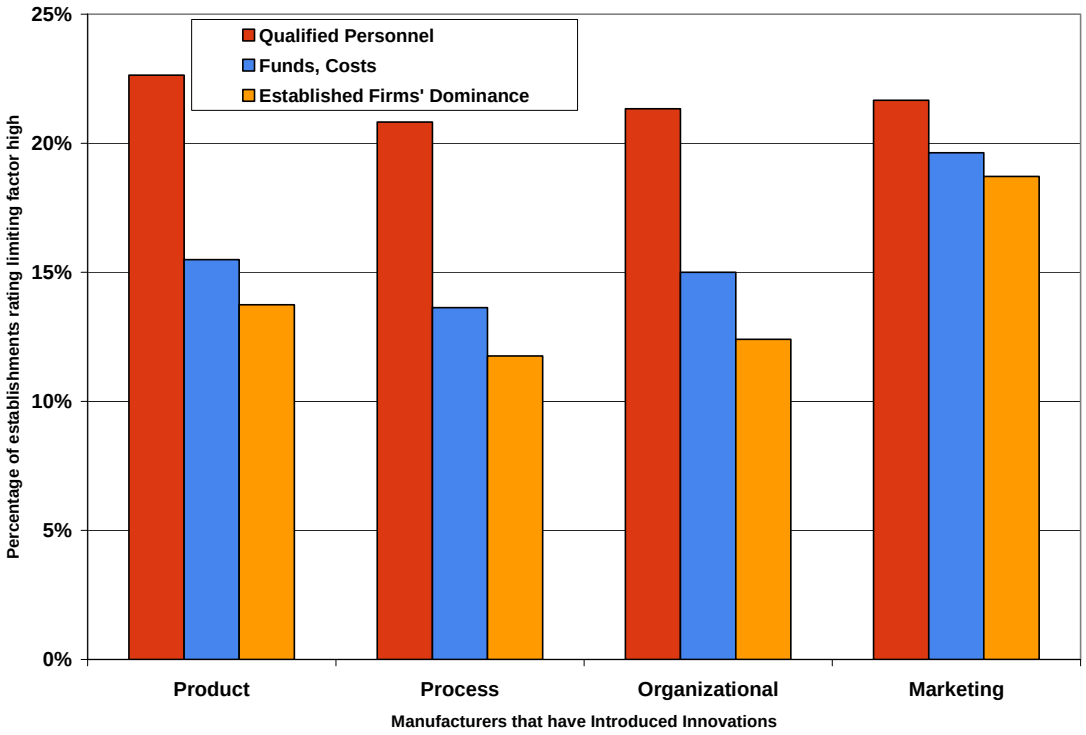
Table 4.11. Top Three Most Prevalent Barriers to Innovation by Respondent Characteristics
(Percentage of respondents rating barrier to be of high importance)

	Qualified Personnel	Funds Costs	Established Firms
Total	21.1%	20.2%	13.8%
Employment			
10-49	20.0%	21.6%	16.4%
50-249	22.5%	14.7%	7.8%
250+	17.6%	5.9%	5.4%
Industry			
Food-text	13.8%	15.4%	13.7%
Material	25.1%	20.1%	13.3%
Mach	18.9%	18.9%	11.2%
Elec-trans	28.7%	20.2%	15.0%
Science	4.6%	10.3%	8.7%
Region			
Atlanta	18.0%	18.1%	9.9%
Augusta	17.8%	18.1%	6.8%
Central	27.1%	21.3%	15.3%
Coastal	26.3%	11.3%	7.4%
Northeast	23.0%	16.0%	16.1%
Northwest	19.7%	16.8%	11.3%
South	24.0%	21.3%	21.7%
West	17.3%	26.5%	19.0%

Source: Georgia Manufacturing Survey 2008, weighted responses of 738 manufacturers.

It is interesting that the prevalence of one of the top three obstacles varied according to the type of innovation a company had introduced. (See Figure 4.11) Manufacturers that have introduced product, process, and organizational innovations are much more apt to rate lack of qualified personnel as having a high degree of impact limiting their ability to innovate than to rate cost of dominance of established firms as highly limiting. In contrast, marketing innovators tended to view all three factors as high barriers to innovation.

Figure 4.11. Top Three Most Prevalent Barriers to Innovation by General Innovation Area
(Percentage of respondents rating barrier to be of high importance)



Source: Georgia Manufacturing Survey 2008, weighted responses of 738 manufacturers.

Chapter
5

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 social, environmental, and business benefits. Sustainable manufacturing is a new theme of the 2008 Georgia Manufacturing Survey. This section examines the theme in terms of identifying manufacturing processes that currently involve sustainable practices, plans for adoption of sustainable practices, use of alternative energy sources, setting of targets to reduce energy usage, use of technologies and techniques for sustainability management, and sources of information and knowledge in sustainable manufacturing.

Sustainability in Manufacturing Processes

We asked manufacturers about their use of technologies and techniques to improve the sustainability of 12 standard manufacturing process areas:

- Supplier selection
- Selection of raw materials
- Extraction and processing of raw materials
- Product design
- Design of manufacturing processes
- Facility design/planning
- Packaging
- Marketing
- Employee training in sustainability practices
- Logistics, transportation services
- Use, reuse and maintenance of product
- End of life

Three quarters of all respondents currently use practices to improve the sustainability of at least one manufacturing process. The most common use of sustainability practices is in the early stages of the manufacturing process: design of processes (60 percent), supplier selection (57 percent), and raw material selection (50 percent). (See Figure 5.1) The next most common area of sustainability practice involves product design: use, reuse and maintenance (42 percent), end of life (41 percent), product design (40 percent), and packaging (39 percent).

With regard to the use of end of life practices, 41 percent may be viewed as being higher than one might expect. One reason is that the respondents may read end of life as referring to recycling; indeed 88 percent of them are using

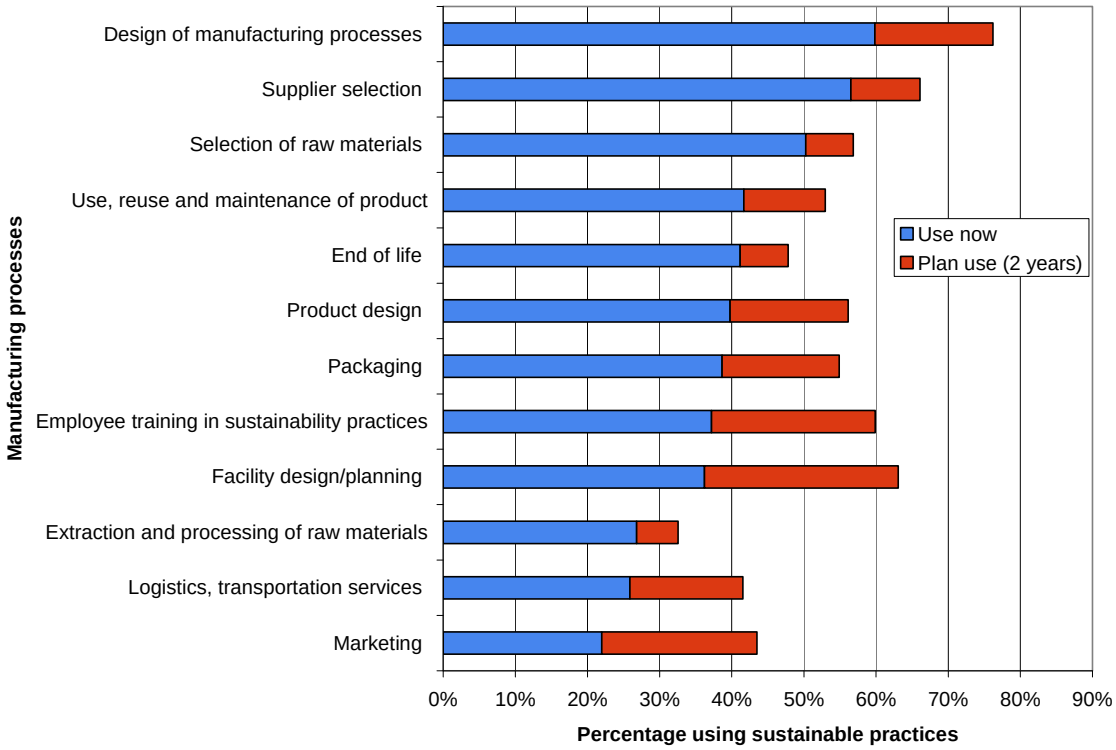
recycling of production materials. On the other hand, only 16 percent currently use life cycle costing which is often inherent in end of life take back planning. We suggest that conclusions based on this percentage should be interpreted with some care.

The next most common process areas also have the highest percentage of manufacturing establishments planning to take them up in the next two years: employee training in sustainability practices (37 percent currently use, 23 percent plan to use) and facility design/planning (36 percent currently use, 27 percent plan to use).

The three least common areas of use of practices to improve sustainability are marketing (22 percent currently use), logistics and transportation services (26 percent currently use), and extraction and processing of raw materials (27 percent currently use). Of these, the marketing area has the highest percentage of respondents that plan to adopt sustainable practices such as green branding and eco labeling in the next two years (22 percent), which represents a doubling of the current share of manufacturers that use sustainable marketing practices today. Sustainability practices in logistics were reported in use by about one in four respondents. However, logistics is the area with the highest percentage of manufacturers – nearly one-third – reporting that they have no sustainability practice plans. Extraction and processing of raw material, currently used by 27 percent of respondents, attracted the highest percentage of respondents – nearly half – answering that this area is not applicable.

Focusing on non-users of sustainable practices, we can take a further look at the percentage of respondents that plan to use these practices in the next two years. Based on the percentage of respondents indicating that they planned to adopt the technology, sustainability plans are most prevalent for facility design and planning, employee training, and marketing. On the other hand, roughly 6 percent of respondents plan to implement sustainability practices in selection of raw materials; this small percentage coupled with the large percentage (over half) that currently use sustainable practices to select raw materials suggests that this practice may be nearer to its maturation point than the others we surveyed.

Figure 5.1. Current and Planned Use of Sustainability Practices in Manufacturing
(Percentage of respondents that currently or plan to use a practice)



Source: Georgia Manufacturing Survey 2008, weighted responses of 738 manufacturers.

We examined the percentage of respondents that currently use sustainability improvement practices by manufacturing establishment characteristics. (See Table 5.1) Large manufacturers are more likely than medium-sized manufacturers to use sustainability practices in facility design planning (63 percent versus 45 percent) and employee training (62 percent versus 39 percent). Medium-sized manufacturers have similar percentage of respondents using sustainability practices as large manufacturers in raw material selection, use/reuse/maintenance, product design, raw material extraction and processing, and marketing. Small manufacturers have similar percentages of respondents using sustainability as their medium-sized and large counterparts in supplier selection, end of life, and logistics.

By industry, science-based manufacturers are more likely to currently use sustainability practices in manufacturing processes. (See Table 5.2) This prevalent use of sustainability practices by science-based manufacturers is particularly evident in the following areas: design of manufacturing processes, supplier selection, raw material selection, use/reuse/maintenance, employee training, and marketing. The food-text group and elec-trans groups have similar prevalence of sustainability adoption in product design and packaging. Moreover, the elec-trans group has the highest levels of take up of sustainability practices in facility design planning and logistics among the five industry groups. The lowest levels of adoption are evidenced in the metals and machinery group.

By region, there are few differences with the exception of noticeably lower percentages of Central region respondents adopting sustainability in supplier and raw materials selection, and lower percentages of Coastal region respondents adopting sustainability practices in packaging. (See Table 5.3)

Table 5.1. Current Use of Sustainability in Manufacturing Processes by Facility Employment Size
(Percentage of establishments reporting that they currently use sustainability in manufacturing processes)

Manufacturing Processes	10-49	50-249	250+	Total
Design of manufacturing processes	54.3%	68.2%	70.1%	59.8%
Supplier selection	54.6%	58.3%	65.0%	56.5%
Selection of raw materials	46.1%	56.6%	58.3%	50.2%
Use, reuse, maintenance	37.8%	48.1%	46.6%	41.7%
End of life	40.1%	42.2%	45.2%	41.2%
Product design	34.8%	47.3%	49.3%	39.8%
Packaging	33.3%	46.0%	52.7%	38.7%
Employee training	33.4%	39.2%	61.8%	37.2%
Facility design planning	28.7%	44.8%	62.6%	36.2%
Extraction and processing raw materials	20.9%	35.5%	38.2%	26.8%
Logistics and transportation	23.7%	29.8%	27.8%	25.9%
Marketing	17.6%	28.8%	30.1%	22.0%

Source: Georgia Manufacturing Survey 2008, weighted responses of 614 manufacturers.

Table 5.2. Current Use of Sustainability in Manufacturing Processes by Industry Group
(Percentage of establishments reporting that they currently use sustainability in manufacturing processes)

Manufacturing Processes	Food-text	Material	Mach	Elec-Trans	Science
Design of manufacturing processes	62.7%	61.3%	51.3%	58.5%	68.1%
Supplier selection	57.1%	53.4%	49.8%	62.1%	77.9%
Selection of raw materials	49.9%	48.1%	41.6%	57.3%	71.9%
Use, reuse, maintenance	41.8%	41.3%	35.7%	40.6%	53.1%
End of life	41.5%	42.6%	36.6%	38.7%	45.0%
Product design	46.3%	37.7%	33.7%	45.1%	46.0%
Packaging	48.0%	35.9%	28.7%	47.8%	48.1%
Employee training	44.6%	30.9%	32.7%	47.7%	54.3%
Facility design planning	40.1%	37.9%	26.6%	49.7%	28.6%
Extraction and processing raw materials	34.2%	29.8%	14.2%	19.6%	34.9%
Logistics and transportation	29.4%	23.9%	21.0%	38.7%	24.3%
Marketing	26.6%	20.0%	10.3%	29.2%	41.2%

Source: Georgia Manufacturing Survey 2008, weighted responses of 614 manufacturers.

Table 5.3. Current Use of Sustainability in Manufacturing Processes by Region
(Percentage of establishments reporting that they currently use sustainability in manufacturing processes)

Manufacturing Process	Atlanta	Augusta	Central	Coastal	North-east	North-west	South	West
Design of manufacturing processes	56.3%	73.0%	57.5%	56.5%	59.2%	69.5%	57.8%	53.8%
Supplier selection	52.8%	57.2%	38.0%	59.1%	57.2%	66.3%	63.3%	59.9%
Selection of raw materials	50.3%	47.7%	32.2%	49.8%	52.7%	58.0%	47.1%	52.0%
Use, reuse, maintenance	41.3%	45.8%	31.8%	29.0%	41.6%	48.3%	48.1%	33.5%
End of life	41.6%	53.9%	28.1%	30.8%	41.2%	48.4%	38.0%	33.7%
Product design	38.5%	43.1%	29.3%	38.3%	37.6%	46.0%	49.8%	32.3%
Packaging	39.5%	33.0%	32.6%	15.8%	36.3%	44.3%	45.3%	42.2%
Employee training	32.8%	45.8%	39.1%	46.6%	38.3%	36.9%	41.4%	36.9%
Facility design planning	32.0%	38.7%	38.2%	34.9%	42.1%	33.4%	45.9%	34.6%
Extraction and processing raw materials	21.4%	27.5%	24.2%	27.6%	26.3%	35.6%	36.1%	26.3%
Logistics and transportation	25.5%	34.3%	29.8%	16.8%	20.9%	22.0%	31.6%	36.1%
Marketing	21.9%	21.8%	14.3%	20.8%	22.6%	29.3%	19.7%	14.3%

Source: Georgia Manufacturing Survey 2008, weighted responses of 614 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. These include:

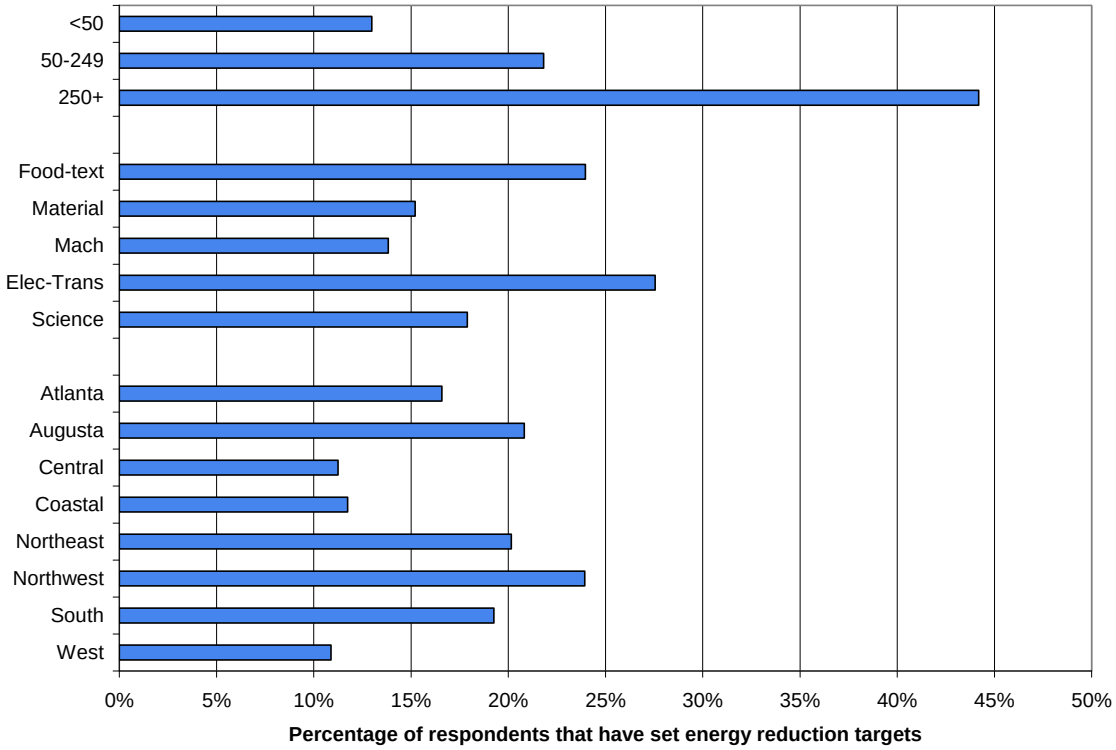
- Product innovators: More likely to have used techniques to improve the sustainability of raw materials selection (57 percent versus 41 percent among non product innovators).
- Process innovators: Higher rates of take up of sustainability practices than non process innovators in many areas including supplier selection, raw material selection, raw material extraction and processing, product design, manufacturing process design, facility design planning, and marketing.
- Organizational innovators: More likely to have used techniques to improve the employee training in sustainability practices (43 percent versus 31 percent among non organizational innovators).
- Marketing innovators: More likely to have introduced marketing practices such as green branding and eco labeling (31 percent versus 18 percent among non marketing innovators).

Alternative Energy Sources

The 2008 questionnaire asked respondents to indicate whether they use any alternative energy sources at their facility. Only 4 percent of respondents (31 respondents) reported using any alternative energy sources. Nineteen of these respondents reported using biomass, and nine reported using biofuels.

Respondents were also asked if their facility set targets to reduce the amount of energy used. Eighteen percent of respondents said that their facility set targets. Large manufacturers were significantly more likely to have set energy reduction targets than their smaller counterparts (See Figure 5.2) with 44 percent reporting energy reduction targets for their facility. By industry group, manufacturers in the elec-trans and food-text groups were more likely to have set energy reduction targets than manufacturers in other groups. Energy reduction target setting was somewhat more prevalent in the Northwest region and least prevalent in the Central, Coastal, and West regions.

Figure 5.2. Percentage of Respondents That Have Set Energy Targets by Facility Employment, Industry Group, and Region



Source: Georgia Manufacturing Survey 2008, weighted responses of 704 manufacturers.

The average (median) targets were:

- 2008: 8 percent (modal categories were 5 and 10 percent)
- 2010: 10 percent (modal categories were 5 and 10 percent)
- 2013 and 2018: 15 percent (modal categories were 10, 15, and 20 percent)

This suggests that manufacturers expect a decrease in energy usage in the near term and another decline in the next 5 to 10 years.

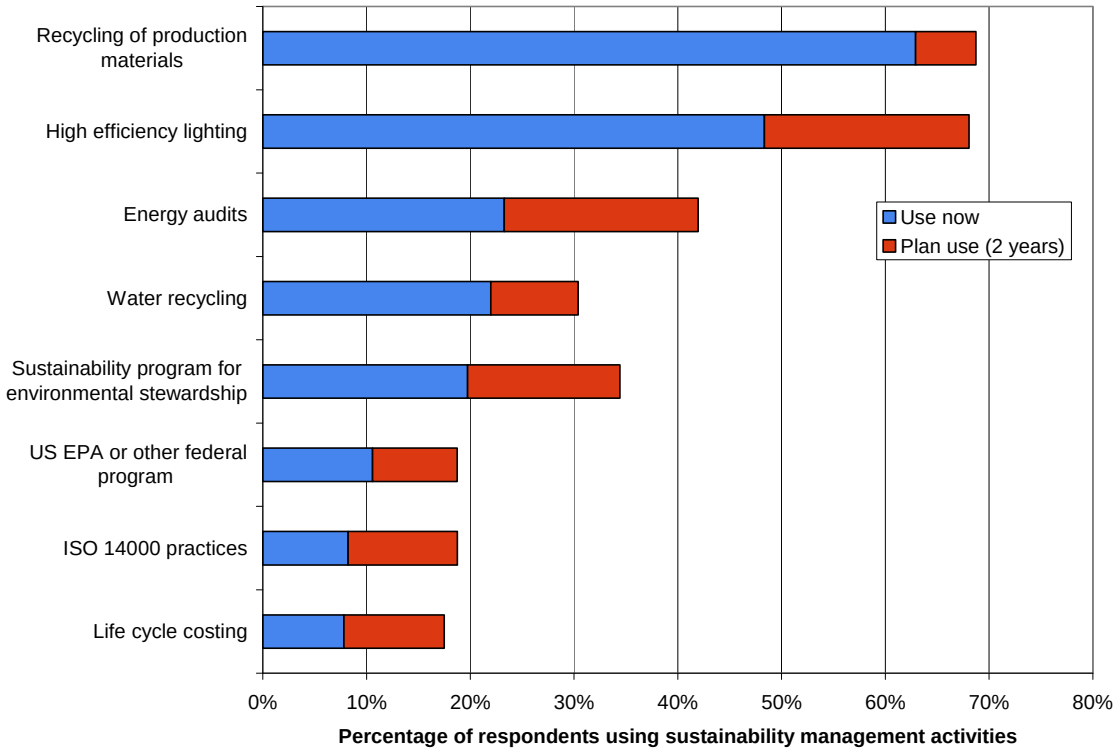
Sustainability Management

The Georgia Manufacturing Survey 2008 asked manufacturers about their take-up of eight sustainability management activities: high efficiency lighting, water recycling, energy audits, recycling of production materials, ISO 14000, life cycle costing, US Environmental Protection Agency (EPA) or other federal program (e.g., Energy Star), and sustainability program for environmental stewardship. Figure 5.3 shows that the most common sustainability management activities are production material recycling and high efficiency lighting. More than 60 percent of respondents recycle production materials and nearly half use high efficiency lighting. Recycling of production materials is at the same level as in the 2005 survey and the percentage that plan to adopt it in two years is the smallest of any of the activities, suggesting that this approach to sustainability is nearing maturity.

On the other hand, high efficiency lighting had the highest percentage of respondents planning to use them. Energy audits were used by 23 percent of respondents, but nearly the same percentage plan to implement an audit in the next two years. Water recycling and sustainability program for environmental stewardship were also adopted by about 20 percent of respondents, with the later registering plans for instituting an environmental stewardship program by another 20 percent. The least likely to be used were federal environmental programs, ISO 14000, and life cycle costing. Regarding ISO 14000, we have consistently asked about its adoption in previous Georgia Manufacturing Surveys and found that only a small percentage of manufacturers use or plan to use it.

Examining current use of sustainability management activities by facility characteristics, we find that large manufacturers are consistently more likely than their small and medium-sized counterparts to use these activities. By industry, the top three industry groups most likely to use sustainability management practices are science-based industries, food-text industries, and elec-trans industries. Science-based industries are especially prominent in their use of recycling of production materials and water and ISO 14000 practices. By region, the Central region has the highest percentage of respondents engaged in water recycling while the Augusta region has the highest percentage with environmental stewardship programs, EPA/other federal program use, and life cycle costing. The West region has the lowest percentage of manufacturers engaged in water recycling, Atlanta has the lowest percentage with environmental stewardship programs, and the Coastal area has no respondents with life cycle costing. (See Tables 5.4 to 5.6)

Figure 5.3. Use of Sustainability Management Activities



Source: Georgia Manufacturing Survey 2008, weighted responses of 693 manufacturers.

Table 5.4. Current Use of Sustainability Management Activities by Facility Employment Size
(Percentage of establishments reporting that they currently use activities)

Sustainability Activity	10-49	50-249	250+	Total
Recycling of production materials	57.3%	70.0%	83.6%	62.9%
High efficiency lighting	44.5%	51.2%	71.0%	48.3%
Energy audits	12.2%	36.4%	60.1%	23.3%
Water recycling	14.8%	28.1%	57.5%	22.0%
Sustainability program for environmental stewardship	12.7%	27.3%	48.5%	19.7%
US EPA or other federal program	8.7%	11.2%	25.2%	10.6%
ISO 14000 practices	4.5%	12.7%	23.3%	8.2%
Life cycle costing	5.0%	9.9%	26.5%	7.8%

Source: Georgia Manufacturing Survey 2008, weighted responses of 693 manufacturers.

Table 5.5. Current Use of Sustainability Management Activities by Industry Group
(Percentage of establishments reporting that they currently use activities)

Sustainability Activity	Food-text	Material	Mach	Elec-Trans	Science
Recycling of production materials	67.1%	59.7%	61.6%	59.8%	75.1%
High efficiency lighting	53.8%	45.3%	49.6%	51.3%	44.4%
Energy audits	31.8%	21.1%	15.4%	28.9%	33.4%
Water recycling	30.3%	19.4%	14.1%	14.4%	48.8%
Sustainability program for environmental stewardship	26.9%	18.2%	8.2%	27.9%	30.6%
US EPA or other federal program	8.9%	11.4%	7.7%	13.9%	14.0%
ISO 14000 practices	10.7%	5.9%	7.2%	12.0%	15.0%
Life cycle costing	10.8%	4.8%	4.9%	16.3%	12.8%

Source: Georgia Manufacturing Survey 2008, weighted responses of 693 manufacturers.

Table 5.6. Current Use of Sustainability Management Activities by Region
(Percentage of establishments reporting that they currently use activities)

Sustainability Activity	Atlanta	Augusta	Central	Coastal	North-east	North-west	South	West
Recycling of production materials	61.1%	55.8%	58.8%	68.2%	59.7%	68.4%	69.7%	63.6%
High efficiency lighting	49.3%	39.7%	48.6%	44.6%	45.7%	49.4%	52.9%	49.5%
Energy audits	19.7%	30.5%	18.9%	24.6%	22.7%	30.0%	22.4%	26.3%
Water recycling	19.9%	22.4%	33.1%	27.8%	20.5%	23.4%	25.1%	13.2%
Sustainability program for environmental stewardship	13.6%	32.9%	26.3%	25.7%	25.3%	19.7%	18.7%	19.5%
US EPA or other federal program	8.3%	24.4%	16.1%	5.1%	11.2%	4.6%	13.9%	17.6%
ISO 14000 practices	4.4%	4.7%	5.9%	12.4%	9.1%	12.1%	9.4%	18.3%
Life cycle costing	7.6%	16.8%	8.6%	0.0%	6.8%	10.6%	4.6%	6.2%

Source: Georgia Manufacturing Survey 2008, weighted responses of 693 manufacturers.

Knowledge Sources for Sustainability Management

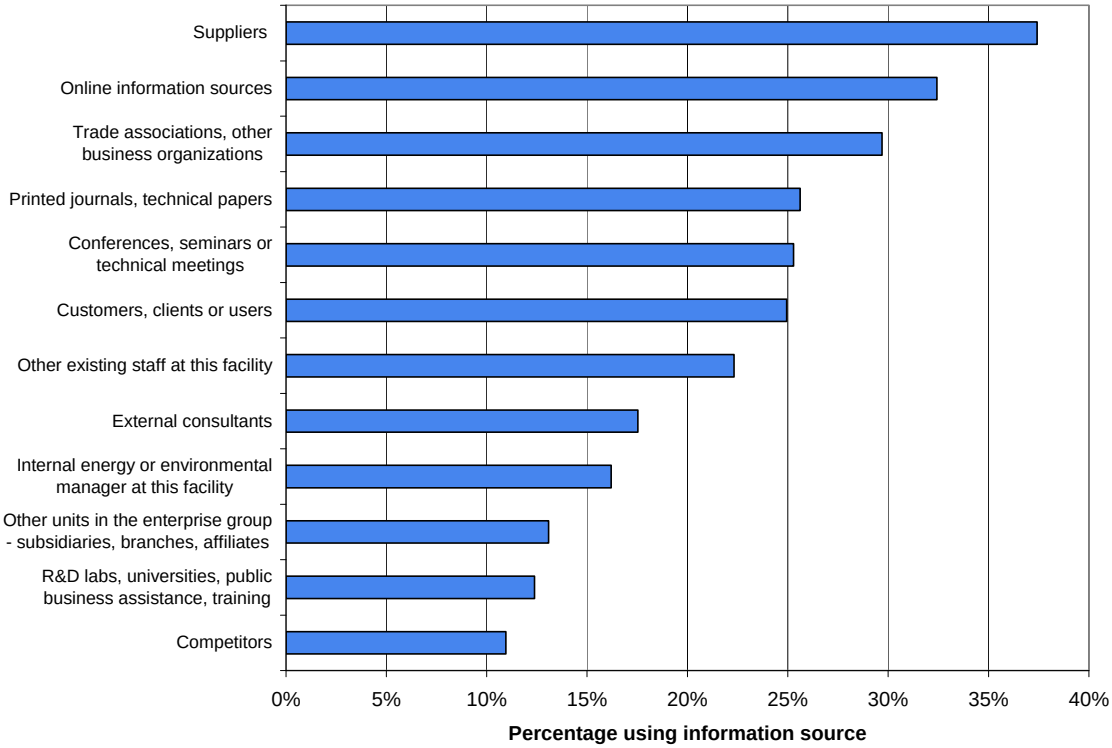
The 2008 survey asked respondents to indicate the sources of information and knowledge they used in the last two years to develop their sustainability management practices. No single type of knowledge source was dominant in the search for sustainability management information. Thirty percent of respondents used no external information and knowledge sources in the last two years, while nearly 60 percent used more than one type of knowledge source. Suppliers were most frequently used by nearly one-third of respondents. The next most common were online sources and trade and business associations. Competitors and R&D/universities/government sources were the least likely to be used. (See Figure 5.4)

Large manufacturers with 250 or more employees had much higher percentages of respondents indicating use of other existing staff at the facility, internal energy or environmental managers, suppliers, trade associations, and R&D laboratories / universities / government sources. Smaller establishments with fewer than 50 employees had similar percentages of respondents as their larger counterparts reporting use of online sources, printed journals, customers / clients / users, and competitors. Medium-sized manufacturers with 50 to 249 employees had higher percentages of respondents than their smaller counterparts but similar percentages to their larger counterparts using conferences, external consultants, and other units in the enterprise group. (See Table 5.7)

By industry, the elec-trans group had substantially higher percentages of respondents using suppliers, online sources, trade associations, and competitors than those in other industries. (See Table 5.8) Science-based manufacturers were more likely than manufacturers in other industry groups to use other existing staff, conferences, internal energy / environmental managers, other units in the enterprise group, and R&D laboratories / universities / government sources. Respondents in the other three industry groups generally had lower percentages using information and knowledge sources, with the metals and machinery group generally exhibiting the lowest percentages of knowledge source use.

By region, the Augusta region displayed distinctly higher percentages of respondents using internal energy / environmental managers, while the Central region had similarly higher percentages of respondents using conferences. (See Table 5.9)

Figure 5.4. Sources of Information and Knowledge for Sustainability Management Practices



Source: Georgia Manufacturing Survey 2008, weighted responses of 693 manufacturers.

Table 5.7. Current Use of Sustainability in Manufacturing Processes by Facility Employment Size
(Percentage of establishments reporting that they currently use sustainability in manufacturing processes)

Sources	10-49	50-249	250+	Total
Suppliers	32.1%	44.5%	53.5%	37.4%
Online information sources	31.2%	33.8%	37.6%	32.4%
Trade associations, other business organizations	27.7%	29.7%	47.2%	29.7%
Printed journals, technical papers	23.7%	28.0%	32.4%	25.6%
Conferences, seminars or technical meetings	21.2%	30.9%	37.4%	25.3%
Customers, clients or users	24.9%	24.2%	28.7%	24.9%
Other existing staff at this facility	12.9%	33.9%	55.3%	22.3%
External consultants	11.4%	26.3%	33.7%	17.5%
Internal energy or environmental manager at this facility	6.9%	27.1%	51.0%	16.2%
Other units in the enterprise group - subsidiaries, branches, affiliates	6.7%	21.6%	32.1%	13.1%
R&D labs, universities, public business assistance, training	9.5%	13.5%	32.6%	12.4%
Competitors	11.0%	10.0%	14.3%	11.0%

Source: Georgia Manufacturing Survey 2008, weighted responses of 693 manufacturers.

Table 5.8. Current Use of Sustainability in Manufacturing Processes by Industry Group
(Percentage of establishments reporting that they currently use sustainability in manufacturing processes)

Sources	Food-text	Material	Mach	Elec-Trans	Science
Suppliers	38.1%	37.2%	31.8%	47.0%	36.6%
Online information sources	29.5%	32.6%	28.4%	42.1%	32.6%
Trade associations, other business organizations	28.0%	26.8%	26.4%	41.1%	37.7%
Printed journals, technical papers	25.8%	23.8%	20.6%	34.2%	32.7%
Conferences, seminars or technical meetings	23.0%	24.5%	23.2%	25.7%	36.8%
Customers, clients or users	17.2%	26.5%	21.3%	30.0%	32.5%
Other existing staff at this facility	24.5%	19.3%	14.6%	31.8%	40.2%
External consultants	21.6%	12.0%	14.6%	30.1%	30.9%
Internal energy or environmental manager at this facility	23.2%	12.0%	8.9%	24.8%	31.3%
Other units in the enterprise group - subsidiaries, branches, affiliates	13.8%	10.2%	7.2%	22.4%	29.8%
R&D labs, universities, public business assistance, training	18.7%	9.2%	6.3%	15.3%	27.8%
Competitors	7.8%	11.5%	10.1%	17.8%	6.8%

Source: Georgia Manufacturing Survey 2008, weighted responses of 693 manufacturers.

Table 5.9. Current Use of Sustainability in Manufacturing Processes by Region
(Percentage of establishments reporting that they currently use sustainability in manufacturing processes)

Sources	Atlanta	Augusta	Central	Coastal	North-east	North-west	South	West
Suppliers	41.0%	46.5%	35.0%	33.6%	32.1%	35.6%	33.7%	38.5%
Online information sources	31.8%	36.2%	38.4%	38.9%	33.7%	34.1%	25.3%	25.8%
Trade associations, other business organizations	29.9%	40.9%	27.5%	44.2%	31.3%	19.0%	33.8%	26.4%
Printed journals, technical papers	23.5%	35.3%	24.7%	26.9%	29.7%	23.9%	27.9%	19.6%
Conferences, seminars or technical meetings	22.6%	26.9%	40.6%	31.2%	31.6%	19.4%	20.7%	23.0%
Customers, clients or users	24.9%	17.5%	29.2%	30.2%	19.6%	26.5%	28.9%	25.9%
Other existing staff at this facility	17.8%	33.4%	26.5%	36.4%	23.7%	23.8%	17.0%	23.9%
External consultants	17.7%	19.4%	16.6%	23.5%	13.7%	16.9%	23.4%	13.5%
Internal energy or environmental manager at this facility	12.0%	41.8%	18.5%	15.0%	15.2%	18.0%	15.0%	15.8%
Other units in the enterprise group - subsidiaries, branches, affiliates	12.5%	15.3%	9.2%	17.5%	12.2%	13.3%	11.4%	19.7%

R&D labs, universities, public business assistance, training	12.7%	24.6%	16.0%	7.5%	7.7%	12.0%	13.8%	10.1%
Competitors	11.1%	12.0%	22.1%	12.6%	5.5%	6.5%	18.0%	8.4%

Source: Georgia Manufacturing Survey 2008, weighted responses of 693 manufacturers.

Dimensions of Sustainability in Manufacturers

We sought to understand if there were underlying dimensions of sustainability practices in manufacturing based on the aforementioned questions in the 2008 survey. These questionnaire items can be interpreted as indicators of underlying dimensions of innovation. To obtain an understanding of these underlying dimensions we can use factor analysis in an exploratory manner. Because the items in this chapter were binary variables, we created a tetrachoric correlation matrix, which served as the basis for running factor analysis using principal components extraction. Commonalities captured from 54 percent to 89 percent of the variance in each of the items. Five factors, which explain 70 percent of the total variance, were extracted. These factors have been interpreted based on high loadings in the rotated matrix. (See Table 5.10)

- We interpret the first factor as measuring sustainability through manufacturing process set up; this interpretation is based on an examination of high loadings on improving the sustainability of supplier selection, selection of raw materials, extraction and processing of raw materials, product design, facility design planning, and packaging.

- The second factor can be viewed as sustainability through recycling and reuse based on high loadings on practices to improve use/reuse/product maintenance, end of life, and recycling of production materials.

- The third factor concerns practices to promote environmental stewardship including undertaking ISO 14000 practices, EPA/federal programs, and sustainability programs for environmental stewardship.

- The fourth factor involves energy reduction practices such as setting targets to reduce the amount of energy used, undertaking energy audits, and water recycling.

- The fifth factor has to do with green practices such as using high efficiency lighting.

Table 5.10. Principal Components Analysis of Sustainability Activities: Rotated Factor Loadings (*)

Sustainability Practices in Manufacturing	Manufact-uring Process	Recycling and reuse	Environ-mental steward-ship	Energy Reduction	Green Practices
Supplier selection	**0.71**	0.27	0.19	0.02	0.05
Selection of raw materials	**0.73**	0.27	0.12	0.22	0.03
Extraction and processing raw materials	**0.61**	0.35	0.11	0.29	-0.02
Product design	**0.81**	0.16	0.09	0.15	0.10
Design of manuf processes	**0.68**	0.23	0.27	0.31	0.12
Facility design planning	**0.52**	0.26	0.28	0.37	0.26
Packaging	**0.58**	0.34	0.17	0.23	0.16
Marketing	**0.58**	0.20	0.36	0.02	0.16
Employee training	**0.57**	0.33	0.47	0.15	-0.05
Logistics	**0.61**	0.29	0.35	-0.15	0.34
Use reuse	0.43	**0.79**	0.10	0.12	0.13
End of life	0.28	**0.87**	0.07	-0.09	0.07
Targets to reduce the amount of Energy used	0.34	-0.02	0.09	**0.70**	0.27
High efficiency lighting	0.08	0.11	0.08	0.12	**0.92**
Water recycling	0.03	0.31	0.24	**0.67**	-0.05
Energy audits	0.23	0.15	0.38	**0.55**	0.20
Recycling production materials	0.08	**0.78**	0.26	0.36	0.08
ISO 14000	0.23	0.02	**0.68**	0.46	0.04
Life cycle costing	0.25	0.36	0.46	0.12	0.35
EPA, federal programs, energy star	0.11	0.10	**0.84**	-0.01	0.00
Sustainability program for Environmental stewardship	0.25	0.23	**0.75**	0.29	0.22
Supplier selection	0.08	0.11	0.08	0.12	**0.92**
Selection of raw materials	0.03	0.31	0.24	**0.67**	-0.05

(*)Factor loadings over 0.50 are highlighted.

Source: Georgia Manufacturing Survey 2008, weighted responses of 504 manufacturers.

Energy Costs and Sustainability Practices

The Georgia Manufacturing Survey asked respondents to estimate energy expenditures (e.g., heat, electricity) in fiscal years 2007 and 2005. Energy costs increased by 13 percent on average (for the median respondent) in the last two years. The average (median) manufacturer spent 2.3 percent of total costs (e.g. purchased materials, parts, and services) on energy in 2007. Energy expenditures as a percentage of costs did not change very much by facility employment size. By industry, the percentage of costs devoted to energy needs was highest for the food-text industry group and lowest for the elec-trans

industry group. However, science-based manufacturers experienced the highest increases in energy costs – 25 percent. By region, energy costs were highest for the median manufacturer in the Coastal region, and lowest in the South and West. Energy costs experienced the lowest increases for the median manufacturer in the Northeast region. (See Table 5.11)

Table 5.11. Energy Costs by Facility Employment Characteristics

	2007 Energy Expenditures as a % of Cost of Goods	% change in Energy Expenditures: 2005-2007
All	2.3%	12.7%
Employment		
10-50	2.3%	12.7%
50-249	2.4%	12.5%
250+	3.0%	14.3%
Industry group		
Food-text	3.2%	12.1%
Material	2.6%	11.1%
Mach	1.9%	16.1%
Elec-Trans	1.0%	12.5%
Science	2.0%	24.5%
Region		
Atlanta	2.2%	13.8%
Augusta	3.0%	13.5%
Central	2.4%	13.7%
Coastal	3.6%	16.7%
Northeast	2.6%	7.9%
Northwest	2.4%	15.4%
South	1.7%	12.7%
West	1.6%	18.1%

Source: Georgia Manufacturing Survey 2008, weighted responses of 470 manufacturers.

Chapter
6

Workforce and Organizational Practices

Workforce and organizational practices are a further enabling factor in encouraging innovation-based competition. This chapter will profile the nature of workforce and production practices among Georgia manufacturers in 2008.

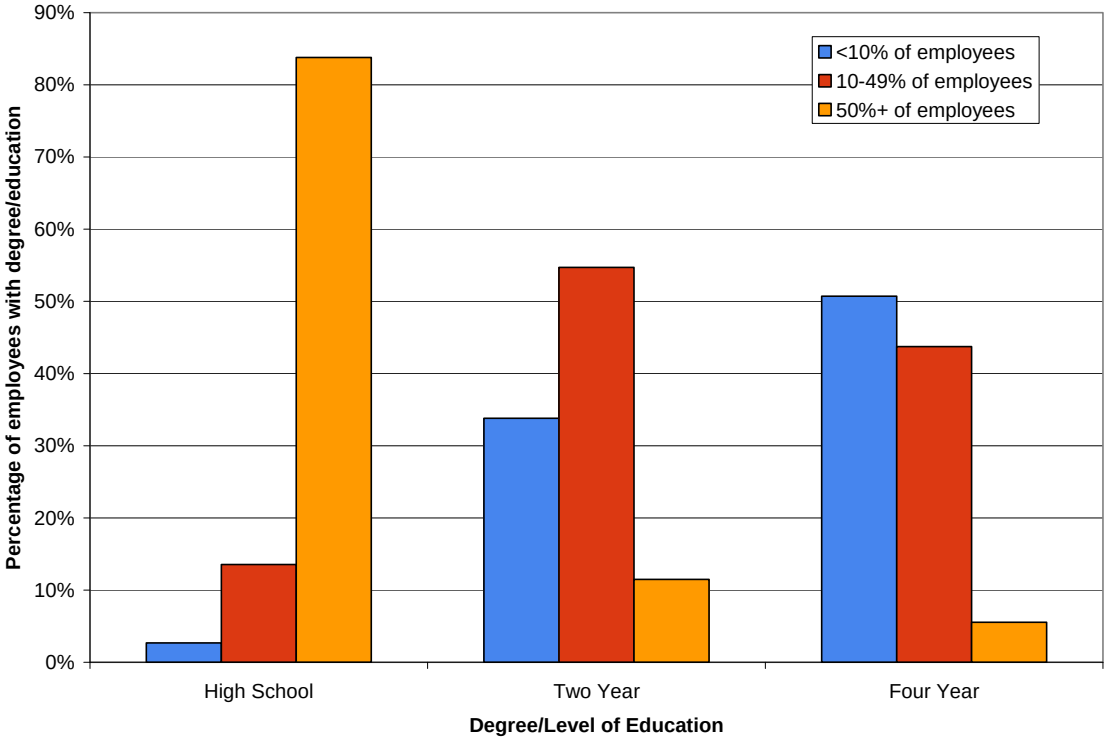
Workforce Capabilities

Internal capabilities – often called absorptive capacity – are an important indicator of the extent to which companies can adopt new technologies, techniques, and strategies. Two common measures of workforce capabilities are: (1) educational level and (2) training.

The 2008 survey asked respondents to report the percentage of employees that had various educational levels. Eight out of every 10 workers in the average (median) manufacturing facility received a high school degree or GED; and for nine out of 10 manufacturers, at least 20 percent of their workers had a high school education. The median respondent's percentage of high school educated employees was higher (90 percent) for manufacturers in the metals and machinery group and even higher (95 percent) for manufacturers in the elec-trans and science groups. Median percentages of workers with high school degrees in Atlanta and the Northwest were 90 percent compared to 75 percent in the South.

We also asked about associates degrees, two or more years of technical college, vocational, school, or apprenticeship training. The median manufacturing establishment had 10 percent of employees with two or more years of technical or vocational college; only 11 percent of manufacturers had technical/vocational education in at least half of their workforce. Regarding four-year college degrees, the median respondent had 8 percent of employees with this level of education; only 6 percent of manufacturers had bachelor's degrees in at least half of their workforce. Not surprisingly science-based manufacturers had relatively higher percentages of employees with associate's and bachelor's degrees (median=20 percent for associate's and 10 percent for bachelor's), followed by respondents in the elec-trans industry group. (See Figure 6.1)

Figure 6.1. Percentage of Facility's Workers with High School, Two Year (Associate's Degree) or Four Year (Bachelor's Degree) Education

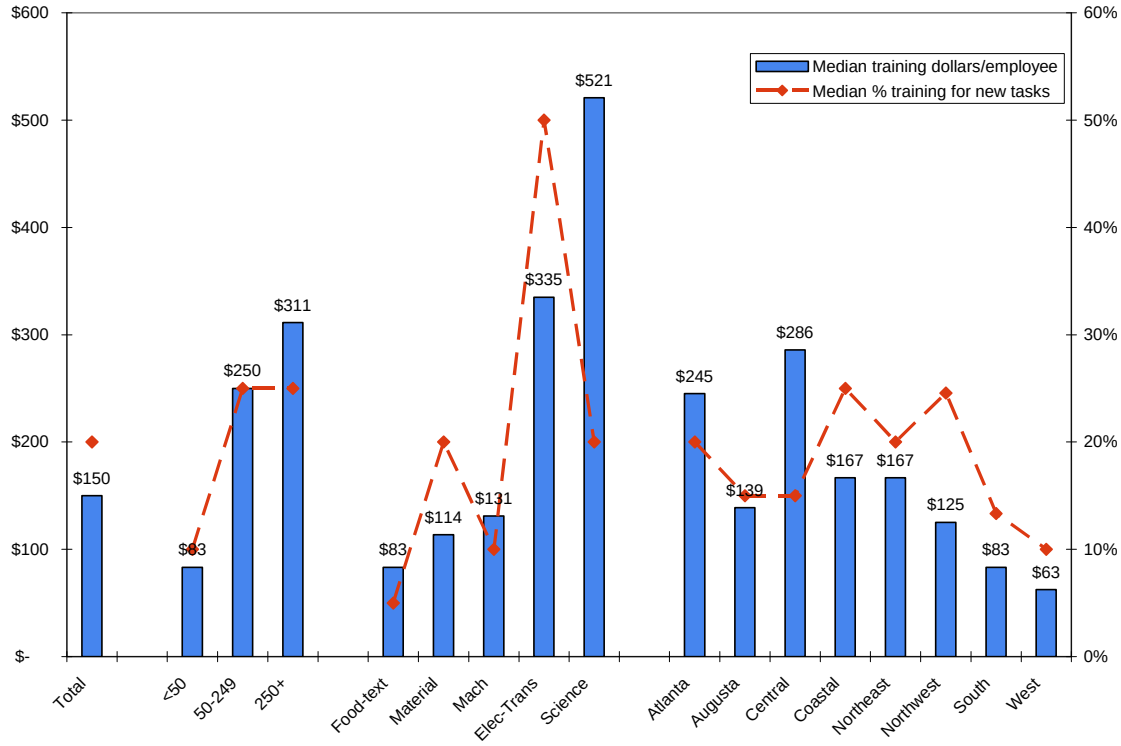


Source: Georgia Manufacturing Survey 2008, weighted results of 583 manufacturers.

In the training area, we asked companies how much they spent on all training activities in 2007. Nearly 80 percent of respondents who answered the question spent something on training activities. The average (median) respondent spent $150 per employee on training, which is somewhat lower than the median expenditure per employee in the 2005 survey ($200). Large manufacturers had higher average training expenditures per employees; indeed large manufacturers with 250 or more employees spent nearly four times what small manufacturers with fewer than 50 employees spent. By industry group, science-based establishments spent the most on training and manufacturers in the food-text industry spending the least. Respondents in the Atlanta and Central regions spent the most on training on a per employee basis and those in the South and West spent the least. (See Figure 6.2)

We also asked what percentage of training dollars were spent on new activities and tasks as opposed to routine training. The median respondent reported that 20 percent of training dollars was spent on non-routine training. This percentage was as high for medium-sized facilities as for large manufacturing facilities, but small manufacturers not only spent less, but most of their spending (90 percent) was for routing training. The elec-trans industry group had the highest percentage of training expenditure allocated to new activities and tasks – 50 percent – while the foot-text group spent only 5 percent of their training dollars in new areas.

Figure 6.2. Median Expenditures per Employee on All Training Activities in 2007 and Median Percentage of Training Dollars Related to New Activities and Tasks
(Left y axis represents the median training expenditure per employee and right y axis represents the percentage of training for new tasks)



Source: Georgia Manufacturing Survey 2008, weighted responses of 467 manufacturers.

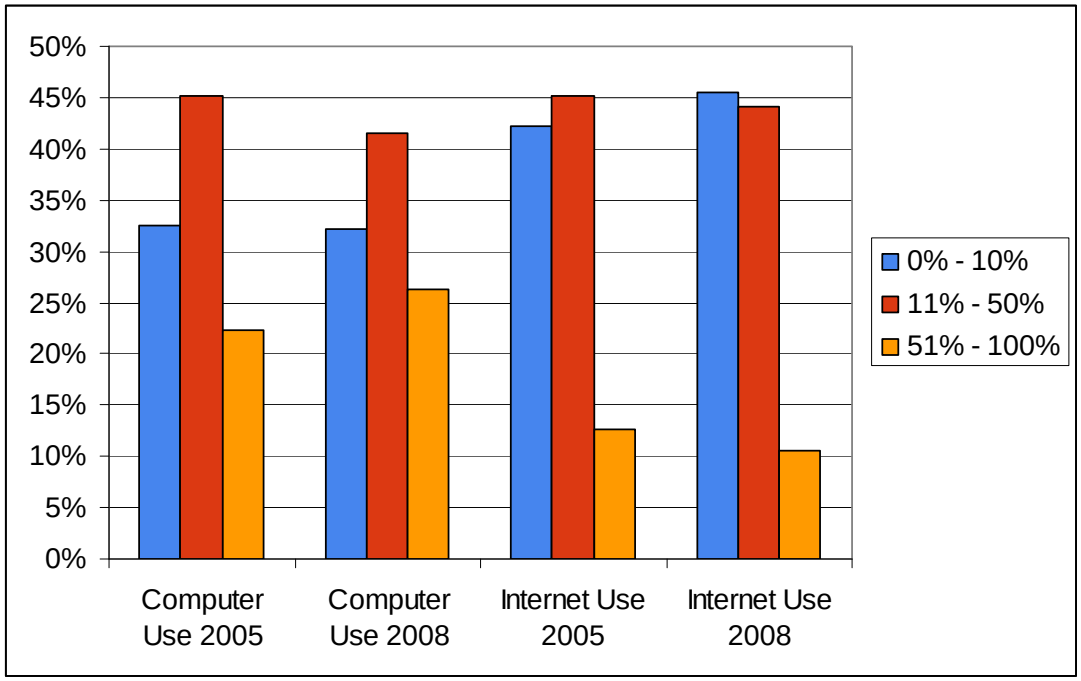
Workforce Capabilities and Information Technology Use

Another indicator of workforce capabilities in the 2008 survey is the use of information technologies by manufacturing employees. The 2008 survey examines use of two information technologies along this dimension: computers and the Internet. We asked responding manufacturers to tell us what percentage of their workers used a computer or programmable controller at least once a week as part of their job. We also asked manufacturers to tell us what percentage of workers used Internet at least once a week as part of their job. We have information from the 2005 Georgia Manufacturing Survey to serve as a benchmark of change.

Figure 6.3 shows that the percentage of employees that regularly use a computer in 2008 has increased slightly, but not very much, over 2005 survey levels. Internet usage in 2008 among manufacturing workers is considerably lower than computer usage and not much changed from, if not a little lower than, 2005 levels. The average (median) manufacturer in 2008 has about 25 percent of workers using computers and 15 percent using Internet. Among the

top 10 percent, these figures are 100 percent and 60 percent respectively, but among the bottom 10 percent, the figures are only 2 percent for both. Table 6.1 indicates that workforce penetration of the Internet is higher for smaller manufacturers than larger ones. Computer and Internet penetration is highest for respondents in the elec-trans industry group and lowest for those in the food-text industry group. The South has the lowest usage of IT technologies.

Figure 6.3. Percentage of Employees Using a Computer/Programmable Controller or E-mail at Least Once a Week as Part of their Job
(Percentage of respondents reporting the percentage of workers using technology)



Source: Georgia Manufacturing Survey 2008, weighted responses of 675 manufacturers.

Table 6.1 Mean Percentages of Workers Using Computers and Internet at least Once a Week as Part of Their Job

	Mean % using computers	Mean % using Internet
All Respondents	37%	23%
Employment		
<50	37%	27%
50-249	36%	18%
250+	42%	18%
Industry Group		
Food-text	30%	17%
Material	33%	20%

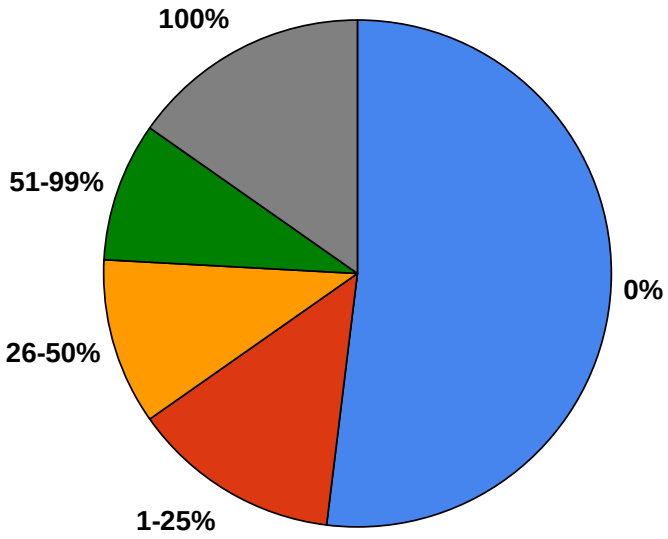
Mach	39%	25%
Elec-Trans	54%	40%
Science	48%	34%
Region		
Atlanta	41%	29%
Augusta	35%	24%
Central	38%	21%
Coastal	43%	19%
Northeast	38%	21%
Northwest	41%	26%
South	21%	13%
West	29%	14%
Number of Respondents	681	675

Source: Georgia Manufacturing Survey 2008, weighted responses.

Organization and Production

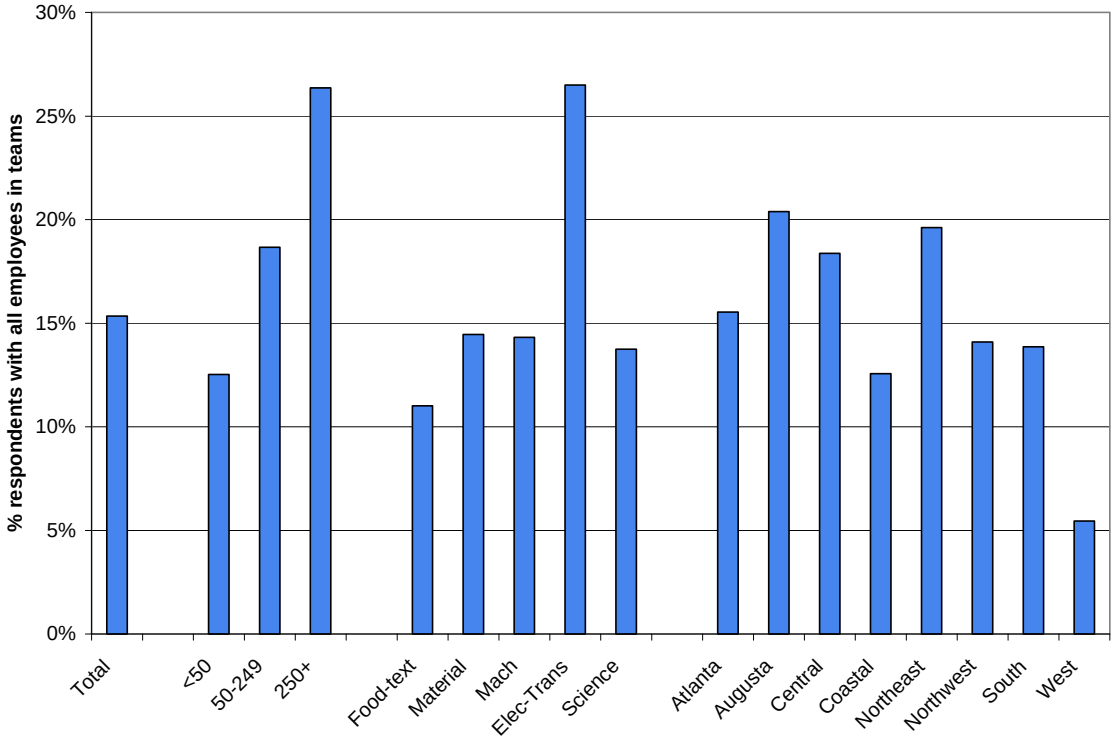
This section examines organizational capabilities in terms of how the workforce is organized for production. The 2008 Georgia Manufacturing Survey asked about use of team-based organizational approaches, information technologies used by workers, and quality improvement approaches. Teamwork in production was explored by asking manufacturers to tell us what percentage of their production workers are in teams. Less than half of respondents (48 percent) use team-based approaches for production work; this is roughly the same percentage as in the 2005 survey (45 percent). Nearly one-quarter of respondents have some of their employees (1-to-50 percent) working in production teams; 15 percent of respondents have all of their employees work in production teams. (See Figure 6.4) Large manufacturers and respondents in the elec-trans group are most apt to have a high percentage of employees working in teams. Manufacturers in the West are least likely to use team-based approaches. (See Figure 6.5)

Figure 6.4. Distribution of Manufacturing Respondents by Percentage of Production Employees Working in Teams



Georgia Manufacturing Survey 2008, weighted results of 635 manufacturers.

Figure 6.5. Percentage of Respondents with All Production Workers in Teams by Facility Employment Characteristics



The Georgia Manufacturing Survey 2008 asked manufacturers about their adoption of continuous improvement practices. Half of all manufacturers use any continuous improvement programs. The most common practice used is lean manufacturing. Larger manufacturers are much more likely to use continuous improvement practices than are their smaller counterparts. Manufacturers in the elec-trans industry group generally had the highest take-up of continuous improvement techniques while those in the material group generally had the lowest. By region, general use of continuous improvement techniques was lowest in the Coastal and West regions, although there were not major regional differences in the percentage of respondents adopting lean manufacturing practices. Quality management systems (e.g., ISO 9000) were especially prevalent in the Augusta region. (See Table 6.2)

Table 6.2. Percentage of Manufacturers Using Continuous Improvement Practices by Facility Characteristics.

	Any continuous improvement program	Lean Manuf-acturing	Quality Systems (Six Sigma)	Quality Management (ISO 9000)
All Respondents	49.7%	31.3%	22.0%	25.7%
Employment Size				
<50	37.9%	21.0%	12.5%	15.8%
50-249	66.5%	46.2%	32.9%	37.9%
250+	81.9%	58.4%	58.1%	60.6%
Industry				
Food-text	48.1%	26.9%	23.5%	22.0%
Material	44.2%	29.8%	19.5%	18.2%
Mach	49.2%	33.8%	17.6%	28.2%
Elec-Trans	66.5%	43.6%	31.2%	49.7%
Science	66.1%	29.3%	33.2%	41.6%
Region				
Atlanta	52.0%	31.8%	20.7%	25.0%
Augusta	52.8%	31.1%	19.4%	34.8%
Central	48.6%	32.8%	27.3%	24.7%
Coastal	40.9%	28.5%	14.8%	19.8%
Northeast	50.1%	30.8%	23.7%	26.3%
Northwest	49.2%	31.7%	26.4%	29.2%
South	51.1%	30.8%	21.1%	23.7%
West	41.1%	30.1%	16.4%	21.3%

Source: Georgia Manufacturing Survey 2008, weighted responses of 676 manufacturers.

Chapter 7

Manufacturing Performance

This chapter tracks the performance of Georgia manufacturers along three measures of business and economic outcomes: (1) competitiveness, (2) productivity, and (3) profitability.

Competitiveness

According to the OECD, competitiveness is "a measure of a country's advantage or disadvantage in selling its products in international markets." [6] In this analysis, we used exporting activity (by value) as a measure of competitiveness.

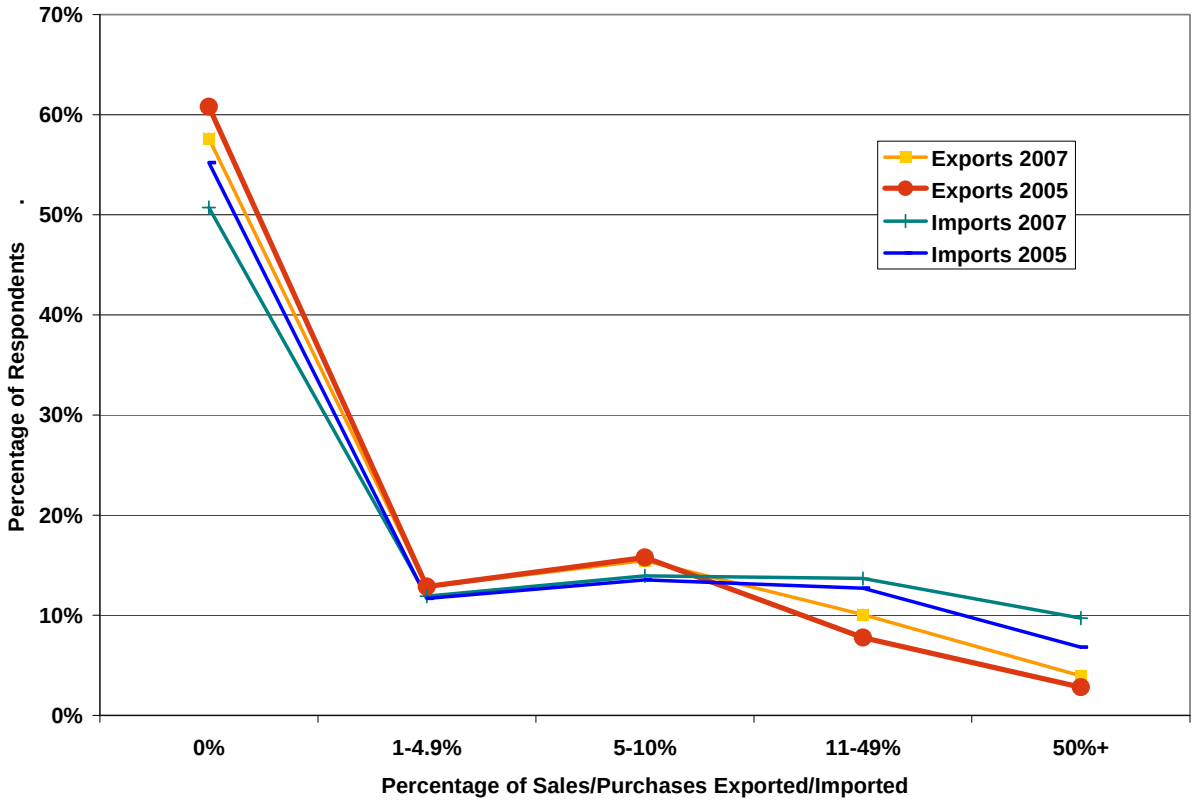
Responses to the Georgia Manufacturing Survey 2008 indicate that more than 40 percent of respondents did some exporting of sales or some importing of materials, parts, and services. The mean percentage of export sales in 2007 was just over 6 percent; the mean percentage of purchases of materials, parts, and services from sources outside the United States was 11.4 percent. The top 10 percent of exporters accounted for 20 percent of their sales through exports. The top 10 percent of importers obtained 41 percent of their materials, parts, and services from non-U.S. sources.

Figure 7.1 compares exporting and importing figures in 2007 with those in 2005. The figure shows export levels in 2005 and 2007 are nearly the same while importing materials / parts / services from outside the US was more prevalent in 2007 than in 2005.

Table 7.1 shows that the propensity to export increases as facility employment size rises. The elec-trans group has the largest percentage of firms with at least some export sales, whereas the materials group has the smallest percentage. The prevalence of exporting firms is highest in the Coastal and Northwest regions and lowest in the Augusta region. These trends also apply to imports of materials, parts, and services from sources outside of Georgia.

[6] OECD Glossary of Statistical Terms, [http://cs3-hq.oecd.org/scripts/stats/glossary/detail.asp?ID=399], January 26, 2004.

Figure 7.1. Exporting and Importing by Value of Sales Exported/Purchases Imported
(Percentage of respondents reporting the share of sales exported and/or purchases imported)



Source: Georgia Manufacturing Survey 2008, weighted responses of 536 manufacturers.

Table 7.1. Percentage of Manufacturers with Any Export Sales or Any Purchases Imported from Sources Outside the United States by Respondent Characteristics

	Percentage of Establishments with Some Export Sales	Percentage of Establishments with Some Imported purchases
All respondents	42.4%	49.3%
Employment		
10-49	33.7%	41.6%
50-249	53.0%	61.2%
250+	77.3%	71.9%
Industry		
Food-text	45.6%	50.1%
Material	32.7%	44.1%
Mach	43.3%	45.9%
Elec-Trans	64.3%	65.2%
Science	60.9%	69.0%

Region		
Atlanta	42.3%	49.4%
Augusta	31.2%	44.7%
Central	39.2%	33.1%
Coastal	50.3%	57.7%
Northeast	43.0%	52.4%
Northwest	48.9%	59.7%
South	40.0%	42.6%
West	36.2%	43.2%

Source: Georgia Manufacturing Survey 2008, weighted responses of 554 manufacturers.

The outsourcing trend in manufacturing has continued received attention since the 2005 survey. The 2008 survey repeated a series of questions that were initiated in the 2005 survey to understand the extent of movement of work away from Georgia facilities to other plants in out-of-state locations. To obtain a balanced picture, we also asked about the extent to which work from outside the state was transferred back to Georgia facilities.

The percentage of Georgia manufacturers impacted by outsourcing in the last two years – 15 percent – was similar to, if not slightly lower than, what was reported in the 2005 survey. US and Asian locations were the most common outsourcing locations (indicated by 7 percent and 6 percent of respondents respectively), followed by Mexico / Central / South America (indicated by 4 percent of respondents). (See Table 7.2)

Table 7.2. Impact of Manufacturing Work from Foreign and Out-of-State Competition

Has any work that was formerly performed at this facility been moved outside of Georgia within the last 2 years?			2008: Yes: 15.4% 2005: Yes: 17.4%		No: 84.6% No: 82.6%
If YES, this work was moved <u>from Georgia</u> to:	Elsewhere in USA	Mexico, other Central or South America	Asia (including China, India)	Europe	Elsewhere in world
2005	9.2%	4.9%	7.3%	1.9%	1.6%
2008	7.3%	3.6%	5.8%	0.6%	1.0%
Has any work been transferred back to this facility in Georgia from outside the state within the last 2 years?			2008 Yes: 12.2% 2005 Yes: 11.0%		No: 87.8% No: 89.0%
If YES, this work was transferred <u>back to Georgia</u> from:	Elsewhere in USA	Mexico, other Central or South America	Asia (including China, India)	Europe	Elsewhere in world
2005	8.8%	1.0%	1.4%	.8%	1.0%
2008	8.3%	.8%	1.6%	1.3%	.8%

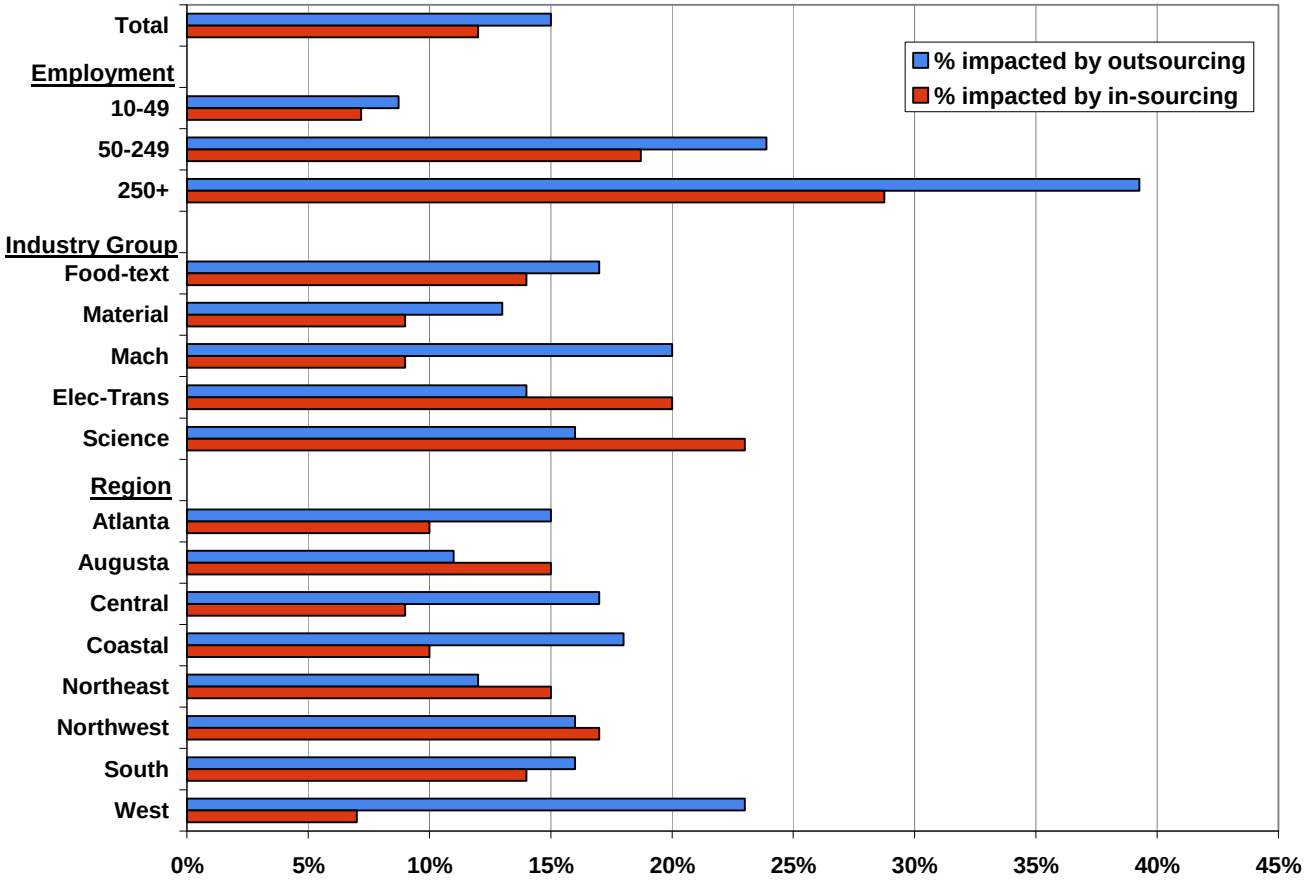
Source: Georgia Manufacturing Survey 2008, weighted responses of 676 manufacturers; Georgia Manufacturing Survey 2005, weighted response of 617 manufacturers.

Survey results continued to show that some "in-sourcing" also occurred over the same two-year period. In-sourcing affected a small percentage of manufacturers, with 12 percent of respondents reporting that some work had been transferred back to their Georgia facility from a location outside the state.

This percentage was similar to that reported in the 2005 survey. In-sourced work most commonly came from another U.S. facility.

Figure 7.2 compared the rate of outsourcing with the rate of in-sourcing across manufacturing facilities of different employment size, industry group, and in-state region. The rate of outsourcing and in-sourcing increased substantially with facility employment size. Moreover, there was a much higher rate of outsourcing than in-sourcing for larger facilities than smaller ones. The rate of in-sourcing was higher than the rate of outsourcing in the science-based and elec-trans industry groups. Outsourcing was much more common than in-sourcing among respondents in the metals/machinery group. The frequency of outsourcing was much higher than that of in-sourcing among manufacturers in the West region. Those in the Northwest, Northeast, and Augusta regions had higher percentages of in-source-impacted than outsource impacted manufacturers.

Figure 7.2. Percentage of Establishments Reporting That Their Facility Was Impacted by Outsourcing or by In-sourcing*

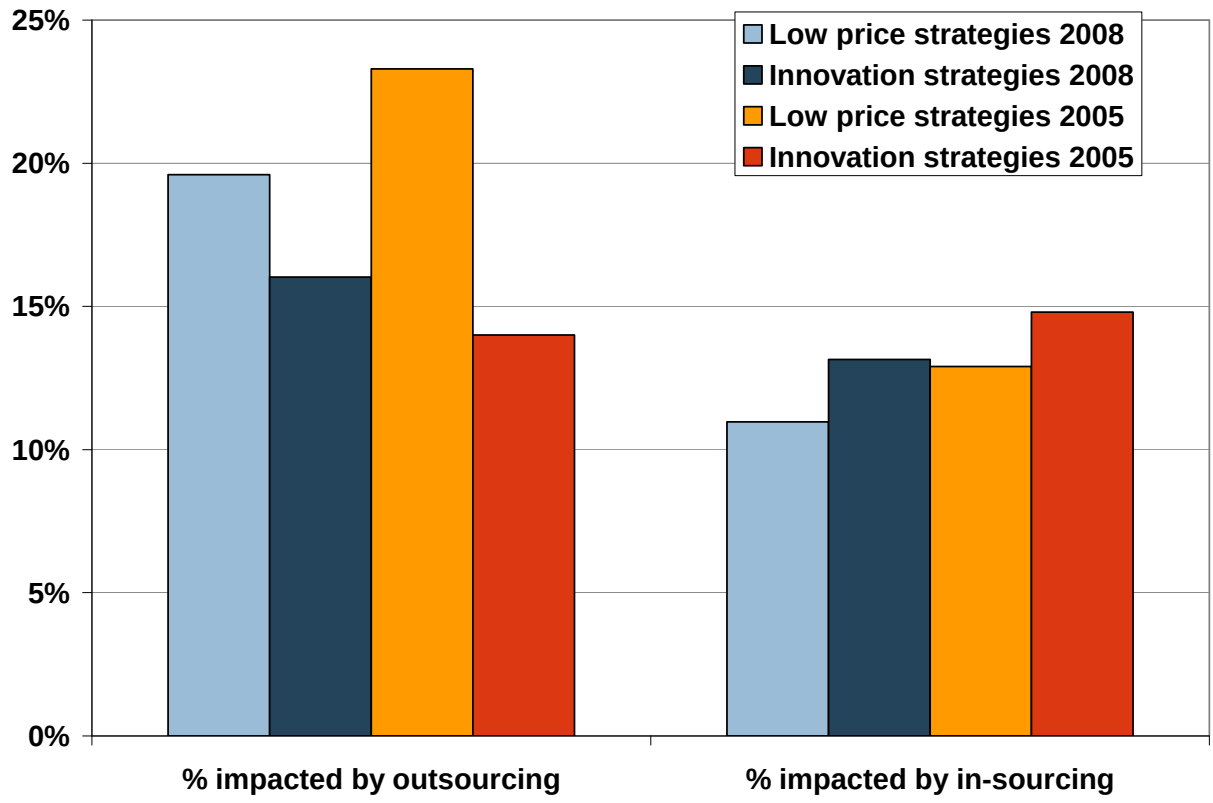


*Outsourcing was defined as worked formerly performed at the Georgia facility having been moved outside of Georgia within the last two years; In-sourcing was defined as work transferred back to the Georgia facility from outside the state within the last two years.

Source: Georgia Manufacturing Survey 2008, weighted responses of 676 manufacturers.

We also looked at outsourcing and in-sourcing rates by the primary competitive strategy. In the 2005 survey we compared the rates of outsourcing and in-sourcing and found that outsourcing was more prevalent among manufacturers that prioritize low price strategies than those that prioritize innovation / technology strategies. We replicated this comparison with the 2008 survey data. The results in Figure 7.3 show the comparison from the 2008 survey in the blue bars relative to the comparison for the 2005 survey in the yellow/red bars. The results show that outsourcing is still more prevalent for manufacturers that prioritize low price (20 percent) versus those prioritizing innovation / technology (16 percent), although the differential is smaller than in 2005. We found the differential in rates of in-sourcing between the two strategies to be similar to what was shown in 2005, with 11 percent of manufacturers prioritizing low price strategies benefitting from in-sourcing compared with 13 percent of those prioritizing innovation. However, the overall levels of in-sourcing are slightly lower for the two types of strategies. (See Figure 7.3)

Figure 7.3. Percentage of Establishments Reporting That Their Facility Was Impacted by Outsourcing or by In-sourcing by Facility Strategy



Source: Georgia Manufacturing Survey 2008, weighted responses of 676 manufacturers; Georgia Manufacturing Survey 2005, weighted responses of 617 manufacturers.

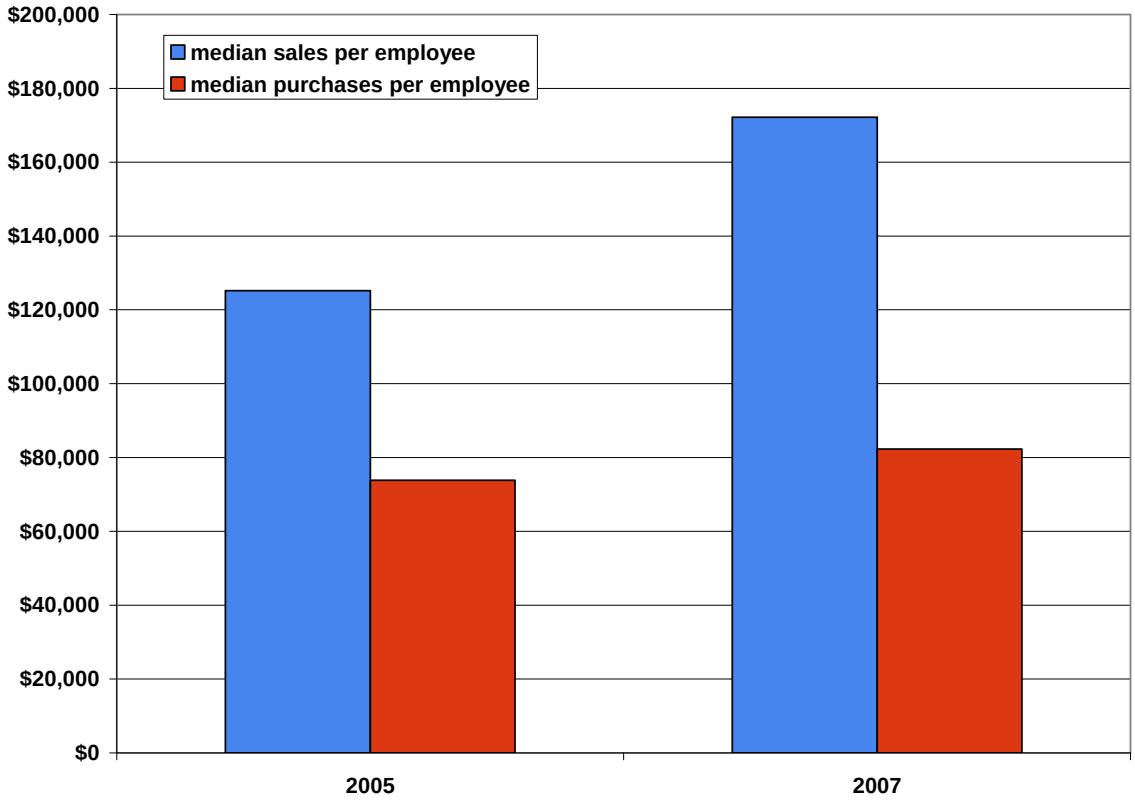
Productivity

Productivity refers to the efficiency of conversion of inputs into outputs and is an important determinant of manufacturing growth. A more productive manufacturing facility makes more outputs with smaller quantities of inputs. There are a variety of measures of productivity.

Productivity is typically measured by examining gross output (sales or revenue) per employee, or value-added (sales minus the purchase of intermediate goods and services) per employee. Two-thirds of respondents to the Georgia Manufacturing Survey reported sales levels higher in 2007 than in 2005. Nearly one-third of respondents lost money between the two years, and another 2 percent reported that their sales were unchanged. The typical (median) manufacturer had 8 percent more sales in 2007 than in 2005. The top 10 percent of respondents had approximately a 50 percent increase in 2007 sales over 2005 levels. These are lower than 2005 levels, which were 20 percent sales increase from 2002 to 2004 for the median respondent and 80 percent sales increase during this time period for the top 10 percent of firms.

Sixty percent of Georgia manufacturers experienced an increase in value-added per employee from 2005 to 2007. This is similar to the percentage as was reported in the 2005 and 2002 surveys. The median company raised the value-added per employee by 6 percent, and the top 10 percent of manufacturers raised its value-added per employee by 67 percent. Among the median respondents with positive changes in value-added per employee, purchased materials grew by 14 percent or roughly $9,100 on a per employee basis from 2005 to 2007. However, sales grew faster, by about $23,000 per employee. (See Figure 7.5)

Figure 7.5. Median Sales and Purchased Materials/Parts/Services Among Respondents with Positive Increases in Value-added Per Employee: 2005 to 2007

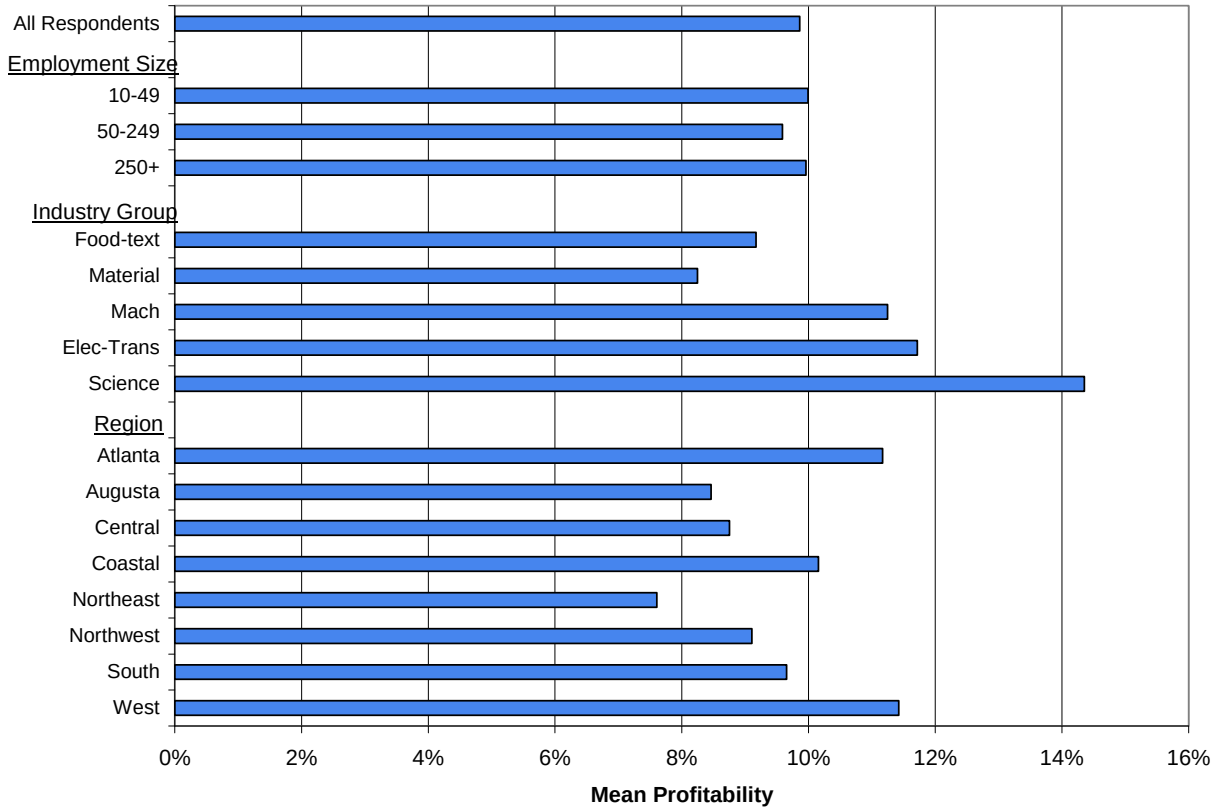


Source: Georgia Manufacturing Survey 2008, weighted responses of 305 manufacturers.

Profitability

Average annual return on pre-tax sales can be considered a measure of profitability. Over the 2005-to-2007 time period, the three-year average annual pre-tax return on sales for the mean firm was 9 percent. The top 10 percent of firms had a 25 percent annual return on sales. Negative return on sales was reported by fewer than 5 percent of respondents. Mean profitability did not differ much by facility employment size. Science-based establishments were most profitable while food-text and materials industry groups had the lowest levels of profitability. By region, manufacturers in Atlanta and West regions had somewhat higher profitability levels and those in the Northeast, lower profitability levels. (See Figure 7.6)

Figure 7.6. Profitability by Respondent Facility Employment Size, Industry Group, and Region
(Median Average Annual Pre-Tax Return on Sales Over the Last Three Years)



Source: Georgia Manufacturing Survey 2008, weighted responses of 484 manufacturers.

Innovation and Manufacturing Performance

In a manufacturing facility, many factors can come together to produce positive business outcomes. This section directs attention to those aspects of economic performance related to innovation enhancement. In essence, this section focuses on the "bottom-line" measures of innovation-driven outcomes such as value-added.

We developed a model to examine the relationship between innovation and value-added per employee (using this as a proxy for productivity and labor efficiency). This model proposes that the change in value-added per employee in from 2005 to 2007 is a function of the introduction of product, process, organizational, or marketing innovations in the 2005-to-2007 time period. We acknowledge that there is a likely lag between the introduction of product, process, organizational, or marketing innovations and value-added per employee, but we were limited to some extent by the emphasis in our survey design on gathering current information. We also added several control

variables based on the innovation value chain work of Stephen Roper and colleagues (2006)[7], including: (1) knowledge sourcing variables comprised of internal R&D, forward links, backward links, horizontal links, public knowledge links, (2) absorptive capacity variables comprised of training and capital expenditures, (3) resource base variables comprised of facility employment size (and size^2), whether the facility is less than three years old, and whether it is part of a multi-establishment enterprise, whether it received public funding for innovation, and (4) industry dummy variables.

Table 7.3 shows the results.

- Product innovations introduced in the 2005-to-2007 period were positively associated with growth in the natural log of value-added per employee from 2005 to 2007. Manufacturers that introduced new products had 11 percent higher growth in value-added per employee than those that did not.

- Process innovations introduced in the 2005-to-2007 period were positively associated with the growth in the natural log of value-added per employee from 2005 to 2007. Manufacturers that introduced new processes had 15 percent higher growth in value added per employee than those that did not.

- Introduction of new marketing approaches is associated with declines in value-added per employee

- The percentage increase in value-added per employee is higher for manufacturers that work with customers to create or design an innovation, and that use public knowledge sources.

Table 7.3. Regressions of Change in Natural Log of Value-added Per Employee from 2005 to 2007 and Innovation

Variables	Coefficients
Innovation Variables	
Process innovation	0.15
	(0.07)**
Product innovation	0.11
	(0.06)*
Advance management systems innovation	-0.04
	(0.07)
Organizational innovation	-0.01
	(0.06)
Marketing innovation	-0.16
	(0.07)***
Knowledge Sources	
In-house R&D	-0.15
	(0.07)**
Suppliers	0.13
	(0.06)**
Customers	0.12
	(0.06)*
Competitors	-0.09
	(0.08)

[7] Roper, S, J H Love, and J Du. 2008. Modelling the Innovation Value Chain. Research Policy 37 (6-7):961-977.

Public knowledge sources	0.15
	(0.06)**
Resource Variables	
Employment size 2005	0.00
	(0.00)
Employment size squared	-0.00
	(0.00)
Began manufacturing after 2004	0.24
	(0.10)**
Part of multi-establishment enterprise	-0.09
	(0.09)
Absorptive Capacity	
Training for innovation	-0.12
	(0.06)*
Capital investment for innovation	0.04
	(0.07)
Financial Assistance	
Public support for innovation	0.01
	(0.12)
Private support for innovation	-0.14
	(0.09)
Industry	
Dftext	0.02
	(0.08)
Dmetmach	0.05
	(0.07)
Electran	-0.09
	(0.10)
Science	0.14
	(0.11)
Constant	-0.09
	(0.07)
Observations	475
R-squared	0.10

Standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Source: Georgia Manufacturing Survey, weighted responses of 475 manufacturers.

Despite the non-availability of data from a longer time frame to estimate the influence of innovation on productivity growth, this analysis confirms the notion that product and process innovations can lead to higher value added per employee. Moreover, these relationships are facilitated by the use of external knowledge sources, especially customer input, and public knowledge sources such as universities.

Chapter
8

Business Assistance Resources

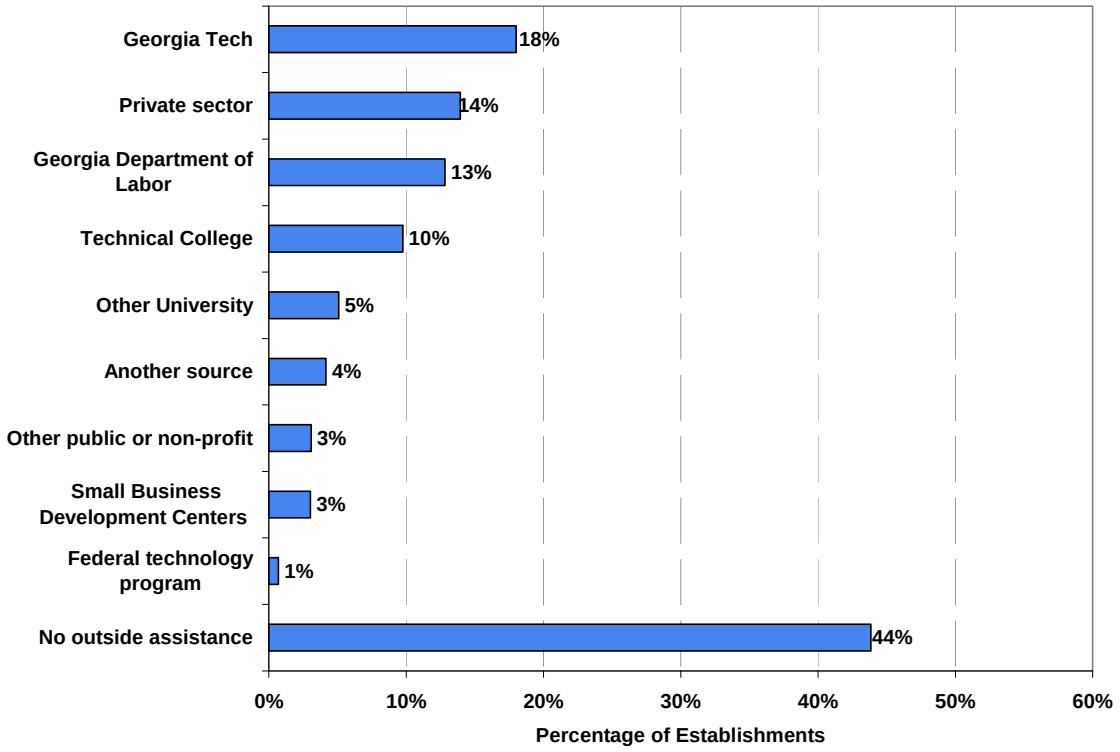
Past Georgia Manufacturing Surveys have found that companies using outside service providers are better off than companies going at it alone. This section takes a further look at assistance source usage. It opens with an examination of the types of companies that seek outside assistance across a range 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 shows that the average client had $3,000 more in value-added per employee (a measure of productivity) than if it had not been a client.

Business Assistance Usage

More than half of Georgia manufacturers use some type of business assistance provider. Georgia Tech was used by 18 percent of all manufacturing survey respondents, followed by a private-sector consulting firm or vendor (14 percent), Georgia Department of Labor (13 percent), and a technical college/Quick Start program (10 percent). (See 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 has a relatively similar percentage of manufacturing users (3 percent) regardless of employment size. The biggest challenge is with the smallest companies having 10 to 49 employees because they are least likely to use any outside assistance source. More than half of the establishments in this smallest employment size category have not obtained outside business assistance. (See Table 8.1)

Figure 8.1 Business Assistance Sources Used by Manufacturers
(Percentage of manufacturers using source in last two years)



Source: Georgia Manufacturing Survey, weighted responses of 617 manufacturers.

By industry, Table 8.2 shows that elec-trans group has the highest percentage of users of business assistance sources, especially Georgia Tech and the Georgia Department of Labor. The food-text group also has a similarly high percentage of users of outside assistance. Manufacturers in the materials group are the least likely to use business assistance sources.

By region, establishments in the South region are most apt to use outside assistance sources; those in the Augusta region are the least apt to use outside assistance. (See Table 8.3) However, the percentage of respondents using Georgia Tech is highest in the Augusta region, along with the South, Coastal, and Central regions. Use of the Georgia Department of Labor is highest in the South. The technical colleges have the highest penetration rates in the Central, Coastal, and West regions.

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

Sources	10-49	50-249	250+
Georgia Tech	11.9%	26.5%	37.7%

Other University	3.9%	5.4%	14.3%
Small Business Development Center	3.9%	1.5%	1.7%
Technical College	3.7%	16.5%	35.5%
Georgia Department of Labor	6.6%	21.1%	34.2%
Federal technology program	0.3%	0.6%	4.5%
Other public/non-profit source	2.8%	2.5%	8.7%
Private sector	10.7%	17.6%	28.1%
Another source	4.6%	2.8%	6.2%
No outside assistance	51.2%	34.2%	18.2%

Source: Georgia Manufacturing Survey 2008, weighted responses of 617 manufacturers.

Table 8.2 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	19.3%	16.1%	18.0%	27.3%	16.3%
Other University	9.0%	3.6%	3.0%	5.5%	9.5%
Small Business Development Center	5.7%	1.0%	3.2%	6.2%	4.1%
Technical College	10.9%	7.2%	10.0%	17.4%	12.2%
Georgia Department of Labor	18.6%	7.9%	11.5%	27.6%	13.6%
Federal technology program	1.9%	0.0%	1.2%	0.0%	1.4%
Other public/non-profit source	3.8%	2.5%	2.5%	3.9%	5.4%
Private sector	12.8%	11.3%	15.4%	16.6%	22.9%
Another source	6.4%	4.1%	4.2%	3.9%	0.0%
No outside assistance	34.2%	49.5%	44.6%	34.8%	40.9%

Source: Georgia Manufacturing Survey 2008, weighted responses of 617 manufacturers.

Table 8.3. Business Assistance Sources Used by Industry
(Percentage of respondents using business assistance source in last two years)

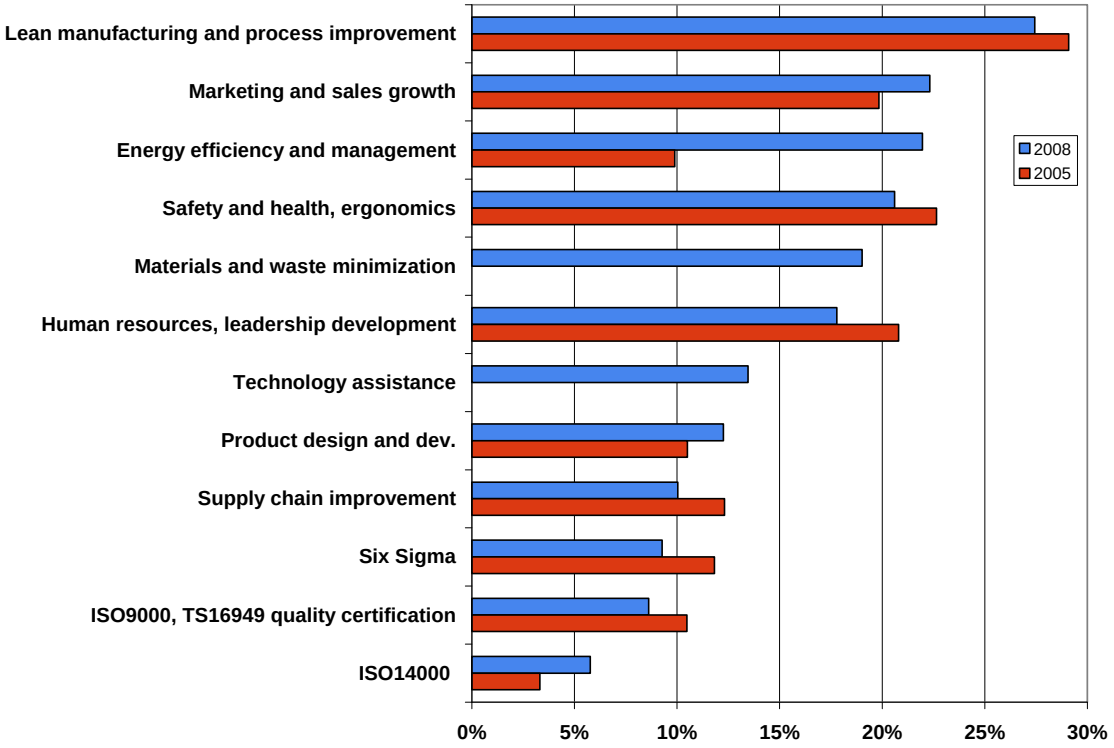
Source	Atlanta	Augusta	Central	Coastal	North-east	North-west	South	West
Georgia Tech	15.6%	25.1%	21.7%	22.7%	14.9%	19.0%	24.3%	12.0%
Other University	4.7%	11.5%	5.9%	4.2%	3.0%	6.2%	3.6%	5.9%
Small Business Development Center	2.7%	2.2%	1.4%	2.9%	3.3%	4.9%	4.6%	0.0%
Technical College	5.0%	9.3%	18.3%	12.3%	8.0%	8.0%	23.6%	9.1%
Georgia Department of Labor	8.0%	4.9%	16.0%	9.9%	6.0%	19.4%	29.7%	15.9%
Federal technology program	0.6%	0.0%	0.0%	3.8%	0.0%	1.9%	0.0%	0.0%
Other public/non-profit source	4.4%	2.1%	1.5%	0.0%	1.9%	2.8%	4.0%	3.5%
Private sector	12.7%	8.3%	14.6%	13.4%	15.2%	16.6%	19.0%	7.7%
Another source	7.5%	2.2%	3.2%	2.9%	2.7%	0.0%	2.3%	6.7%
No outside assistance	47.5%	54.3%	43.0%	34.1%	46.3%	41.3%	29.7%	47.3%

Source: Georgia Manufacturing Survey 2008, weighted responses of 617 manufacturers.

Areas of Interest in Training/Technical Assistance

Half of the companies responding to the Georgia Manufacturing Survey 2008 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, marketing and sales growth, energy efficiency, safety and health, materials and waste minimization, and human resources/leadership development. Comparing these percentages to those in the 2005 survey, energy efficiency and management has attracted the greatest increase in interest. (See Figure 8.2) Lean manufacturing was also the top non-managerial interest area, followed by team and problem-solving skills, technical skills, and English-speaking skills. (See Figures 8.2 and 8.3)

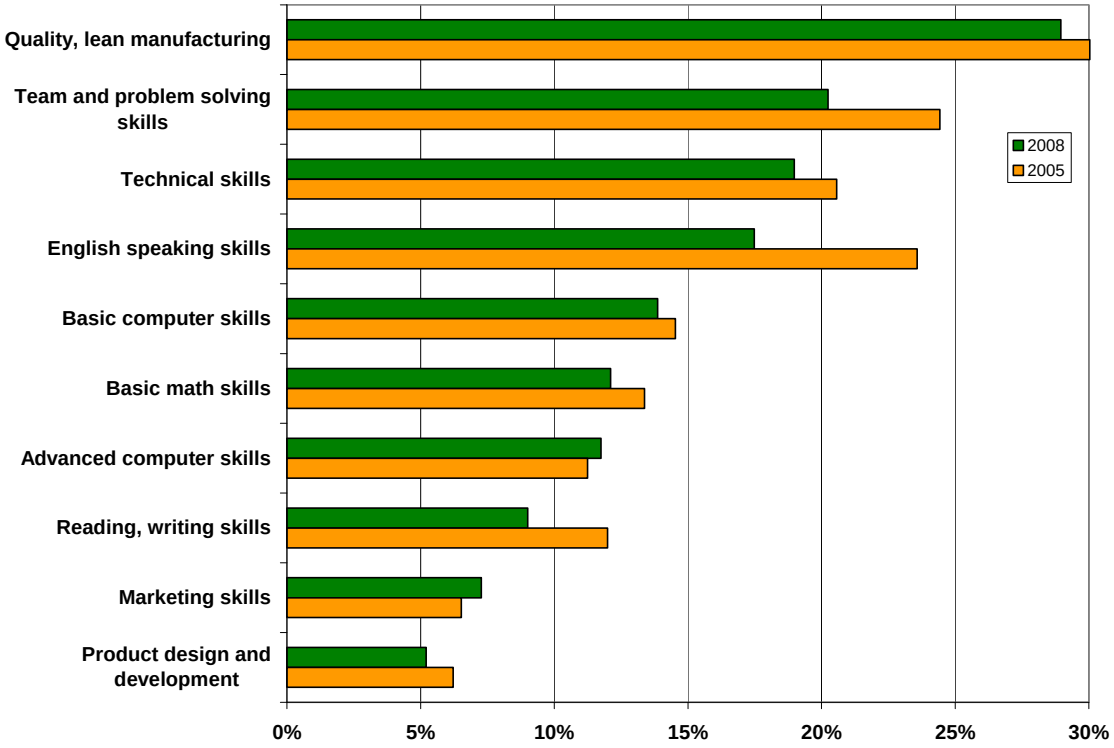
Figure 8.2. Areas of Interest for Training and Technical Assistance: Management
(Percentage of respondents indicating interest in area)



Source: Georgia Manufacturing Survey 2008, weighted responses of 384 manufacturers. Georgia Manufacturing Survey 2005, weighted responses of 393 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 2008, weighted responses of 527 manufacturers. Georgia Manufacturing Survey 2005, weighted responses of 529 manufacturers.

Managerial training and technical assistance areas of interest were stronger for large than smaller manufacturers in some areas and not so in others. Lean manufacturing, energy efficiency, safety and health, human resources, and Six sigma were more prevalent among the largest manufacturers. Interest in marketing, product development, technology assistance, and ISO 9000 were similarly prevalent among small and medium-sized manufacturers. By industry, the science-based group was more likely than the other groups to express interest in safety and health, materials and waste minimization, human resources, and supply chain management. The elec-trans group was more likely than other groups to be interested in technology assistance, product development, and Six Sigma. In general, the food-text group had relatively lower percentages of manufacturers interested in assistance across the areas referenced in the survey. We also present regional breakdowns of the percentage of manufacturers with interest in assistance these areas. In general, interest is relatively higher in the Central, Northeast, and Northwest regions and lower in the Coastal region. (See Tables 8.5a, 8.5b, 8.5c)

Non-managerial training programs attracted the highest percentage of interest among larger manufacturers in areas such as technical skills, basic math skills, and reading and writing skills. English speaking skills resonated as greater need to medium-sized manufacturers, while smaller manufacturers were relatively more likely to express a need for marketing skills. By industry, elec-

trans industry group respondents were relatively more interested in programs that advance skills in quality and lean for their non-managerial employees. The metals and machinery group had a higher percentage of respondents indicating a need for training in technical skills than did the other industry groups. Basic computer skills were especially more important in science-based industries than in the other groups. The food-text group had the lowest percentages of manufacturers indicating a need for non-managerial training. Regional differences in frequency of interest in non-managerial training programs are also presented. The level of interest in non-managerial training across region does not differ as much as was the case with managerial training. Among the most emphasized were the interest in marketing skills in the Northeast, technical skills in Atlanta, and reading and writing skills in Augusta. (See Tables 8.6a, 8.6b, 8.6c)

Table 8.5a. 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	20.1%	38.5%	46.9%	27.4%
Marketing and sales growth	24.2%	19.8%	16.1%	22.3%
Energy efficiency and management	14.0%	33.4%	45.3%	22.0%
Safety and health, ergonomics	14.6%	28.8%	39.7%	20.6%
Materials and waste minimization	14.7%	25.3%	31.0%	19.0%
Human resources, leadership development	12.7%	23.5%	39.6%	17.8%
Technology assistance	11.4%	17.1%	16.3%	13.5%
Product design and dev.	11.7%	12.9%	14.3%	12.3%
Supply chain improvement	5.8%	16.4%	21.3%	10.0%
Six Sigma	4.6%	15.2%	26.3%	9.3%
ISO9000, TS16949 quality certification	7.6%	10.5%	10.1%	8.6%
ISO14000 environmental management certification	3.4%	9.5%	11.6%	5.8%

Source: Georgia Manufacturing Survey 2008, weighted responses of 384 manufacturers.

Table 8.5b. 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	24.3%	27.7%	27.2%	30.0%	29.5%
Marketing and sales growth	15.9%	22.9%	24.9%	25.1%	20.8%
Energy efficiency and management	25.0%	22.0%	17.5%	23.7%	24.1%
Safety and health, ergonomics	14.1%	19.0%	23.6%	23.7%	32.2%
Materials and waste minimization	16.7%	20.5%	16.9%	15.8%	26.6%
Human resources, leadership development	16.7%	13.5%	20.8%	25.1%	26.9%
Technology assistance	8.9%	12.8%	15.1%	22.0%	13.0%
Product design and dev.	5.1%	13.6%	12.3%	18.9%	12.9%
Supply chain improvement	6.5%	6.9%	9.7%	20.4%	24.0%
Six Sigma	5.1%	8.5%	12.4%	16.4%	7.8%
ISO9000, TS16949 quality certification	5.1%	6.2%	13.4%	14.2%	11.8%
ISO14000 environmental management certification	1.3%	4.0%	8.1%	15.0%	9.3%

Source: Georgia Manufacturing Survey 2008, weighted responses of 384 manufacturers.

Table 8.5c. Interest in Managerial Training and Technical Assistance by Region
(Percentage of respondents indicating interest in area)

Area	Atlanta	Augusta	Central	Coastal	North-east	North-west	South	West
Lean manufacturing and process improvement	28.4%	21.1%	33.8%	20.1%	29.3%	29.9%	25.9%	18.1%
Marketing and sales growth	23.2%	21.1%	24.1%	7.3%	28.3%	24.5%	26.2%	3.8%
Energy efficiency and management	21.4%	16.6%	21.3%	8.9%	24.0%	28.2%	23.7%	17.8%
Safety and health, ergonomics	18.1%	25.8%	21.7%	14.7%	18.5%	27.5%	26.1%	12.6%
Materials and waste minimization	17.8%	15.8%	23.2%	6.5%	26.0%	20.3%	18.9%	14.0%
Human resources, leadership development	16.2%	25.5%	16.1%	11.3%	21.0%	24.3%	14.9%	8.8%
Technology assistance	15.8%	11.9%	13.1%	6.6%	13.4%	16.6%	8.0%	9.2%
Product design and dev.	15.7%	7.7%	15.1%	1.9%	18.5%	10.5%	3.9%	6.0%
Supply chain improvement	12.6%	10.0%	10.8%	0.0%	10.4%	10.7%	10.6%	0.0%
Six Sigma	8.3%	10.7%	7.1%	4.5%	13.0%	14.1%	2.8%	9.5%
ISO9000, TS16949 quality certification	11.2%	6.4%	12.8%	0.0%	7.3%	10.3%	2.9%	6.2%
ISO14000 environmental management certification	6.8%	8.1%	6.7%	1.9%	6.8%	5.1%	4.3%	2.1%

Source: Georgia Manufacturing Survey 2008, weighted responses of 384 manufacturers.

Table 8.6a. 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%	41.0%	42.0%	29.0%
Team and problem solving skills	12.0%	34.0%	34.0%	20.0%
English speaking skills	13.0%	25.0%	45.0%	19.0%
Technical skills	14.0%	25.0%	19.0%	17.0%
Basic computer skills	9.0%	21.0%	26.0%	14.0%
Basic math skills	8.0%	16.0%	30.0%	12.0%
Reading, writing skills	11.0%	13.0%	12.0%	12.0%
Advanced computer skills	7.0%	12.0%	18.0%	9.0%
Marketing skills	8.0%	6.0%	3.0%	7.0%
Product design and development	5.0%	5.0%	5.0%	5.0%

Source: Georgia Manufacturing Survey 2008, weighted responses of 527 manufacturers.

Table 8.6b. 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	19.3%	29.0%	32.3%	36.3%	30.9%
Team and problem solving skills	15.9%	19.2%	21.1%	25.4%	27.0%
English speaking skills	14.1%	16.3%	30.6%	19.7%	16.3%
Technical skills	19.2%	20.1%	13.4%	15.9%	13.3%
Basic computer skills	15.5%	11.8%	12.0%	14.9%	25.6%
Basic math skills	11.5%	11.8%	13.2%	9.5%	16.1%
Reading, writing skills	9.0%	11.6%	13.0%	10.9%	17.3%
Advanced computer skills	5.8%	10.2%	11.0%	4.7%	10.7%
Marketing skills	3.8%	6.5%	10.1%	9.4%	10.2%
Product design and development	2.6%	4.4%	6.1%	10.3%	7.8%

Source: Georgia Manufacturing Survey 2008, weighted responses of 527 manufacturers.

Table 8.6c. Interest in Non-managerial Training and Technical Assistance by Region
(percentage of respondents indicating interest in area)

Area	Atlanta	Augusta	Central	Coastal	North-east	North-west	South	West
Quality, lean manufacturing	34.6%	18.9%	27.0%	27.9%	32.2%	26.7%	22.0%	19.9%
Team and problem solving skills	19.4%	23.2%	23.5%	12.7%	26.6%	19.3%	18.6%	14.3%

English speaking skills	18.4%	24.5%	13.5%	21.7%	20.8%	19.6%	22.1%	11.9%
Technical skills	24.3%	4.9%	7.9%	5.7%	15.1%	18.3%	18.0%	15.7%
Basic computer skills	12.4%	23.2%	11.5%	7.0%	13.6%	18.4%	14.5%	10.9%
Basic math skills	11.3%	11.1%	17.8%	13.3%	11.4%	14.4%	12.5%	5.1%
Reading, writing skills	14.1%	18.1%	10.2%	5.1%	11.0%	11.6%	9.0%	7.7%
Advanced computer skills	9.7%	4.5%	9.6%	2.9%	11.0%	10.6%	9.3%	4.5%
Marketing skills	8.7%	0.0%	6.8%	0.0%	15.3%	6.5%	4.6%	0.0%
Product design and development	7.4%	1.7%	2.9%	4.7%	5.2%	5.8%	1.6%	3.9%

Source: Georgia Manufacturing Survey 2008, weighted responses of 527 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 2005-to-2007 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 2005 to 2007(logged), as a function of receiving Georgia Tech services. We controlled for an array of facility characteristics, including:

- facility employment growth 2005-2007 (logged)
- change in capital intensity, i.e., the capital/labor ratio 2005-2007 (logged)
- industry classification (dummy variables)

This model was estimated using ordinary least squares. Table 8.7 presents the results. Georgia Tech assistance is positively and significantly linked to

[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).

productivity growth. Over the study period, Georgia Tech clients experienced a 12 percent increase in value-added per employee over non-clients.

Table 8.7. Productivity is Significantly Higher for Georgia Tech Clients Than for Non-clients.
(Ordinary Least Squares – Value-Added per Employee Change 2005-2007)

Variables	OLS	Instrumental Variable Regression
Received assistance from Georgia Tech	0.12 (0.06)*	0.32 (0.19)*
Change in employment 2005-7 logged	0.03 (0.10)	0.13 (0.10)
Change in capital/labor 2005-7 logged (capital intensity)	1.09 (0.18)***	1.33 (0.12)***
Industry dummies	Generally not significant	Not significant
Constant	-0.08 (0.07)	-0.07 (0.09)
Observations	475	347
R-squared	0.44	0.57

Dependent variable is the log of value-added per employee in 2007 – log of value added per employee in 2005. Robust standard errors in parentheses
* Significant at 10%; ** Significant at 5%; *** Significant at 1%

Source: Georgia Manufacturing Survey 2008.

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. The model uses a selection equation similar to what Jarmin used as follows:

Georgia Tech assistance = f(interest in technical assistance, log of change in employment, log of change in capital/labor, location in urban area, part of a multi-unit enterprise, age, initial productivity level logged, initial capital intensity level logged, size dummies, industry dummies)

Interest in business assistance is the instrument used in this equation. Interest can be considered a precursor to use of service and, indeed, this variable is modestly correlated with use of Georgia Tech assistance (tetrachoric r=.42).[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 (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 modified and extended beyond the notion of "bricks and mortar." A separate Probit analysis of the selection equation suggests that interest is positively and significantly associated with use of Georgia Tech assistance (p<.001).

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 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.

NAICS-Based Industries	# respon dents	Modified Pavitt Taxonomy	GMS 2008 grouping	Median Employ-ment	Mean # Scientists, Engineers
Food – 311,2	52	Supplier dominated	Food-text	97	10

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

Textiles – 313,4	77	Supplier dominated	Food-text	60	9
Apparel – 315,6	14	Supplier dominated	Food-text	35	1
Wood – 321	93	Supplier dominated	Materials	26	5
Furniture – 337	33	Supplier dominated	Materials	30	12
Paper – 322	32	Supplier dominated	Materials	63	10
Printing – 323	29	Supplier dominated	Materials	25	8
Chemicals – 324,5	72	Science-based	Science	34	18
Plastics – 326	65	Supplier dominated	Materials	50	13
Nonmetallic– 327	37	Scale intensive	Materials	25	367
Prim. Metals–331	17	Multiple	Mach.	35	39
Fab. Metals–332	155	Specialized suppliers	Mach.	28	14
Machinery–333	53	Specialized suppliers	Mach.	26	21
Computer–334	12	Science-based	Elec-trans	22	64
Electrical–335	27	Science-based	Elec-trans	44	15
Transportation–336	24	Scale intensive	Elec-trans	52	18
Medical supply–3391	9	Science-based	Science	21	32
Misc	3	Supplier dominated	Materials	17	4

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 from Dun & Bradstreet's Market Place database. This list of companies was cleaned of duplicates, out-of-state companies, and insufficient addresses. Further refinement was provided by a process of calling these companies that took place through the Georgia Tech Business and Industry Services marketing function. Companies that had moved or had an undeliverable address were removed from the list. This process resulted in 4,469 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 2008 survey specifically focused on two areas: (1) innovation, and (2) sustainable manufacturing practices.

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 the manufacturers and EDI field staff and executives were incorporated into a final version presented in Appendix 2.

Administration

The survey was conducted from May 2008 to August 2008 using three 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 4,469 manufacturing establishments. Similar second and third follow-up mailings were sent. This entire process yielded a total response of 804 surveys.[11]

The response to the survey was as follows:

Companies in initial database	5,193
Wrong address/undeliverable, out of business, not a manufacturer	724
Total surveys delivered to active manufacturers	4,469
Declared refusals	5
Non-respondents	3,665
Total surveys received	804
Respondents with less than 10 employees	66
Complete surveys with manufacturers having 10+ employees	738
Response rate	18%

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 (804) was divided by the total number of manufacturing establishments, established as legitimate, in the target population (4,469). The response rate was 18 percent. Our analysis focuses only in those establishments with 10 or more employees (738).

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

[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.

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 4,510 establishments was used to calculate these weights. Note that Table 1.1 has a total survey response of 738. 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 (2007) vs. Survey Respondents

	GA Dept. of Labor		Georgia Survey	
	# estab.	% estab.	# estab.	% estab.
Industry Group				
Food-text	821	18%	136	18%
Materials	1,988	44%	268	36%
Mach	900	20%	201	27%
IT-Trans	419	9%	58	8%
Science	382	8%	75	10%
Employment				
10-19	1,471	33%	168	23%
20-99	2,110	47%	384	52%
100+	929	21%	186	25%

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 66 percent rate for return on sales may reflect a preference not to disclose this information, whereas the 73 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 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).

[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.

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 2008 Georgia Manufacturing Survey

Georgia Tech is conducting this survey 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 and 2005. We appreciate your cooperation in making the 2008 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 them.
- Survey questions refer to this facility or plant.
- Web-based survey is available at www.cherry.gatech.edu/survey

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

Jan Youtie
GMS 2008 – EII Project Number [ID]
Enterprise Innovation Institute
Georgia Institute of Technology
Atlanta, Georgia 30332-0640

Questions about the survey?

Telephone: (404) 894-6111 Fax: (404) 894-1447
e-mail: gms2008@innovate.gatech.edu www.cherry.gatech.edu/survey

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
Center for Paper and Business Industry Studies

Georgia Department of Labor

QUICKSTART **Georgia Department of Technical and Adult Education**

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 _____(US state) or _____ (country outside of the U.S.)

1.2. At what year did you begin manufacturing at this facility? ☐

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

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

_____

1.4. 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 market place 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
- ☐ Customer service that adds value to products/processes (i.e., training, consulting)

1.5. In which of the following areas does your facility have the most significant problems or needs? (*Check all boxes 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
- ❑ Water resource management
- ❑ Environmental compliance and improvement
- ❑ Safety compliance, health, workplace environment
- ❑ Other (please describe)

_____

2. PRODUCT, PROCESS AND ORGANIZATIONAL INNOVATION

2.1. **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.*

During the period 2005-2007, did your facility introduce: ***(please check if yes)***

- ❑ New or significantly improved goods (exclude resale of goods purchased elsewhere or changes to color or look)
- ❑ New or significantly improved services

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 2005-2007 *(check all that apply)*

- ❑ **New to your market?** (introduced before your competitors)
- ❑ **New only to your facility?** (already available from your competitors)

2.3 Using the definitions above, please give the percentage of your total sales from goods and services introduced during the period 2005 to 2007.

Sales from good and services that were **new to your market**	%
Sales from good and services that were **new to your firm**, but NOT to your market	%
Sales from existing products	%
	100 %

2.4. **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.*

During the period 2005-2007, did your facility introduce: *(please check if yes)*

- ❑ Any new or significantly improved process or manufacturing technology
- ❑ Any new or significantly improved logistics, delivery, or distribution method
- ❑ Other processes not covered above, such as new or significantly improved purchasing, accounting, or maintenance processes

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

During the period 2005-2007, did your facility engage in any of the following organizational innovation activities?

- ❑ Implement new or significantly improved management systems to better use or exchange information, knowledge and skills
- ❑ Make a major change to the organization of work, such as changes in management or departmental structure
- ❑ New or significant changes in your relations with other firms, such as alliances, partnerships, outsourcing, or subcontracting

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

During the period 2005-2007, 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)
- ❑ New or significant changes to sales methods or distribution channels, such as Internet sales, franchising, direct sales or distribution licenses

2.7. **During the period 2005-2007, did your facility engage in any of the following innovation-related activities?** (*check all boxes that apply)*

- ❑ In-house R&D (to increase knowledge or devise innovations, including software research)
- ❑ Purchase R&D from research organizations or other branches of your company
- ❑ Purchase 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 staff to develop or introduce innovations
- ❑ Market research, advertising, and other marketing activities linked to implementing an innovation

2.8. **Please estimate your expenditures for the following innovation activities over the last 12 months.** (Include personnel and related costs). *Insert zero if your facility had no expenditures in the last 12 months in these categories.*

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 2005-2007, 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
- ❑ Staff published one or more papers or technical articles (in journals or conference proceedings)

2.10. **During the period 2005-2007, did your facility receive any public or private financial support for innovation activities?**

- ❑ Public support (tax credits, loans, grants from the national, state, or local government)
- ❑ Private support (venture capital, angel funding, bank loans)

2.11. **If you undertook any innovations in the period 2005-2007, what was the degree of impact of the innovations in each of the following areas?**	**Degree of Impact from Innovation**			
	High	Medium	Low	Not Relevant
Increased variety of goods or services	❑	❑	❑	❑
Increased market share or entered new markets	❑	❑	❑	❑
Improved quality of goods or services	❑	❑	❑	❑
Reduced time to respond to customer needs	❑	❑	❑	❑
Improved flexibility of production or service provision	❑	❑	❑	❑
Increased capacity of production or service provision	❑	❑	❑	❑
Reduced labor costs per unit output	❑	❑	❑	❑
Reduced materials and energy required per unit output	❑	❑	❑	❑
Reduced environmental impacts/improved health & safety	❑	❑	❑	❑
Met regulatory requirements	❑	❑	❑	❑
Improved employee satisfaction/reduced worker turnover	❑	❑	❑	❑

PLEASE ANSWER Q. 2.12., WHETHER YOU DID OR DID NOT UNDERTAKE INNOVATIVE ACTIVITIES

2.12. **During 2005-2007, how important were the following factors in limiting your ability to innovate?**	**Degree of Impact on Innovation**			
	High	Medium	Low	Not experienced
Lack of qualified personnel	❑	❑	❑	❑
Lack of information on technology	❑	❑	❑	❑
Lack of information on markets	❑	❑	❑	❑
Difficulty finding partners	❑	❑	❑	❑
Market dominated by established companies	❑	❑	❑	❑
Uncertain demand for innovative goods or services	❑	❑	❑	❑
No need due to prior innovations	❑	❑	❑	❑
Lack of funds, costs too high	❑	❑	❑	❑

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 social, environmental and cost-savings benefits.

3.1. Please can you indicate whether you use or plan to use technologies or techniques to improve the sustainability of the manufacturing processes at this facility in the following areas. (Check one option for each item.)

	Use Now	*Plan to use in next 2 years*	*No plan to use*	*Not applicable*
Supplier selection (good sustainability performance, practice)	❑	❑	❑	❑
Selection of raw materials (lead-free, lower toxicity materials)	❑	❑	❑	❑
Extraction and processing of raw materials	❑	❑	❑	❑
Product design (design to reduce resource use)	❑	❑	❑	❑
Design of manufacturing processes (waste reduction)	❑	❑	❑	❑
Facility design/planning (e.g., for energy efficiency)	❑	❑	❑	❑
Packaging (reduction, reusability)	❑	❑	❑	❑
Marketing (green branding, eco labeling)	❑	❑	❑	❑
Employee training in sustainability practices	❑	❑	❑	❑
Logistics, transportation services (for emission reduction)	❑	❑	❑	❑
Use, reuse and maintenance of product	❑	❑	❑	❑
End of life (take back, recycling, disposal)	❑	❑	❑	❑

3.2. Do you use any alternative energy sources at this facility?

❑ **No** (*skip to Question 3.3)*

❑ **Yes**→Which of the following alternative fuels are used at your facility? (Please check all that apply)

- ❑ Biofuels (e.g. ethanol, biodiesel, etc)
- ❑ Biomass (e.g. wood or agricultural waste, byproducts)
- ❑ Solar power
- ❑ Wind power
- ❑ Landfill gas
- ❑ Other (please describe)

3.3. Has this facility set targets to reduce the amount of energy used by this facility?

❑ **No** (*skip to Question 3.4)*

❑ **Yes**→If this facility has energy use reduction targets. Please indicate targeted percentage of reduction for the following time-frames (Please estimate if necessary):

Targeted reduction for 2008	Targeted reduction for Next 2 years	Targeted reduction for Next 5 years	Targeted reduction for Next 10 years
%	%	%	%

3.4. Which of the following sustainability management activities are currently used at your facility? If not currently used, please indicate whether there are any plans for use. Check one option for each item.

	Use Now	*Plan to use in next 2 years*	*No plan to use*	*Not applicable*
High efficiency lighting	❑	❑	❑	❑
Water recycling	❑	❑	❑	❑
Energy audits	❑	❑	❑	❑
Recycling of production materials	❑	❑	❑	❑
ISO 14000 practices	❑	❑	❑	❑
Life cycle costing	❑	❑	❑	❑
US EPA or other federal program (e.g. Energy Star)	❑	❑	❑	❑
Sustainability program for environmental stewardship	❑	❑	❑	❑

3.5. Have you used any of the following sources of information and knowledge in the last two years to develop your sustainability management practices? *(Check all that apply)*

❑	Internal energy or environmental manager at this facility
❑	Other existing staff at this facility
❑	Other units in the enterprise group – subsidiaries, branches, affiliates
❑	Suppliers (e.g. materials, components, equipment, software)
❑	Customers, clients or users
❑	Competitors
❑	External consultants
❑	R&D labs, universities, government research organizations, public business assistance, technical or training centers
❑	Trade associations, other business organizations
❑	Conferences, seminars or technical meetings
❑	Printed journals, technical papers
❑	Online information sources

4. MANUFACTURING PRODUCTION AND PERFORMANCE

4.1. For the following questions, use approximate numbers or give an estimate. Answers can be rounded.

All estimates should be for this facility.	**2007**	**2005**
What were your **total annual sales or gross value** of shipments at this plant in fiscal year 2007? In 2005?	$	$
Approximately how much did you spend at this location on purchased materials, parts, and services (i.e. **cost of goods**) in fiscal year 2007? In 2005?	$	$
What were your **energy expenditures** (e.g. heat, electricity) in fiscal year 2007? In 2005?		
Approximately how much **new capital investment** was made at this location, including facility, equipment, machinery, and information systems in fiscal year 2007? In 2005?	$	$

	2007	**2005**
What was the approximate percentage of your facility's sales exported outside of the United States (by value)	%	%
What was the approximate percentage of your facility's purchases of materials, parts, and services imported or acquired from sources outside of the United States (by value)	%	%

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

← 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 moved <u>from Georgia</u> 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 <u>back to Georgia</u> from:*	❑Elsewhere in USA	❑Mexico, other Central or South America	❑Asia (including China, India)	❑Europe	❑Elsewhere in world	

4.4. Does this facility have a continuous improvement program?

❑ **No** (*skip to Question 5.1)*

❑ **Yes** → If you have a continuous improvement program, do you use any of the following? (*check all that apply*)

- ❑ Lean manufacturing
- ❑ Quality systems, techniques (e.g., Six Sigma)
- ❑ Quality management (e.g., ISO 9000)

5. WORKFORCE AND TRAINING

5.1. Now, we would like to ask a few questions about your work force. If you don't know exact numbers, just give an estimate.

	2007	**2005**
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
What was your total payroll at this location in fiscal year 2007? In 2005? (Please include direct payroll plus indirect fringe benefit payroll expenses. Include payments to agencies for temporary workers.)	Payroll $	Payroll $

5.2. On average in 2007, what percentage of your workers used

a. A computer or programmable controller at least once a week as part of their job? ____ %

b. Internet at least once a week as part of their job? ____ %

5.3. In 2007, what percentage of employees at this facility had at least the following training or educational qualification:

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.) or higher graduate degrees? ____

➥ Of these, how many majored in science, engineering or information technology? ____

5.4. In total, approximately how much did your company spend on all training activities in fiscal year 2007? $ ____

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

5.5. What percentage of employees in production work are in teams (i.e. 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)
- ❑ Other university (not Georgia Tech)
- ❑ Small Business Development Centers
- ❑ Technical college (Georgia Department of Technical and Adult Education, 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 non-profit business assistant source
- ❑ A private-sector business assistance source, such as a private consultant, 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 assistance
- ❑ Marketing and sales growth
- ❑ Lean manufacturing and process improvement
- ❑ Supply chain improvement
- ❑ ISO 9000, TS 16949 quality certification
- ❑ Six Sigma
- ❑ ISO 14000 environmental management certification
- ❑ Human resources, leadership development
- ❑ Safety & 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 more training of employees in that category, but it 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, email)
- ❑ Advanced computer skills (e.g., database, ERP, Web design)
- ❑ Other topics *(please describe)*_____

_____

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

❑ **Please check this box to receive information about Georgia Tech's services, seminars, and workshops.**

Appendix
3

Manufacturer Responses by Survey Question

(Total respondents as of 10/01/2008 is 738)

1. Facility-Industry and Needs

1.1. This facility is	
Single establishment enterprise	63.0%
An affiliate of a parent group or holding company	37.0%
	100.0%
Total respondents	719
1.1a. Is your company's head office located in Georgia	
Yes	37.2%
No	62.8%
	100.0%
Total respondents	281
1.1b. Head office located in	
another U.S. state	23.0%
country outside of the U.S.	4.7%
Total respondents	302
1.2. At what year did you begin manufacturing at this facility	
2005-	4.8%
2000-2004	13.8%
1990-1999	27.2%
1980-1989	22.3%
1970-1979	14.0%
1960-1969	8.7%
1950-1959	5.0%
Before 1950	4.3%
	100.0%
Total respondents	687
1.3. Your facility's main product or manufacturing activity is:	
Food beverages, feed	6.6%
Textiles	9.7%
Apparel,leather	1.8%
Lumber and wood, except furniture	13.3%

Furniture (wood or metal)	5.2%
Pulp Paper and paper products	4.7%
Printing and publishing	4.4%
Chemical, petroleum, coal & allied products	7.5%
Plastics or Rubber	9.8%
Stone, clay, glass or concrete	6.1%
Primary metals (iron, steel, nonferrous)	1.5%
Fabricated metals	13.3%
Machinery (industry, nonindustrial)	5.2%
Computer and electronic products, Instruments	1.7%
Electrical equipment, appliances, or components	4.2%
Transportation equipment	3.4%
Medical or laboratory supplies	1.0%
Other (please describe)	0.7%
	100.0%
Total respondents	738

1.4. Rank order of importance of the following factors facility competition for sales (percent ranking factor #1)	%#1 Rank
Low price	19.2%
High quality	52.7%
Innovation/new technology	9.4%
Quick delivery	11.8%
Adapting product to customer needs	15.5%
Customer service that adds value to products/processes	12.5%

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

Expansion planning, facility layout	17.6%
Lean manufacturing and workflow improvement	32.3%
Quality assurance (e.g., ISO 9000, QS-9000, Six Sigma)	17.1%
Product development/design	15.5%
Marketing and sales	32.9%
Information systems and hardware	10.7%
Business strategy, financial analysis, competitiveness planning	13.0%
Basic workforce skills (e.g., reading, writing, math, keyboard skills)	21.9%
Technical skills (e.g., machining, electrical work)	23.8%
Management and leadership	12.6%
Energy cost management	23.2%
Water resource management	5.1%
Environmental compliance and improvement	8.7%
Safety compliance, health, workplace environment	13.3%
Other (please describe)	7.7%
Total respondents	677

2. Product, Process and Organizational Innovation

2.1. During the period 2005-2007, did your facility introduce:

New or significantly improved goods	47.6%
New or significantly improved services	18.3%
Total respondents	414

2.2. Were any of your goods and service innovations during 2005-2007

New to your market? (introduced before your competitors)	29.5%
New only to your facility? (already available from your competitors)	28.7%
Total respondents	386

2.3. Please give the percentage of your total sales from goods and services introduced during the period 2005 to 2007.

2.3a Sales from goods and services that were **new to your market**

0 - 5.0%	44.1%
5.1 - 10.0%	17.6%
10.1 - 15.0%	8.7%
15.1 - 20.0%	14.0%
20.1% +	15.6%
	100.0%
Total respondents	326

2.3b Sales from goods and services that were **new to your firm**, but NOT to your market

0 - 5.0%	35.9%
5.1 - 10.0%	19.7%
10.1 - 15.0%	9.6%
15.1 - 20.0%	10.9%
20.1% +	23.9%
	100.0%
Total respondents	323

2.3c Sales from existing products

0 - 5.0%	0.8%
5.1 - 10.0%	1.3%
10.1 - 15.0%	0.0%
15.1 - 20.0%	1.1%
20.1% +	96.8%
	100.0%
Total respondents	389

2.4. During the period 2005-2007, did your facility introduce: (please check if yes)

Any new or significantly improved process or manufacturing technology	39.1%
Any new or significantly improved logistics, delivery, or distribution method	9.7%

Other processes not covered above, such as new or significantly improved purchasing, accounting, or maintenance processes	10.6%
Total respondents	391

2.5. During the period 2005-2007, did your facility engage in any of the following organizational innovation activities?

Implement new or significantly improved management systems to better use or exchange information, knowledge and skills	23.0%
Make a major change to the organization of work, such as changes in management or departmental structure	31.4%
New or significant changes in your relations with other firms, such as alliances, partnerships, outsourcing, or subcontracting	19.8%
Total respondents	395

2.6. During the period 2005-2007, 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)	13.1%
New or significant changes to sales methods or distribution channels, such as Internet sales, franchising, direct sales or distribution licenses	19.0%
Total respondents	203

2.7. During the period 2005-2007, 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)	29.7%
Purchase R&D from research organizations or other branches of your company	5.7%
Purchase machinery, equipment, computers or software to implement innovations	53.3%
Planning, engineering, design, or other development work to implement an innovation	29.3%
Purchase or license patents, inventions, know-how, or other types of knowledge to implement an innovation	8.1%
Training staff to develop or introduce innovations	22.7%
Market research, advertising, and other marketing activities linked to implementing an innovation	16.0%
Total respondents	531

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)	
0 - 50,000	62.5%

50,001 - 100,000	11.4%
100,001 - 500,000	17.6%
500,001+	8.4%
Mean In-house R&D	$ 287,532
Median In-house R&D	$ 25,000
In-house R&D of Top 10%	$ 500,000
Mean In-house R&D/employee	$ 3,816
Median In-house R&D/employee	$ 500
In-house R&D of Bottom 10%	$ 0
In-house R&D/employee of Top 10%	$ 7,159
In-house R&D/employee of Bottom 10%	$ 0
Total respondents	409

2.8b Acquisition of external R&D

0 - 10,000	87.1%
10,001 -25,000	2.8%
25,001 - 100,000	5.7%
100,001+	4.4%
Mean external R&D	$ 24,642
Median external R&D	$ 0
External R&D of Top 10%	$ 37,800
External R&D of Bottom 10%	$ 0
Total respondents	294

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

0 - 25,000	42.7%
25,001 -100,000	20.9%
100,001 - 500,000	19.7%
500,001+	16.8%
Mean acquisition of machinery, equipment and software	$ 653,757
Median acquisition of machinery, equipment and software	$ 52,500
Acquisition of machinery, equipment and software of Top 10%	$ 1,500,000
Acquisition of machinery, equipment and software of Bottom 10%	$ 0
Total respondents	476

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

0 - 10,000	73.5%
10,001 -25,000	7.9%
25,001 - 100,000	9.9%
100,001+	8.6%
Mean other development work	$ 54,667
Median other development work	$ 0
Other development work of Top 10%	$ 100,000
Other development work of Bottom 10%	$ 0
Total respondents	320

2.8e Total (sum of above 4 categories)

0 - 50,000	42.2%
50,001 - 100,000	12.4%
100,001 - 500,000	24.7%
500,001+	22.6%
Mean Total	$ 833,532
Median Total	$ 100,000
Total of Top 10%	$ 2,000,000
Mean Total/employee	$ 10,113
Median Total/employee	$ 2,305
Total of Bottom 10%	$ 0
Total/employee of Top 10%	$ 20,919
Total/employee of Bottom 10%	$ 0
Total respondents	530

2.9. During the period 2005-2007, check if your facility

Ever worked with customers to create or design a product, process or other innovation	60.2%
Ever worked with suppliers to create or design a product, process or other innovation	42.4%
Applied for a patent or registered an industrial design	13.7%
Registered a trademark or assumed a copyright	12.9%
Signed a confidentiality agreement	40.3%
Staff published one or more papers or technical articles (in journals or conference proceedings)	7.2%
Total respondents	550

2.10. During the period 2005-2007, did you receive for innovation activities from

Public support (tax credits, loans, grants from government)	5.2%
Private support (venture capital, angel funding, bank loans)	12.4%
Total respondents	127

2.11. If you undertook any innovations in the period 2005-2007, what was the degree of impact on this facility in each of the following areas?

	% High importance
Increased variety of goods or services	27.7%
Increased market share or entered new markets	19.1%
Improved quality of goods or services	22.5%
Reduced time to respond to customer needs	20.5%
Improved flexibility of production or service provision	16.1%
Increased capacity of production or service provision	26.3%
Reduced labor costs per unit output	20.8%
Reduced materials and energy required per unit output	11.1%
Reduced environmental impacts/improved health & safety	12.8%
Met regulatory requirements	18.4%

Improved employee satisfaction/reduced worker turnover	13.4%

2.12. During 2005-2007, how important were the following factors in limiting innovation activities or influencing a decision not to innovate?

	% High importance
Lack of qualified personnel	20.6%
Lack of information on technology	5.2%
Lack of information on markets	8.5%
Difficulty finding partners	3.9%
Market dominated by established companies	12.9%
Uncertain demand for innovative goods or services	9.9%
No need due to prior innovations	5.3%
Lack of funds, costs too high	18.4%

3. Sustainable manufacturing

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

	% use now
Supplier selection (good sustainability performance, practice)	56.5%
Selection of raw materials (lead-free, lower toxicity materials)	50.2%
Extraction and processing of raw materials	26.8%
Product design (design to reduce resource use)	39.8%
Design of manufacturing processes (waste reduction)	59.8%
Facility design/planning (e.g., for energy efficiency)	36.2%
Packaging (reduction, reusability)	38.7%
Marketing (green branding, eco labeling)	22.0%
Employee training in sustainability practices	37.2%
Logistics, transportation services (for emission reduction)	25.9%
Use, reuse and maintenance of product	41.7%
End of life (take back, recycling, disposal)	41.2%
Total respondents	362

3.1a. Supplier selection (good sustainability performance, practice)

Used Now	56.5%
Plan to Use in next 2 years	9.6%
No Plan to use	17.7%
Not applicable	16.3%
	100.0%
Total Respondents	637

3.1b. Selection of raw materials (lead-free, lower toxicity materials)

Used Now	50.2%
Plan to Use in next 2 years	6.6%

No Plan to use	14.5%
Not applicable	28.6%
	100.0%
Total Respondents	644

3.1c. Extraction and processing of raw materials

Used Now	26.8%
Plan to Use in next 2 years	5.7%
No Plan to use	19.2%
Not applicable	48.2%
	100.0%
Total Respondents	614

3.1d. Product design (design to reduce resource use)

Used Now	39.8%
Plan to Use in next 2 years	16.4%
No Plan to use	17.0%
Not applicable	26.9%
	100.0%
Total Respondents	623

3.1e. Design of manufacturing processes (waste reduction)

Used Now	59.8%
Plan to Use in next 2 years	16.4%
No Plan to use	11.3%
Not applicable	12.5%
	100.0%
Total Respondents	643

3.1f. Facility design/planning (e.g., for energy efficiency)

Used Now	36.2%
Plan to Use in next 2 years	26.9%
No Plan to use	21.1%
Not applicable	15.8%
	100.0%
Total Respondents	626

3.1g. Packaging (reduction, reusability)

Used Now	38.7%
Plan to Use in next 2 years	16.2%
No Plan to use	18.1%
Not applicable	27.0%
	100.0%
Total Respondents	628

3.1h. Marketing (green branding, eco labeling)

Used Now	22.0%
Plan to Use in next 2 years	21.5%

No Plan to use	25.0%
Not applicable	31.5%
	100.0%
Total Respondents	619

3.1i. Employee training in sustainability practices

Used Now	37.2%
Plan to Use in next 2 years	22.7%
No Plan to use	22.5%
Not applicable	17.7%
	100.0%
Total Respondents	638

3.1j. Logistics, transportation services (for emission reduction)

Used Now	25.9%
Plan to Use in next 2 years	15.6%
No Plan to use	32.9%
Not applicable	25.5%
	100.0%
Total Respondents	623

3.1k. Use, reuse and maintenance of product

Used Now	41.7%
Plan to Use in next 2 years	11.3%
No Plan to use	19.3%
Not applicable	27.8%
	100.0%
Total Respondents	629

3.1i. End of life (take back, recycling, disposal)

Used Now	41.2%
Plan to Use in next 2 years	6.7%
No Plan to use	21.2%
Not applicable	31.0%
	100.0%
Total Respondents	638

3.2. Alternative energy sources at this facility

Yes	4.2%
No	95.8%
Total respondents	708

3.2c to 3.2oth. Use any of these alternative energy sources

Biofuels (e.g. ethanol, biodiesel, etc)	1.1%
Biomass (e.g. wood or agricultural waste, byproducts)	2.4%
Solar power	0.4%

Wind power	0.1%
Landfill gas	0.1%
Other (please describe)	0.8%
Total respondents	31

3.3. Has the facility set targets to reduce the amount of energy used?

Yes	17.8%
No	82.2%
Total respondents	704

3.3b to 3.3e. Please indicate the targeted reduction for the following time-frames

Targeted reduction for 2008	
0%	0.8%
1 - 9%	49.8%
10% +	49.4%
Targeted reduction for Next 2 years	
0%	0%
1 - 9%	29.7%
10% +	70.3%
Targeted reduction for next 5 years	
0%	1.9%
1 - 9%	18.5%
10% +	79.6%
Targeted reduction for next 10 years	
0%	2.2%
1 - 9%	15.6%
10% +	82.2%
Total respondents	122

3.4. Which of the following sustainability management activities are used at this facility?

	% use now
High efficiency lighting	48.3%
Water recycling	22.0%
Energy audits	23.3%
Recycling of production materials	62.9%
ISO 14000 practices	8.2%
Life cycle costing	7.8%
US EPA or other federal program (e.g. Energy Star)	10.6%
Sustainability program for environmental stewardship	19.7%
Total respondents	693

3.4a. High efficiency lighting	
Used Now	48.3%
Plan to Use in next 2 years	19.7%
No Plan to use	22.6%
Not applicable	9.3%
	100.0%
Total Respondents	668
3.4b. Water recycling	
Used Now	22.0%
Plan to Use in next 2 years	8.4%
No Plan to use	35.1%
Not applicable	34.5%
	100.0%
Total Respondents	653
3.4c. Energy audits	
Used Now	23.3%
Plan to Use in next 2 years	18.7%
No Plan to use	38.8%
Not applicable	19.2%
	100.0%
Total Respondents	651
3.4d. Recycling of production materials	
Used Now	62.9%
Plan to Use in next 2 years	5.8%
No Plan to use	13.4%
Not applicable	17.9%
	100.0%
Total Respondents	662
3.4e. ISO 14000 practices	
Used Now	8.2%
Plan to Use in next 2 years	10.5%
No Plan to use	46.1%
Not applicable	35.2%
	100.0%
Total Respondents	624
3.4f. Life cycle costing	
Used Now	7.8%
Plan to Use in next 2 years	9.7%
No Plan to use	46.3%
Not applicable	36.2%
	100.0%
Total Respondents	625

3.4g. US EPA or other federal program (e.g. Energy Star)

Used Now	10.6%
Plan to Use in next 2 years	8.1%
No Plan to use	47.9%
Not applicable	33.4%
	100.0%
Total Respondents	625

3.4h. Sustainability program for environmental stewardship

Used Now	19.7%
Plan to Use in next 2 years	14.7%
No Plan to use	37.3%
Not applicable	28.3%
	100.0%
Total Respondents	638

3.5. Have you used any of the following sources of knowledge in the last two years to develop sustainability management practices?

Internal energy or environmental manager at this facility	15.1%
Other existing staff at this facility	20.9%
Other units in the enterprise group – subsidiaries, branches, affiliates	12.2%
Suppliers (e.g. materials, components, equipment, software)	35.5%
Customers, clients or users	23.8%
Competitors	10.4%
External consultants	16.5%
R&D labs, universities, government research organizations, public business assistance, technical or training centers	11.6%
Trade associations, other business organizations	28.1%
Conferences, seminars or technical meetings	23.9%
Printed journals, technical papers	24.3%
Online information sources	30.6%
Total respondents	485

4. Manufacturing Production and Performance

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

	2007	**2005**
0 - 1,000,000	8.5%	11.4%
1,000,001 - 10,000,000	54.6%	54.4%
10,000,001 - 20,000,000	11.5%	10.5%

20,000,001 +	25.5%	23.7%
Mean sales	$ 60,325,954	$ 57,265,017
Median sales	$ 7,577,000	$ 6,599,863
Sales of Top 10%	$ 66,190,000	$ 60,000,000
Sales of Bottom 10%	$ 1,260,248	$ 1,200,000
Mean sales/employee	$ 337,588	$ 264,498
Median sales/employee	$ 169,566	$ 133,929
Sales/employee of Top 10%	$ 623,832	$ 525,072
Sales/employee of Bottom 10%	$ 69,871	$ 6,287
Total Respondents	574	561

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

	2007	**2005**
0 - 1,000,000	25.4%	31.5%
1,000,001 - 10,000,000	45.6%	42.1%
10,000,001 - 20,000,000	11.2%	10.0%
20,000,001 +	17.8%	16.4%
Mean spending on direct inputs	$ 31,371,888	$ 31,276,030
Median spending on direct inputs	$ 4,445,940	$ 3,400,000
Spending on direct inputs of Top 10%	$ 40,000,000	$ 42,600,000
Spending on direct inputs of Bottom 10%	$ 523,000	$ 400,000
Mean spending/employee on direct inputs	$ 165,797	$ 119,225
Median spending/employee on direct inputs	$ 101,566	$ 70,292
Spending/employee on direct inputs of Top 10%	$ 400,000	$ 378,361
Spending/employee on direct inputs of Bottom 10%	$ 24,000	$ 21,887
Total respondents	531	517

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

	2007	**2005**
0 - 50,000	49.2%	53.3%
50,001 - 250,000	26.3%	24.5%
250,000 +	24.6%	22.2%
Mean energy expenditure	$ 1,118,034	$ 1,003,919
Median energy expenditure	$ 150,000	$ 62,330
Energy expenditure of Top 10%	$ 1,199,421	$ 1,050,400
Energy expenditure of Bottom 10%	$ 14,160	$ 11,000
Mean energy expenditure/employee	$ 11.16	$ 8.68
Median energy expenditure/employee	$ 2.31	$ 2.19
Energy expenditure/employee of Top 10%	$ 11.08	$ 10.00
Energy expenditure/employee of Bottom 10%	$ 0.49	$ 0.48
Total respondents	495	483

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

	2007	**2005**
0 - 50,000	43.4%	48.7%
50,001 - 250,000	26.9%	23.8%

250,000 +	29.8%	27.5%
Mean new capital investment	$ 3,194,562	$ 3,005,343
Median new capital investment	$ 108,000	$ 100,000
New capital investment of Top 10%	$ 2,000,000	$ 1,786,500
New capital investment of Bottom 10%	$ 0	$ 0
Mean new capital investment/employee	$ 7,206	$ 4,484
Median new capital investment/employee	$ 1,923	$ 1,471
New capital investment/employee of Top 10%	$ 10,000	$ 7,361
New capital investment/employee of Bottom 10%	$ 605	$ 0
Total respondents	531	508

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

	2007	2005
0 - 1	62.6%	66.7%
2 - 5	15.5%	15.1%
6 +	21.9%	18.2%
Mean percentage of sales outside the U.S.	6.4%	5.1%
Median percentage of sales outside the U.S.	0.0%	0.0%
Percentage of sales outside the U.S. of Top 10%	20.0%	15.0%
Percentage of sales outside the U.S. of Bottom 10%	0.0%	0.0%
Total respondents	586	554

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)

	2007	2005
0 - 1	56.7%	61.1%
2 - 5	11.8%	12.0%
6 +	31.5%	26.9%
Mean percentage of purchases outside the U.S.	11.4%	9.4%
Median percentage of purchases outside the U.S.	1.0%	0.0%
Percentage of purchases outside the U.S. of Top 10%	48.5%	32.0%
Percentage of purchases outside the U.S. of Bottom 10%	0.0%	0.0%
Total respondents	564	536

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

-25% or less	0.8%
-15%	0.5%
-9%	0.9%
-6%	0.8%
-3%	4.4%
0%	7.9%
+3%	18.6%
+6%	12.4%
+9%	16.7%
+15%	17.2%

+25% or more	19.6%
Average return on sales - mean	9.9%
Average return on sales - median	9.0%
Average return on sales over the last 3 years of Top 10%	25.0%
Average return on sales over the last 3 years of Bottom 10%	0.0%
Total respondents	484

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

Yes	15.4%
No	84.6%
Total Respondents	697

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

Elsewhere in USA	47.6%
Mexico, other Central or South America	23.6%
Asia (including China, India)	37.9%
Europe	3.6%
Elsewhere in world	6.3%

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

Yes	12.2%
No	87.8%
Total Respondents	676

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

Elsewhere in USA	67.8%
Mexico, other Central or South America	6.8%
Asia (including China, India)	13.0%
Europe	10.6%
Elsewhere in world	2.1%

4.5. Does this facility have a continuous improvement program?

Yes	49.7%
No	50.3%
Total Respondents	676

4.5a to 4.5c. If yes, do you use any of the following?

Lean manufacturing	62.9%
Quality systems, techniques (e.g. Six Sigma)	44.2%
Quality management (e.g. ISO 9000)	51.8%

5. Workforce and Training

5.1a. How many employees worked at this location?

	2007	2005
10 - 20	36.4%	9.5%
21 - 100	43.9%	43.5%
101 and above	5.1%	20.0%
Mean number of employees	120	127
Median number of employees	40	38
Number of employees of Top 10%	220	220
Number of employees of Bottom 10%	13	12
Total respondents	738	687

5.1b. What was total payroll?

	2007	2005
0 - 1,000,000	51.7%	55.7%
1,000,001 - 2,000,000	15.9%	13.3%
2,000,001 +	32.4%	31.0%
Mean payroll	$ 4,098,765	$ 3,786,517
Median payroll	$ 1,400,000	$ 1,152,000
Payroll of Top 10%	$ 7,562,339	$ 7,559,023
Payroll of Bottom 10%	$ 350,000	$ 300,000
Mean payroll/employee	$ 37,815	$ 41,514
Median payroll/employee	$ 33,840	$ 32,136
Payroll/employee of Top 10%	$ 62,018	$ 59,735
Payroll/employee of Bottom 10%	$ 17,340	$ 16,360
Total respondents	506	488

5.2a. On average in 2007, what percentage of your workers used a computer or programmable controller at least once a week as part of their job?

0% - 10%	32.2%
11% - 50%	41.5%
51% - 100%	26.3%
Mean percentage of workers using computers	37.2%
Median percentage of workers using computers	25.0%
Percentage of workers using computers in Top 10%	98.0%
Percentage of workers using computers in Bottom 10%	3.0%
Total respondents	681

5.2b. What percentage of your workers used Internet at least once a week as part of their job?

0% - 10%	45.5%
11% - 50%	44.0%
51% - 100%	10.5%
Mean percentage of workers using computers	23.5%

Median percentage of workers using computers	15.0%
Percentage of workers using computers in Top 10%	50.0%
Percentage of workers using computers in Bottom 10%	2.0%
Total respondents	675

5.3a. What percentage of employees were high school graduate or GED?

0-20	10.3%
21-50	12.9%
50+	76.8%
Mean number of workers graduated in high school	74
Median number of workers graduated in high school	81
Number of workers graduated in high school in Top 10%	100
Number of workers graduated in high school in Bottom 10%	25
Total respondents	649

5.3b. What percentage had two or more years of industrial-related training?

0-10	54.3%
11-50	38.5%
50+	7.2%
Mean number of workers with 4 year of industrial training	19
Median number of workers with 4 year of industrial training	10
Number of workers with 4 year of industrial training in Top 10%	50
Number of workers with 4 year of industrial training in Bottom 10%	1
Total respondents	583

5.3c. What percentage had a 4 year college degree or higher?

0-10	65.9%
11-50	30.6%
50+	3.6%
Mean number of workers with 4 year college degrees	13
Median number of workers with 4 year college degrees	8
Number of workers with 4 year college degrees in Top 10%	30
Number of workers with 4 year college degrees in Bottom 10%	0
Total respondents	633

5.3e. How many persons majored in science, engineering or information technology?

0-1	47.7%
2-5	22.2%
5+	29.9%
Mean number of workers with science or engineering degrees	31
Median numbers of workers with science or engineering degrees	2
Number of workers with 4 year college degrees in Science/Eng. in Top 10%	50
Number of workers with 4 year college degrees in Science/Eng.in Bottom 10%	0
Total respondents	564

5.4a. How much did the company spend on training in 2007.

$0 - $1,000	33.1%
$1,001 - $50,000	52.5%
$50,001 +	14.5%
Mean spending on training	$ 85,532
Median spending on training	$ 9,100
Spending on Training of Top 10%	$ 116,400
Spending on Training of Bottom 10%	$ 0
Mean spending/employee on training	$ 596
Median spending/employee on training	$ 167
Spending/employee on Training of Top 10%	$ 1,251
Spending/employee on Training of Bottom 10%	$ 0
Total respondents	539

5.4b. What percentage was related to new activities and tasks?

0% - 1%	35.1%
2% - 50%	40.0%
51% - 100%	24.9%
Mean percentage training related to new activities	32.7%
Median percentage training related to new activities	20.0%
Training related to new activities - Top 10%	100.0%
Training related to new activities - Bottom 10%	0.0%
Total respondents	467

5.5. What percentage of employees in production work is in teams?

None	52.0%
1% - 50%	23.9%
51% - 100%	24.1%
Mean percentage of employees in teams	28.6%
Median percentage of employees in teams	1.0%
Employees in teams - Top 10%	100.0%
Employees in teams - Bottom 10%	0.0%
Total respondents	635

6. Business Assistance Resources

6.1. Have you received business assistance from:

Georgia Tech (main campus or regional office)	18.0%
Other university (not Georgia Tech)	5.1%
Small Business Development Centers	3.0%
Technical college (Georgia Department of Technical and Adult Education, Quick Start)	9.8%

Georgia Department of Labor's recruitment, labor market information, or welfare-to-work services	12.8%
Federal laboratory, NASA, or other federal technology program	0.7%
Other public or non-profit business assistant source	3.1%
A private-sector business assistance source, such as a private consultant, vendor	13.9%
Another source not included in the above	4.2%
Facility has not received outside business assistance	43.9%
Total Respondents	617

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

Product design and development	12.3%
Technology assistance	13.5%
Marketing and sales growth	22.3%
Lean manufacturing and process improvement	27.4%
Supply chain management	10.0%
ISO 9000, TS 16949 quality certification	8.6%
Six Sigma	9.3%
ISO 14000 environmental management certification	5.8%
Human resources, leadership development	17.8%
Safety & health, ergonomics	20.6%
Energy efficiency and management	22.0%
Materials and waste minimization	19.0%
Other topics	1.8%
Total Respondents	384

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

English speaking skills	17.5%
Reading, writing skills	9.0%
Basic math skills	12.1%
Technical skills (e.g., machinist)	19.0%
Product design and development	5.2%
Marketing skills	5.2%
Team and problem solving skills	20.2%
Quality, lean manufacturing	29.0%
Basic computer skills (e.g., keyboarding, word processing, email)	13.9%
Advanced computer skills (e.g., database, ERP, Web design)	11.7%
Other topics	2.0%
Check here if facility does not need/would not use	19.8%
Total Respondents	527