Innovation in Manufacturing: Needs, Practices, and Performance in Georgia, 2002-2005

GaMEP Evaluation Working Paper: E200502

By

Jan Youtie
Philip Shapira
John Slanina
Jue Wang
Jingjing Zhang

Georgia Tech Policy Project on Industrial Modernization
Georgia Institute of Technology
Atlanta, GA 30332-0345, USA
E-mail: ps25@prism.gatech.edu

Acknowledgements:

Sponsorship of this study was provided by the Georgia Manufacturing Extension Partnership at the Georgia Tech Economic Development and Technology Ventures, the Georgia Tech School of Public Policy, the Center for Paper Business and Industry Services at Georgia Tech, the Georgia Department of Labor, and the QuickStart program of the Georgia Department of Technical and Adult Education.

INNOVATION IN MANUFACTURING: THE 2005 GEORGIA MANUFACTURING SURVEY
EXECUTIVE SUMMARY

The Georgia Manufacturing Survey (GMS) is a statewide study conducted every 2-3 years by Georgia Tech's office of Economic Development and Technology Ventures and the Georgia Tech School of Public Policy to assess the business and technological conditions of Georgia's manufacturers. The theme of GMS 2005 is Innovation in Manufacturing. This summary presents the key findings.

Process, Cost and Skill Concerns Uppermost in 2005

Compared with previous years, manufacturing process and energy costs have become more important to Georgia manufacturers in 2005. In addition, worries about basic reading, writing, math, and keyboarding skills have risen dramatically. Yet, training expenditures still remain low among Georgia manufacturers – and 20 percent of them do not spend anything on training activities. Reflecting current cost concerns, fewer Georgia manufacturers report problems or needs in technological areas such as product design and computing technologies than they did in the late 1990s and early 2000s.

Innovation Gaps Divide Small and Large Manufacturers

More than half of Georgia manufacturers introduced changes to product or services offerings in the last two years. The most common benefits of these changes were increased capacity, greater quality, increased variety of offerings, and greater responsiveness to customers. But the biggest barriers were high costs and lack of qualified personnel. We found that small manufacturers tend towards informal methods of innovation regarding their products, whereas larger manufacturers use more formalized methods such supplier engagement on product, process or service activities. It continues to be important to help small manufacturers catch up with the leading-edge of innovation practices in their industry.

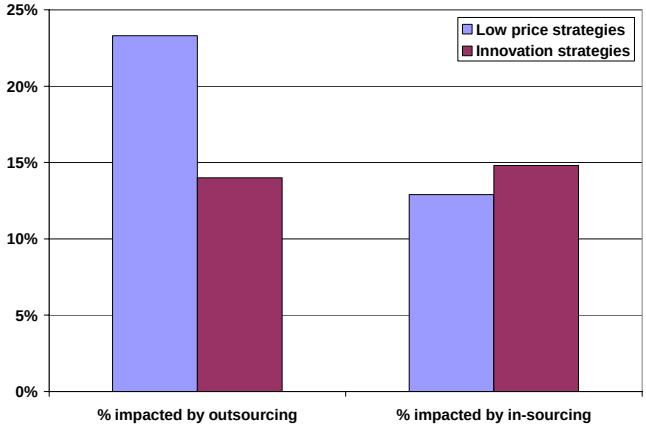
Profits Decline for Firms Competing on Low Price

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. Profit rates declined generally between 2002 and 2005, but dropped much more sharply for manufacturers that prioritized low price strategies compared to those that compete primarily through innovation.

Outsourcing Has Impacted Nearly One-Fifth of Georgia Manufacturers

Outsourcing of work has affected 18 percent of Georgia manufacturers over the last two years. At the same time, 12 percent of Georgia manufacturers gained work from in-sourcing.

Most of the in-sourcing into Georgia facilities came from U.S. manufacturers. Georgia still looks attractive when companies want to transfer work within the United States. But Asia (including China and India), Mexico and Central/South America tend to get the work if companies are looking to outsource internationally. Manufacturers that compete primarily based on innovation are much less apt to be impacted by outsourcing than those competing primarily through low price. More than 23 percent of establishments competing on low price reported that work was outsourced compared to 14 percent of establishments competing on innovation.



Manufacturing Assistance Leads to Higher Productivity

Compared to manufacturers not assisted by Georgia Tech, Georgia Tech clients on average experienced a value-added increase of $9,400 to $10,000 per employee between 2002 and 2004.

About the Survey

- Mail surveys were sent to 4,000 manufacturers with 10 or more employees from February to July 2005. Completed surveys from 648 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

Table of Contents

List of Tables

List of Figures

Chapter
1

Introduction: The 2005 Georgia Manufacturing Survey

The Georgia Manufacturing Survey 2005 is the fifth 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 2005 survey focuses on problems and needs, operational performance, trends in product, process, and organizational innovation, current and planned use of new technology, and the impact and effectiveness of Georgia's manufacturing assistance programs.

The 2005 survey went to all Georgia manufacturing firms with 10 or more employees. Of the 743 responses received, 648 surveys met the criteria of manufacturers with 10 or more employees. These were weighted to reflect the actual distribution of manufacturers by industry and employment size in Georgia.

This report is divided into six sections. Section 2 examines manufacturer problems and needs. Section 3 focuses on use of manufacturing technologies and techniques. Section 4 looks at manufacturing strategies. Section 5 examines operating, workforce, and performance measures. Section 6 summarizes survey responses about use of information and assistance sources, including Georgia Tech. For more information about the survey, see Appendix 1.

Definitions

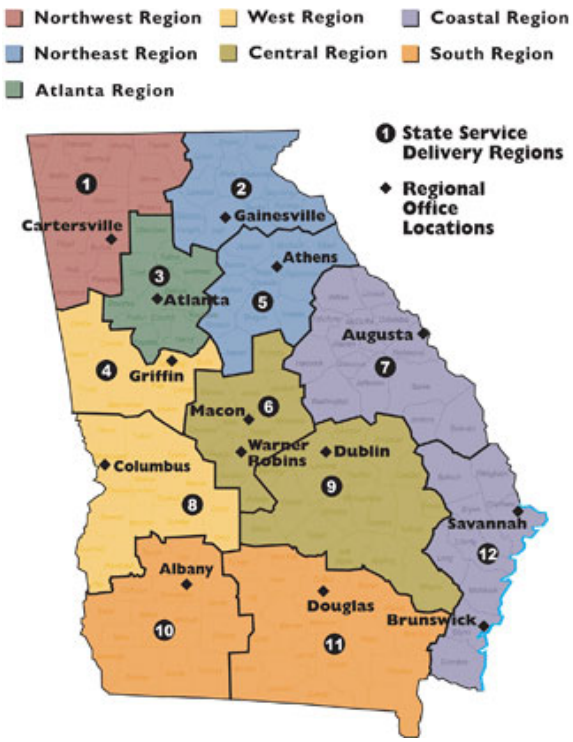
Throughout this report, information will be broken down by employee size, industry group, and Georgia Tech service delivery region in 2005. Industry groupings and their North American Industrial Classification System (NAICS) are described in Box 1. These breakdowns are based on Pavitt's technology trajectories sectoral model.[2] Results will also be presented terms of Georgia major geographic service areas—Northwest (Dalton, Rome, Cartersville), Northeast (Gainesville, Athens), Atlanta, West (Carrollton, Newnan, Columbus, Griffin), East (Augusta), Central (Macon, Dublin, Warner Robins), South, (Albany, Douglas), and Coastal (Savannah, Brunswick). (See Figure 1.)

[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

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
		339	Miscellaneous (doll 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
		339	Miscellaneous (jewelry, sign manufacturing)
Specialized suppliers	Elec-Trans	336	Transportation equipment
		334	Computer and electronic product manufacturing
		335	Electrical equipment, applicance & component manuf.
		339	Miscellaneous (office products manufacturing)
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 2005 asked a question that has been posed in all five manufacturing surveys, including those conducted in 1994, 1996, 1999, and 2002: "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 2002 survey:

- The terms "Expansion planning, facility layout" replaced "plant layout, expansion planning."
- "Lean manufacturing and workflow improvement" was substituted for "manufacturing process, setup, scrap."
- Computer hardware and software were conjoined.
- Business strategy and financial analysis were asked in combination.
- We asked about waste products, pollution prevention rather than the more general waste management.
- Safety compliance, health, workplace environment was asked instead of environmental, health, and safety compliance.

Nearly all of the respondents (96 percent) indicated that they had at least one significant problem or need at their facility. The average respondent checked 2.6 problem areas. Although 22 percent noted only one problem, a handful reported seven to nine problems.

Manufacturers' Problems – Back to Basics

The demand for skilled workers is a central tenet of today's economy. We find that Georgia manufacturers consider human resources to be a foremost need, as has been the case in the past three surveys. Forty-eight percent of respondents mentioned human resources as a problem or need. This is above 2002 levels. However, the emphasis on skilled vs. basic workers has changed dramatically. In marked contrast to other surveys, basic skills rose to become a top human resource need among more than one in four manufacturers. (See Table 2.1.) The influx of non-native English-speaking workers into Georgia manufacturing may have contributed to this rapid rise in importance of basic skills. Technical skill needs were also common to human resource problems, with 23 percent of respondents indicating problems finding technical skills. Supervisory skill problems dropped in relative position, with 16 percent reporting problems in this area, down from 26 percent in 2002.

Lean manufacturing needs ranked very high among manufacturers' concerns in the 2005 survey. Nearly 40 percent of respondents reported that they had lean manufacturing-related needs. This percentage is up from what it was in 2002. There was a parallel growth in interest in saving energy costs and conservation. Nearly 20 percent of respondents had problems in the energy area as compared with 15 percent in 2002.

Although 2002 saw a rise in manufacturers indicating problems in the marketing and product development areas, this was not the case in 2005. The percentage of establishments with marketing problems dropped from 37 percent in 2002 to 25 percent in 2005. Manufacturers with product development needs also declined from 19 percent in 2002 to 13 percent in 2002. Concerns about information technology hardware and software continued to decline from peak 1999 levels. Only 14 percent of respondents reported that they had information technology-related issues in 2005.

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

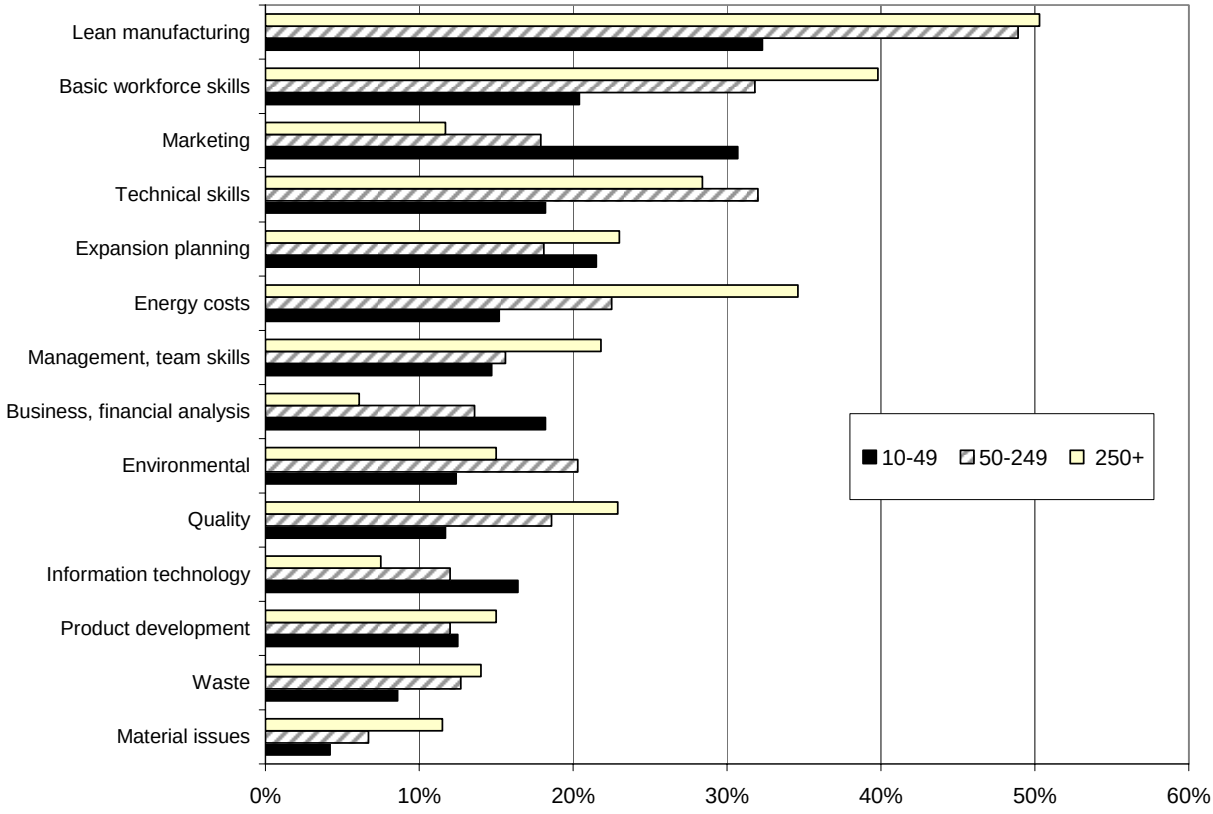
Problems/Needs	2005	2002	1999	1996	1994	Difference 2005-2002
Human resources problems	48.4%	43.8%	39.0%	53.0%	44.0%	4.6%
Basic skills	25.6%	10.6%	13.0%	16.0%	n/a	15.0%
Technical skills	23.3%	26.6%	25.0%	31.0%	n/a	-3.3%
Supervisory, team skills	15.6%	26.2%	21.0%	33.0%	n/a	-10.6%
Manufacturing process	38.9%	34.4%	29.0%	27.0%	37.0%	4.5%
Market development, exporting	25.2%	36.9%	25.0%	17.0%	15.0%	-11.7%
Expansion planning, facility layout	20.6%	24.0%	22.0%	22.0%	25.0%	-3.4%
Energy costs, conservation	19.1%	15.3%	10.0%	13.0%	16.0%	3.8%
Business, Finance	15.8%	19.7%	n/a	n/a	n/a	-3.9%
General business analysis	n/a	16.3%	11.0%	n/a	n/a	n/a
Financial planning	n/a	5.6%	n/a	12.0%	12.0%	n/a
Environmental, health & safety	15.0%	17.6%	15.0%	17.0%	29.0%	-2.6%
Quality assurance	14.7%	17.2%	17.0%	19.0%	22.0%	-2.5%
Computer applications	14.3%	20.1%	27.0%	17.0%	13.0%	-5.8%
Computer software/packages	n/a	15.9%	19.0%	23.0%	26.0%	n/a
Computer hardware/systems	n/a	10.3%	16.0%	n/a	n/a	n/a
Automation	n/a	n/a	n/a	15.0%	8.0%	n/a
Product development, design	12.5%	19.0%	13.0%	13.0%	12.0%	-6.5%
Waste management	10.3%	15.7%	11.0%	n/a	n/a	-5.4%
Material-related	5.7%	8.8%	5.0%	5.0%	10.0%	-3.1%

Source: 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 skills and management skills than were smaller manufacturers. They were also more concerned with lean, quality, and energy costs than were smaller establishments. However, medium-sized firms with 50 to 249 employees were almost as likely to express a need for lean manufacturing as their large manufacturing equivalents. They also more frequently indicated problems finding employees with technical skills and placed more emphasis on worries about environmental-related 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 and computer hardware and software. (See Figure 2.1.)

Figure 2.1. Manufacturing Needs and Problems by Facility Employment Size



Source: Georgia Manufacturing Survey 2005, weighted responses of 648 manufacturers.

The emphasis given to specific problems differed by industry groups. Lean manufacturing was the top interest for all industry groups, although less so for respondents in the metals and machinery group. The food/textile/apparel/leather group indicated more concern with problems such as basic workforce skills, marketing, energy costs, and environmental compliance. Manufacturers in the materials group tended to follow the overall needs patterns, although with slightly greater emphasis on basic skills and waste product issues. Metals and machinery industries most often mentioned problems with finding technically-skilled workers. Electrical, electronics, and transportation manufacturers were more acutely focused on basic skills, management skills, and quality assurance needs. Science-based industries had the greatest need for expansion planning, product devel-

opment, and waste product issues. They also showed a need to address marketing issues. (See Table 2.2.)

Table 2.2. Manufacturing Problems and Needs by Industry

Problems/Needs	Food-Text	Material	Mach	Elec-Trans	Science
Lean manufacturing, workflow improvement	41.0%	39.9%	34.6%	38.2%	40.0%
Basic workforce skills	*27.5%*	*25.6%*	*27.1%*	*28.4%*	14.0%
Marketing, niche marketing, market planning, exporting	29.6%	21.5%	28.1%	23.8%	26.0%
Technical skills	19.9%	20.1%	*33.6%*	24.8%	22.0%
Expansion planning, facility layout	21.3%	17.7%	20.0%	18.3%	*36.0%*
Energy costs, conservation	*28.4%*	21.5%	13.9%	5.3%	10.0%
Business strategy, financial analysis, competitiveness planning	16.6%	17.6%	14.2%	14.3%	10.0%
Management, team, problem-solving skills	10.6%	17.1%	15.3%	*21.0%*	16.0%
Safety compliance, health, workplace environment	*20.7%*	14.3%	12.5%	11.2%	14.0%
Quality assurance (e.g., ISO 9000, QS-9000, Six Sigma)	10.9%	13.3%	15.4%	*26.2%*	18.0%
Computer equipment & systems (hardware or software)	14.8%	17.1%	9.0%	14.3%	12.0%
Product development/design	12.5%	6.9%	16.4%	14.8%	*28.0%*
Waste products, pollution prevention	7.6%	*15.0%*	2.1%	8.5%	*16.0%*
Material failure, wear patterns, other material-related issues	6.8%	5.3%	5.1%	6.5%	4.0%

Source: Georgia Manufacturing Survey 2005, weighted responses of 648 manufacturers.

Lean manufacturing needs were most commonly expressed by respondents in Atlanta, Northeast, Northwest, and South regions. Marketing was the most common concern for manufacturers in the Northwest and Central regions. Basic skills needs were particularly prominent among manufacturers in Northeast, Coastal, and South regions. Technical skills concerns were frequently mentioned by respondents in all but the Central and Northwest regions. Expansion planning needs were most evident for firms in the regions abutting metro Atlanta. Energy costs registered particularly highly in the Northeast, Northwest, and Coastal regions. The highest proportion of firms with environmental compliance issues were found in the Northeast and West regions. (See Table 2.3.)

Table 2.3. Manufacturing Problems and Needs by Region

Problems/Needs	Atlanta	Northeast	Northwest	West	Central	Coastal	South
Lean manufacturing, workflow improvement	*40.7%*	*39.8%*	*40.3%*	33.5%	32.9%	33.0%	*42.7%*
Basic workforce skills	19.1%	*33.0%*	23.8%	26.2%	24.0%	*34.9%*	*33.8%*
Marketing, niche marketing, market planning, exporting	27.2%	23.2%	*31.8%*	19.0%	*35.2%*	15.7%	16.8%
Technical skills	21.8%	*27.6%*	17.6%	*30.3%*	14.5%	*29.5%*	*26.4%*
Expansion planning, facility layout	22.7%	21.0%	20.5%	13.5%	25.1%	16.7%	18.5%
Energy costs, conservation	13.3%	*27.5%*	*26.0%*	18.2%	11.8%	*26.2%*	18.4%
Business strategy, financial analysis, competitiveness planning	16.4%	18.5%	17.9%	11.0%	17.1%	17.0%	8.9%
Management, team, problem-solving skills	13.8%	19.0%	15.0%	11.8%	14.9%	17.7%	19.9%
Safety compliance, health, workplace environment	12.6%	*20.4%*	13.0%	*25.0%*	9.8%	15.4%	13.5%
Quality assurance (e.g., ISO 9000, QS-9000, Six Sigma)	19.8%	11.4%	14.8%	9.9%	9.8%	8.4%	14.0%
Computer equipment & systems (hardware or software)	16.0%	6.3%	*21.4%*	14.3%	17.6%	11.7%	9.7%
Product development/design	14.2%	10.9%	11.4%	10.7%	14.2%	10.4%	12.4%
Waste products, pollution prevention	11.2%	*16.3%*	7.4%	5.4%	8.1%	7.8%	10.1%
Material failure, wear patterns, other material-related issues	3.9%	2.9%	4.1%	*10.5%*	4.2%	*10.2%*	*11.0%*

Source: Georgia Manufacturing Survey 2005, weighted responses of 648 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 and 2002, which facilitates exploration of changes in primary manufacturing strategies over time.

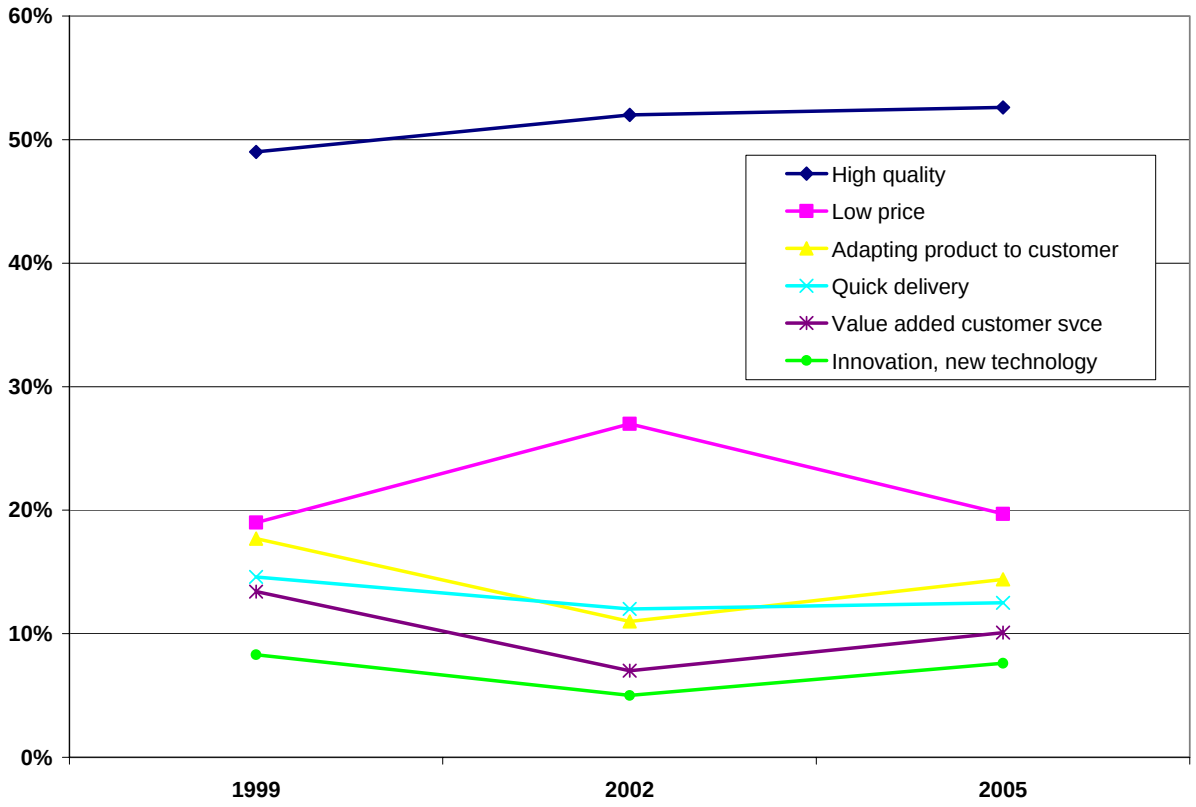
More than half of Georgia manufacturers chose quality of service as their primary strategy in competing for customer sales. Low price was a primary strategy for just under 20 percent of Georgia manufacturers. Adapting to customers needs was cited by 14 percent of the manufacturers, followed by quick delivery at 12 percent and value-added services at 10 percent. Innovation/new techniques constituted a top strategy for the fewest manufacturers (less than 8 percent).

Since 2001, the percentage of respondents competing for sales primarily based on low price declined significantly from 27 percent in 2002 to less than 20 percent in 2005. Even acknowledging that managing costs is a basic driver of any business, this is a substantial drop. We do not know whether this fall-off in firms competing primarily through low price strategies is a result of past low price manufacturers having gone out of business, or whether more Georgia manufacturers are migrating business strategies away from those oriented solely toward low price. The percentage of firms competing for sales primarily through quick delivery stayed about the same, while the other strategies increased slightly from 2002 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 quick delivery or value-added services was a primary strategy for them than were the largest companies. Large manufacturers were less apt to compete through customization than were small and medium-sized respondents. The percentage of firms competing for sales through innovation-oriented strategies did not vary much by size. (See Table 3.1.)

Figure 3.1. Top Manufacturing Strategies: 1999-2005
(Percentage of Firms Ranking Strategy as the Most Important)



Source: Georgia Manufacturing Survey 2005, weighted responses of 639 manufacturers.

All industries favored high quality as a primary sales strategy and were least likely to favor innovation-related strategies. Food/textile/apparel/leather firms were the most apt to respond that low price was their primary strategy for competing for sales in the market. Respondents in the materials and metals/machinery groups followed the average firm in terms of their distribution of primary strategies. One would expect that science-based industries would have the highest percentage of firms competing for sales primarily through innovation and technology. Although a higher percentage of science-based industries competed on innovation than was the case with the average survey respondent (13 percent vs. 8 percent, respectively), manufacturers in the electronics/electrical/transportation group actually had the highest percentage of respondents (18 percent) saying they compete primarily through innovation and technology. Compared with other sectors, science-based firms were most apt to say that they compete by offering value-added services. (See Table 3.2.)

Competition based on high quality was the most common strategy for respondents in all regions of the state. The South region had the highest percentage of manufacturers competing primarily on low price (29 percent), whereas the Atlanta region had the lowest percentage (13 percent), less than half that of the South region. The Northwest and West region had the highest percentage of firms that compete based on adapting to customer needs. Manufacturers were most likely to rank quick delivery as a top strategy for all but the South and Coastal regions. Value-added services accounted for a higher percentage

of respondents in the Atlanta, Northwest, Central, and South regions than in the rest of the state. Innovation-oriented strategies accounted for the highest percentage of respondents in the Central and Atlanta regions. (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	54.4%	46.8%	61.2%
Low price	18.2%	21.8%	23.2%
Adapting product to customer needs	15.7%	13.2%	8.7%
Quick delivery	14.6%	9.9%	7.2%
Value-added customer service	12.0%	7.1%	7.3%
Innovation, new technology	7.4%	8.2%	7.3%

Source: Georgia Manufacturing Survey 2005, weighted responses of 639 manufacturers.

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	50.4%	53.2%	50.8%	53.7%	58.0%
Low price	*27.6%*	16.8%	19.6%	19.7%	14.0%
Adapting product to customer needs	13.5%	13.7%	17.2%	9.6%	18.0%
Quick delivery	11.5%	14.1%	13.8%	11.2%	6.0%
Value-added customer service	6.9%	12.7%	6.4%	6.7%	*18.0%*
Innovation, new technology	2.2%	7.4%	7.7%	*17.9%*	12.0%

Source: Georgia Manufacturing Survey 2005, weighted responses of 639 manufacturers.

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

Strategy	Atlanta	Northeast	Northwest	West	Central	South	Coastal
High quality	51.6%	55.2%	47.5%	53.2%	56.2%	54.6%	54.4%
Low price	13.4%	20.0%	25.2%	22.7%	20.7%	*28.8%*	22.9%
Adapting product to customer needs	14.1%	8.9%	*18.1%*	*19.8%*	10.3%	15.8%	*15.1%*
Quick delivery	11.4%	15.1%	15.9%	15.6%	15.7%	6.5%	7.9%
Value-added customer service	*13.4%*	7.4%	*10.9%*	3.0%	*13.5%*	*11.0%*	1.5%
Innovation, new technology	*9.7%*	6.3%	7.2%	4.6%	*11.1%*	5.6%	4.1%

Source: Georgia Manufacturing Survey 2005, weighted responses of 639 manufacturers.

Outcomes of Strategies

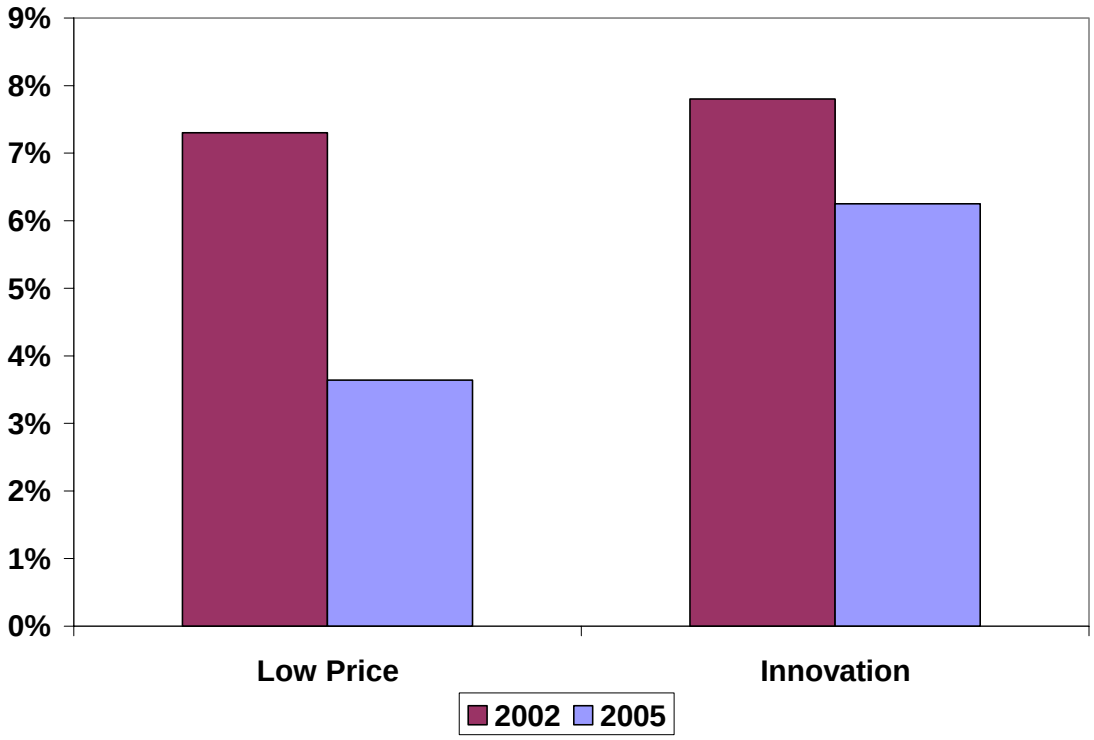
How have these strategies fared in generating return on sales, which manufacturers care about, and employee wages, which economic developers care about? Average return on sales over a three-year period is a measure of the profitability of an establishment. We found that average return-on-sales margins have declined since 2002. In 2002, the mean (average) return on sales was 7.9 percent and the median (50th percentile) was 6.0 percent. By 2005, these figures were 5.3 percent and 6.0 percent, respectively. Median mar-

gins were actually higher in 2005 than the mean, whereas the reverse was the case in 2002.

We found that the average margins 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. But 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. Figure 3.2 illustrates these differences. Returns had fallen much faster for companies competing on low price.

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.

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

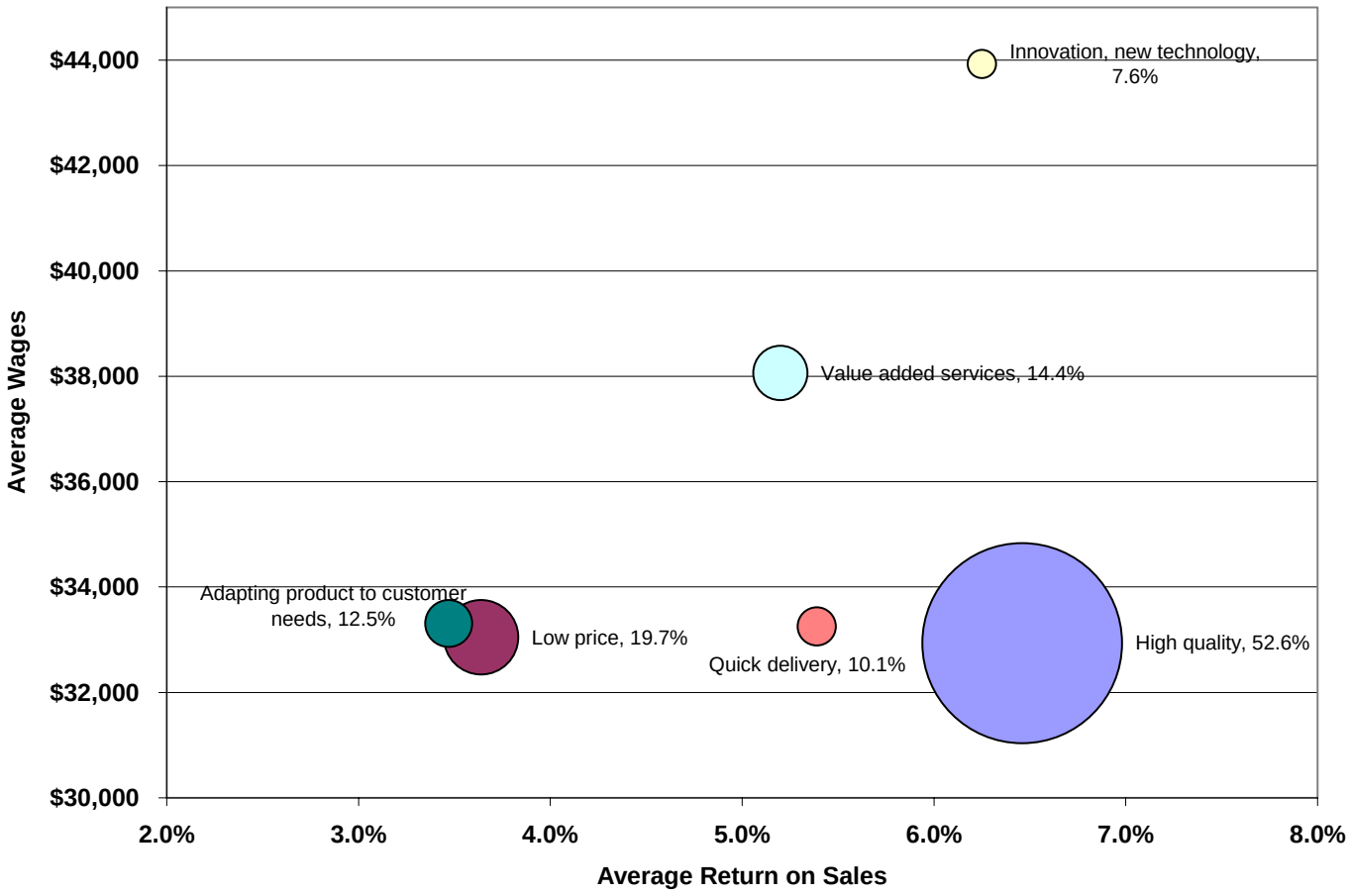


Source: Georgia Manufacturing Survey 2005, weighted responses of 639 manufacturers.

Average wages are calculated by dividing annual payroll by number of employees. It 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 were at around $33,000 for all but two strategies: value-added services (associated with an average wage of around $38,000) and innovation strategies (associated with an average wage of nearly $44,000).

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 2004 wages associated with these strategies. The horizontal axis shows average return on sales from 2003-2005 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 low wages.

Figure 3.3. Manufacturing Returns and Wages By Percentage of Respondents Ranking Strategies Highest in 2005



Source: Georgia Manufacturing Survey 2005, weighted responses of 639 manufacturers.

Summary

This chapter showed that about half the manufacturers compete for sales based on high quality strategies. Fewer establishments competed through low price strategies, and the margins associated with this strategy dropped dramatically between 2000 and 2005 relative to those associated with innovation. Quality- and innovation-oriented strategies were associated with relatively high profitability. Value-added services and innovation paid average annual wages that were $5,000 to $10,000 higher than the other strategies, but fewer than 20 percent of the manufacturers have adopted these strategies.

Chapter
4

Innovation

The previous chapter indicated that fewer than 8 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 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

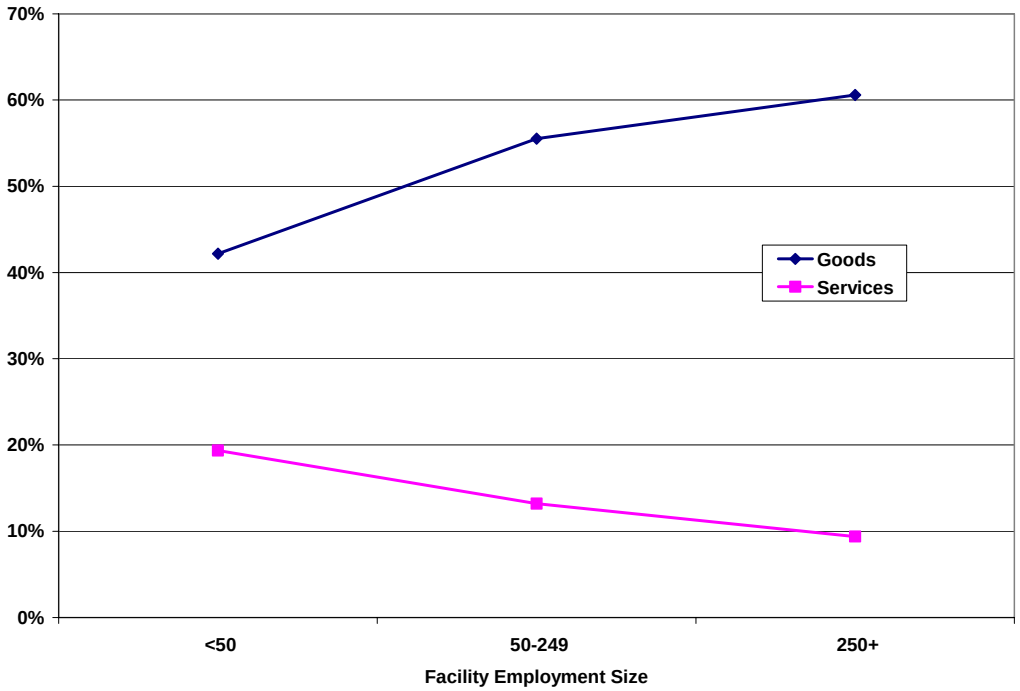
We asked survey respondents to tell us whether their facility introduced any new or significantly improved goods or services during the period 2002 to 2004. Excluded were small changes to the color or look or resale of goods purchased elsewhere. Nearly half of the respondents had introduced a new or significantly improved good. Seventeen percent of the establishments had introduced a new or significantly improved service.

Introduction of new goods was highest among larger manufacturing establishments, The percentage of establishments that had introduced a new service was higher among the smallest manufacturers. (See Figure 4.1). The science-based industry group had the highest percentage of establishments that had introduced a new good, followed by the elec-trans group. By region, the Atlanta, Coastal, and West regions had the highest percentage of establishments that introduced new goods, with the Northwest coming in at the lowest percentage. New services were more prominent among establishments in all but the Coastal and West regions. (See Figure 4.2a.) As was the case in the 2002 Georgia Manufacturing Survey, we continued to find that branch plants with headquarters outside the state had the highest rates of product/service innovation, and that single establishment enterprises had the lowest rates. (See Figure 4.2b.)

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 one-third of respondents reported that they had introduced a new-to-the-market product in the 2002 to 2004 timeframe. This percentage is up from 22 percent reported in 2002. New-to-the-market innovations varied positively with the facility employment size class, but the proportion of establishments with new-to-the-facility innovations did not vary much by facility employment size. By industry, one would expect new-to-the-market innovations to be most common in science-based industries, which was true, followed closely in frequency by the elec-trans group. However, the elec-trans group had among the lowest proportion of respondents with new-to-the-facility product innovations. By region, the Atlanta region had the highest percentage of new-to-the-market innovations, as one would expect. (See Table 4.1.)

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 2002-2004)



Source: Georgia Manufacturing Survey 2005, weighted responses of 421 manufacturers.

Figure 4.2a. Introduction of New or Significantly Improved Goods and Services by Industry Group and Region
(Percentage of Establishments that Introduced New Goods or Services from 2002-2004)

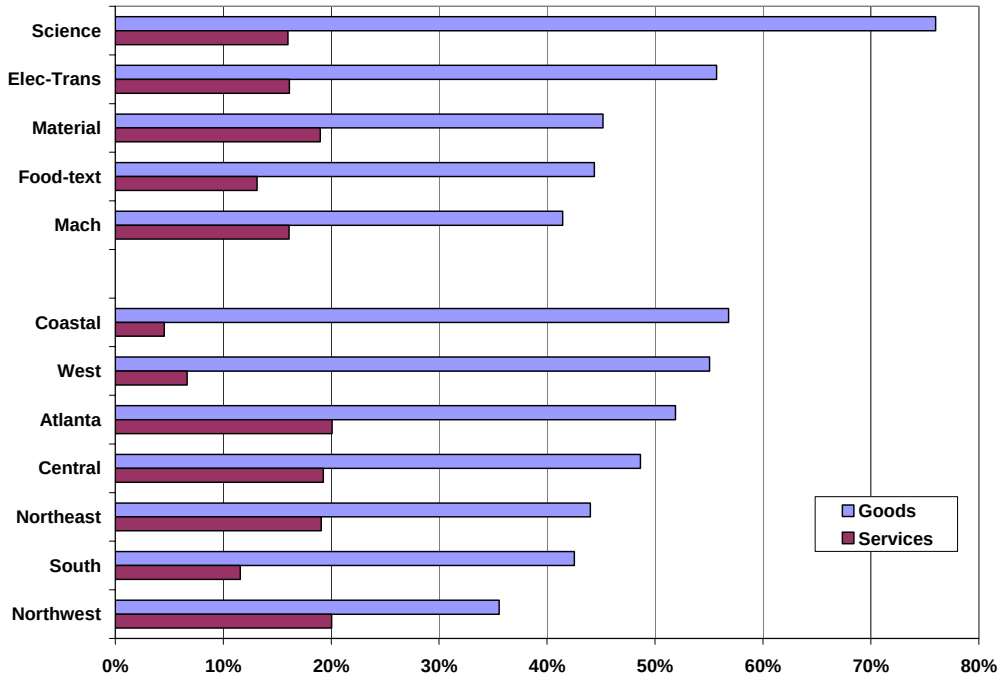


Figure 4.2b. Introduction of New or Significantly Improved Goods and Services by Industry Group and Region

(Percentage of Establishments that Introduced New Goods or Services from 2002-2004)

Source: Georgia Manufacturing Survey 2005, weighted responses of 640 manufacturers.

Table 4.1. New to Market vs. New to Facility Innovations

(Percentage of Establishments that Introduced the Innovations)

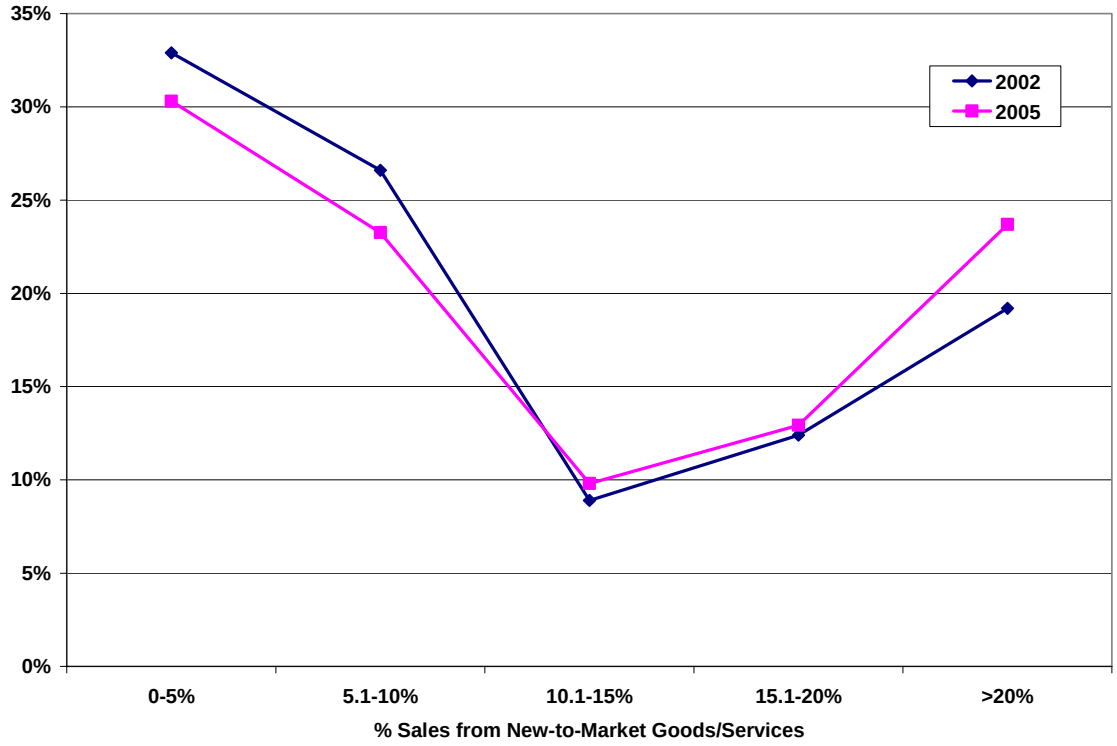
	New to Market	New to Facility
Total	31.8%	32.1%
Employment		
10-49	28.2%	30.2%
50-249	35.5%	35.6%
250+	45.2%	32.9%
Industry		
Science	52.0%	46.0%
Elec-Trans	47.4%	24.6%
Mach	32.0%	26.1%
Material	27.1%	33.3%
Food-text	26.3%	33.0%
Region		
Atlanta	37.5%	32.6%
West	33.1%	30.3%
Coastal	31.8%	33.9%

Central	31.6%	33.9%
Northeast	29.9%	35.6%
South	26.8%	33.1%
Northwest	22.4%	25.5%

Source: Georgia Manufacturing Survey 2005, weighted responses of 421 manufacturers.

New-to-the-industry 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 20 percent of the facility's sales. However, for almost 12 percent of the respondents with new-to-the-market products or services, these offerings comprised half or more of their sales. Figure 4.3 shows that the percentage of sales from new-to-the-market goods and services is about the same as it was in 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 vs. 2005



Source: Georgia Manufacturing Survey 2005, weighted responses of 421 manufacturers.

Process Innovation

Over the last three years, 48 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 38 percent of respondents. Logistics and distribution innovations were introduced by 11 percent of respondents. Purchasing, accounting, maintenance, or other similar processes were introduced by about 12 percent of respondents. Smaller establishments lagged larger ones in shop floor and logistics innovation introduction, but office and related process innovations were introduced at comparable rates across size classes. Shop floor innovations did not significantly differ by industry group, with the exception of a lower rate of adoption in the food-text group. Logistics-related innovations also did not vary much by industry group, but office-related innovations were markedly higher among science-based firms. By region, establishments in the Atlanta, Coastal, and Central areas had the highest rates of process innovation introduction, while the establishments in the South had the lowest rates. (See Table 4.2.)

Table 4.2. Process Innovations Introduced from 2002 to 2004
(Percentage of Establishments that Introduced the Innovations)

	Techniques, Technologies	Logistics, Distribution	Purchasing, Accounting	Any Process
Total	38.4%	11.4%	12.4%	48.2%
Employment Size				
10-49	30.3%	9.4%	11.2%	39.8%
50-249	49.7%	11.6%	14.6%	59.6%
250+	55.7%	25.5%	12.9%	67.1%
Industry				
Science	40.0%	20.0%	24.0%	62.0%
Elec-Trans	41.6%	16.8%	16.5%	53.2%
Material	41.8%	9.7%	11.3%	49.3%
Food-text	31.4%	9.3%	9.4%	39.6%
Mach	36.9%	11.0%	11.1%	47.2%
Region				
Atlanta	39.1%	16.1%	16.8%	52.1%
Coastal	43.1%	8.7%	12.5%	51.9%
Central	36.2%	13.3%	16.0%	51.2%
West	42.6%	6.7%	9.5%	49.3%
Northwest	37.4%	6.9%	5.9%	46.0%
Northeast	40.8%	4.6%	6.6%	43.9%
South	28.2%	15.2%	14.2%	37.7%

Source: Georgia Manufacturing Survey 2005, weighted responses of 327 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 roughly one-third of respondents. New management systems were reported by 27 percent of respondents, and new relationships with other firms by 16 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 the Coastal area for management system changes, the West area for new inter-firm relationships, and the Atlanta area for overall introduction of organizational innovations.

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 Size				
10-49	21.3%	28.1%	13.2%	44.0%
50-249	32.3%	39.1%	17.6%	59.2%
250+	*50.1%*	*56.2%*	*32.8%*	*79.8%*
Industry				
Science	*44.0%*	38.0%	20.0%	60.0%
Elec-Trans	34.7%	*42.7%*	*29.5%*	60.6%
Material	26.6%	32.9%	12.0%	52.8%
Food-text	19.0%	29.4%	17.3%	42.3%
Mach	26.3%	34.8%	16.0%	52.1%
Region				
Atlanta	33.3%	38.0%	18.4%	57.8%
West	22.5%	33.5%	*24.4%*	56.1%
Coastal	*38.4%*	33.5%	11.6%	53.8%
Central	24.3%	28.7%	14.1%	49.0%
Northwest	17.4%	35.5%	14.6%	48.7%
Northeast	21.3%	28.8%	13.2%	45.2%
South	24.2%	28.3%	12.8%	40.2%

Source: Georgia Manufacturing Survey 2005, weighted responses of 352 manufacturers.

Marketing Innovations

Nearly 30 percent of manufacturers participating in the survey introduced at least one marketing innovation during the 2002 to 2004 time period. This suggests that marketing innovations are the least common improvement in manufacturing. The percentage of establishments introducing new sales and distribution channels was almost the same as those introducing new packaging changes. Differences by size, industry, and region were less pronounced in the marketing area. 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 much by size. Science-based and food-text firms were about equally likely to have introduced new packaging designs. But science-based firms were much more apt to have rethought their sales and distribution channels. Regional differences were also less prominent on the packaging side, although the sales side showed more frequency among Central and Atlanta region establishments.

Table 4.4. Marketing Innovations Introduced from 2002 to 2004
(Percentage of Establishments that Introduced the Innovations)

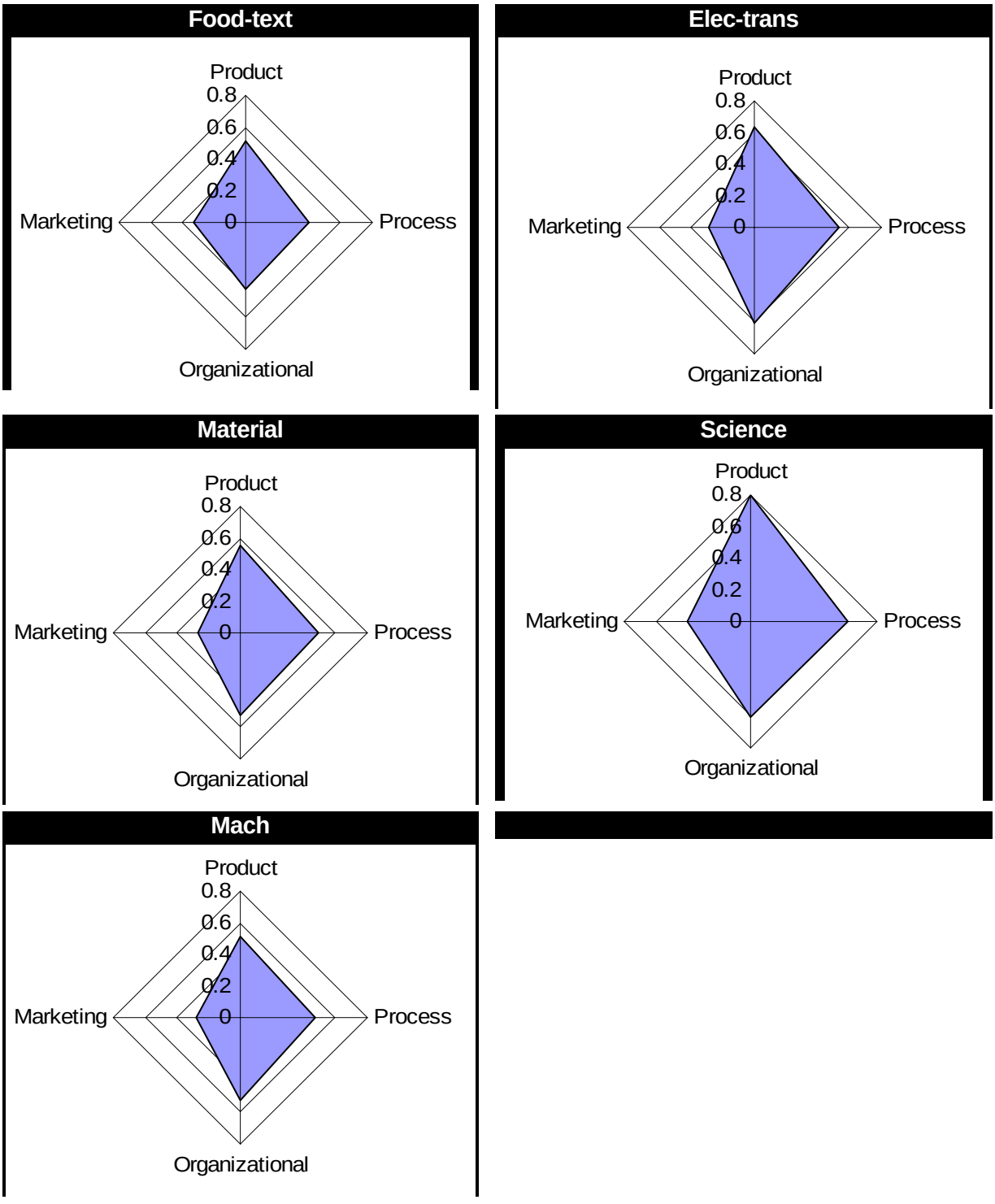
	Packaging	Sales	Any Marketing Innovation
Total	14.9%	18.2%	29.5%
Employment Size			
10-49	12.3%	18.1%	28.3%
50-249	17.6%	17.4%	30.5%
250+	24.1%	22.1%	34.7%
Industry			
Science	22.0%	*28.0%*	40.0%
Food-text	22.8%	14.8%	32.9%
Elec-Trans	19.5%	19.3%	29.1%
Mach	9.1%	19.7%	27.9%
Material	11.0%	17.0%	26.4%
Region			
Central	18.4%	*22.7%*	39.0%
Atlanta	13.7%	*23.3%*	31.8%
Northeast	16.5%	16.2%	29.3%
West	15.9%	12.5%	27.7%
Coastal	10.5%	16.5%	27.1%
South	20.7%	9.8%	26.4%
Northwest	12.0%	15.4%	23.8%

Source: Georgia Manufacturing Survey 2005, weighted responses of 194 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 move 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 .8. Where a measure is closer to the outside perimeter of the graph, this represents a stronger sector performance. Conversely, where a measure is closer to the center of the graph, this represents a weaker performance. 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.

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 elec-trans group looks similar to the science-based group, except that product and marketing innovations are less

prevalent. The metals and machinery and materials groups also had more product, process, and organizational innovation than marketing innovation. The food-text group has the smallest visual innovation profile. However, marketing innovations appear to be a bigger proportion of its framework than is the case with the other groups.

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 2002-to-2004 time period. The average respondent implemented three of these activities. The most common activities were:

- Working with customers to create or design a product, process, or other innovation – 62 percent,
- Purchasing machinery, equipment, computers, or software to implement innovations – 58 percent.

The least common activities were:

- Purchasing R&D from research organizations or other branches of the company (applicable to facilities in a multi-establishment enterprise) – 6.9 percent.
- Purchasing or licensing patents, inventions, know-how, or other types of knowledge – 7.2 percent.
- Publishing papers or technical articles – 7.3 percent.

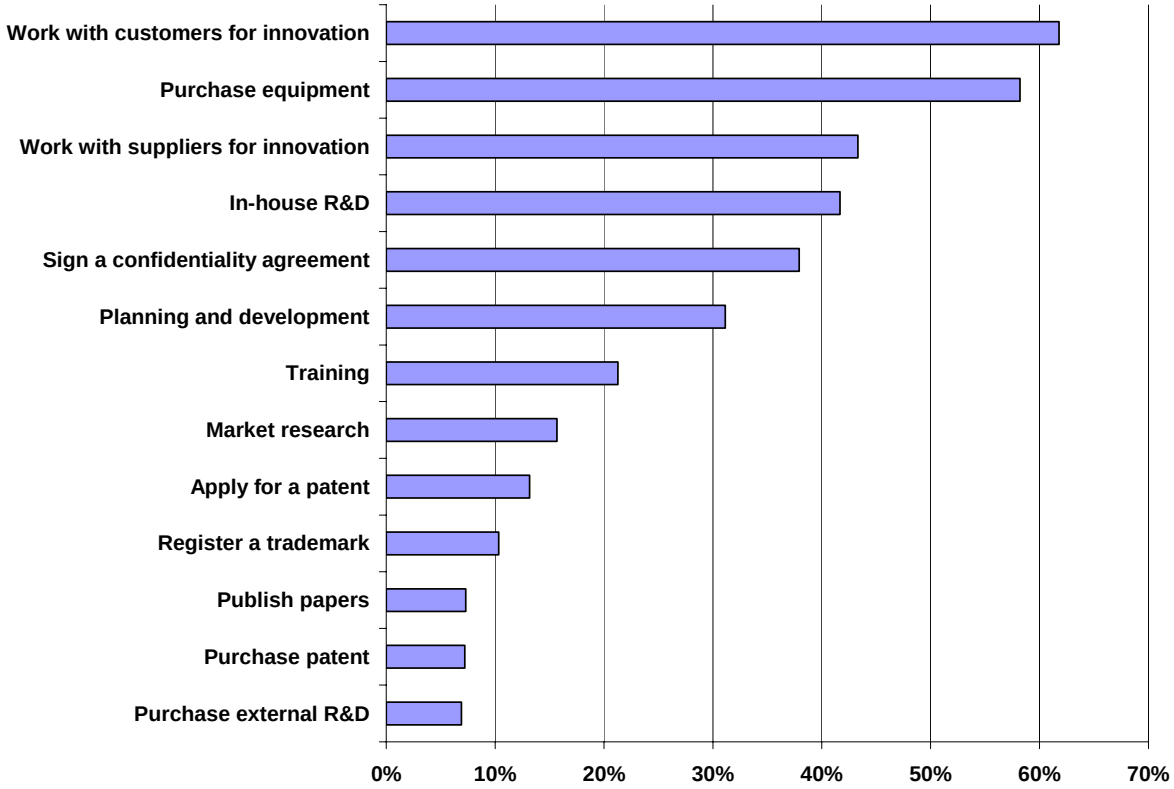
Several of these activities were particularly impacted by facility employment size. Larger establishments were much more likely than medium-sized firms and especially than smaller firms to purchase equipment, work with suppliers on product or process design, engage in in-house R&D, train staff to introduce innovations, apply for a patent, register a trademark, or license a patent. Working with customers on product or process design was equally prominent—among slightly more than 60 percent of establishments—regardless of size. Confidentiality agreements and planning and development were at the same levels among medium-sized establishments as among large ones. Market research among small establishments was at the same level as medium-sized firms. Publishing papers and procuring external R&D were at low levels regardless of size.

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

By industry, science-based establishments would be expected to have higher take-up rates of innovation activities. This is generally the case. However, working with customers to design products or processes is the top innovation activity across all industry classes. For many innovation activities, the elec-trans industry group has very high levels of take-up, approaching that of the science groups. Working with customers, working with suppliers, and purchasing equipment are prominent in the food-text industry. In addition to working with customers and purchasing equipment, signing confidentiality agreements was particularly prevalent in the metals and machinery industry.

We would also expect respondents in the Atlanta region to have the highest rates of adoption of these innovation activities. While this is generally true, we also see fairly high rates of adoption of various innovation activities in the Coastal and Northeast regions.

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



Source: Georgia Manufacturing Survey 2005, weighted responses of 494 manufacturers.

Table 4.5. Adoption of Specialized Innovation Activities from 2002 to 2004 by Facility Employment Size

(Percentage of Establishments Engaged in Innovation Activities)

Innovation Activity	10-49	50-249	250+
Work with customers for innovation	61.4%	62.6%	61.6%
Purchase equipment	52.2%	66.7%	70.3%
Work with suppliers for innovation	36.1%	52.7%	61.3%
In-house R&D	35.7%	48.8%	59.7%
Sign a confidentiality agreement	33.1%	45.7%	44.6%
Planning and development	24.6%	40.3%	45.1%
Training	17.3%	25.8%	33.8%
Market research	15.6%	13.4%	24.9%
Apply for a patent	9.8%	16.4%	26.1%
Register a trademark	8.5%	10.8%	21.9%
Publish papers	5.0%	10.5%	12.5%
Purchase patent	4.4%	9.5%	19.0%
Purchase external R&D	5.6%	8.6%	10.1%
Mean # Innovation Activities	3.1	4.1	4.9

Source: Georgia Manufacturing Survey 2005, weighted responses of 494 manufacturers.

Table 4.6. Adoption of Specialized Innovation Activities from 2002 to 2004 by Industry Group

(Percentage of Establishments Engaged in Innovation Activities)

Innovation Activity	Science	Elec-Trans	Mach	Food-text	Material
Work with customers for innovation	64.0%	62.2%	64.2%	63.9%	58.9%
Purchase equipment	64.0%	51.6%	58.5%	59.9%	57.4%
Work with suppliers for innovation	56.0%	49.4%	33.7%	52.7%	39.0%
In-house R&D	66.0%	52.4%	41.7%	39.6%	35.6%
Sign a confidentiality agreement	64.0%	58.8%	43.5%	32.7%	28.0%
Planning and development	50.0%	46.3%	30.1%	26.2%	27.0%
Training	40.0%	21.7%	16.0%	19.4%	20.9%
Market research	36.0%	27.5%	13.5%	15.6%	9.9%
Apply for a patent	36.0%	26.4%	13.6%	9.2%	7.4%
Register a trademark	28.0%	16.8%	10.2%	10.2%	5.4%
Publish papers	24.0%	19.9%	5.7%	3.1%	4.1%
Purchase patent	30.0%	11.8%	8.0%	3.3%	3.1%
Purchase external R&D	20.0%	18.3%	5.2%	4.8%	3.6%
Mean # Innovation Activities	5.8	4.6	3.4	3.4	3.0

Source: Georgia Manufacturing Survey 2005, weighted responses of 494 manufacturers.

Table 4.5. Innovations Introduced from 2002 to 2004 by Region
(Percentage of Establishments Engaged in Innovation Activities)

Innovation Activity	Atlanta	Central	Coastal	Northeast	Northwest	South	West
Work with customers for innovation	64.3%	62.5%	75.9%	58.7%	59.3%	51.3%	60.5%
Purchase equipment	57.1%	51.7%	58.2%	63.4%	64.1%	56.3%	52.3%
Work with suppliers for innovation	48.0%	41.0%	49.5%	40.2%	42.8%	31.7%	40.3%
In-house R&D	44.8%	26.3%	44.6%	40.2%	42.5%	38.3%	45.4%
Sign a confidentiality agreement	48.2%	35.6%	28.8%	38.8%	28.2%	29.8%	29.0%
Planning and development	34.9%	28.8%	35.1%	32.8%	22.4%	33.2%	22.8%
Training	24.0%	20.0%	22.0%	17.1%	12.9%	24.7%	26.9%
Apply for a patent	19.0%	3.8%	16.7%	10.0%	9.7%	9.6%	8.9%
Market research	18.9%	21.5%	6.2%	16.4%	13.0%	14.1%	10.7%
Register a trademark	15.2%	5.9%	12.9%	5.5%	5.6%	7.5%	11.0%
Publish papers	11.5%	11.0%	2.8%	8.1%	2.7%	1.4%	3.8%
Purchase patent	9.8%	4.4%	14.5%	4.0%	4.6%	5.6%	4.4%
Purchase external R&D	7.9%	4.8%	4.8%	6.4%	5.4%	10.7%	5.3%
Mean # Innovation Activities	4.0	3.2	3.7	3.4	3.1	3.1	3.2

Source: Georgia Manufacturing Survey 2005, weighted responses of 494 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 3. The "gap" between small and large establishments (by the median-sector knowledge content measures) is 2 innovation activities.

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 have profiles of innovation activity usage far exceeding the 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 the two "ends" of the innovation spectrum--In the food-text and science-based industry groups—have relatively little gap between large and small establishments, even though large establishments score somewhat higher than smaller ones. The SME-large establishment innovation gap is great-

est for metals/machinery establishments, followed to a lesser degree by material and then elec-trans 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 elec-trans groups with many less well-performing SMEs to catch up with the leading edge of innovation practices in their sectors could be helpful.

Figure 4.6. Number of Innovation Activities Used by Establishment Size

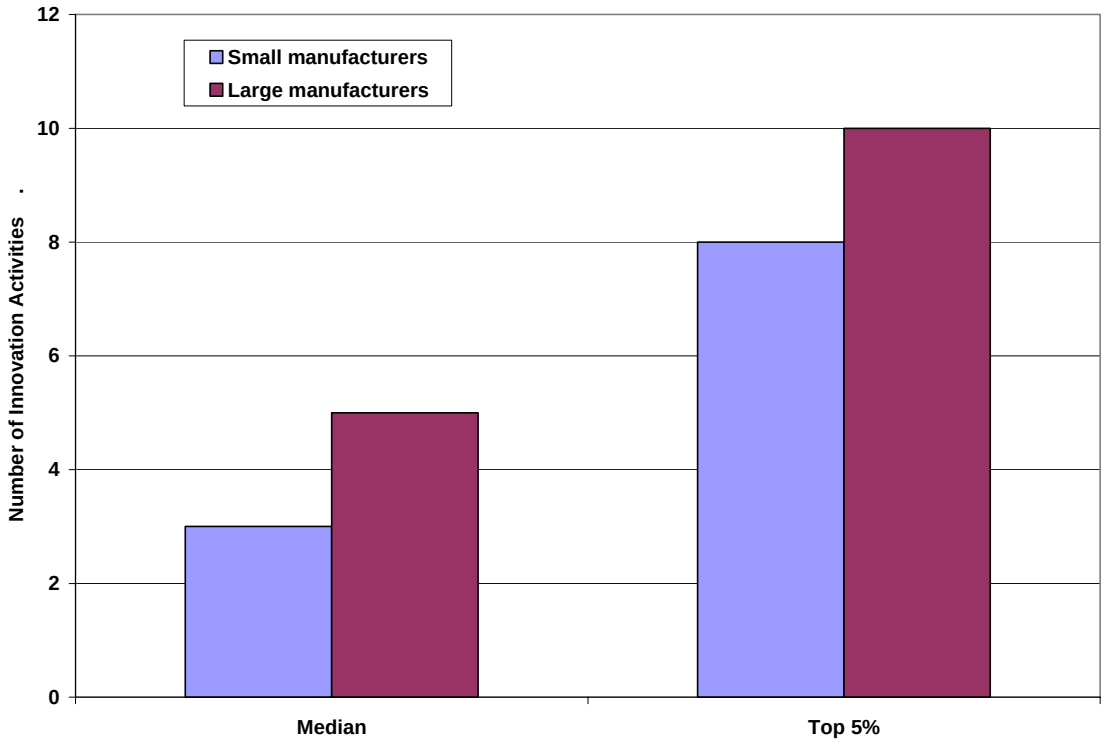
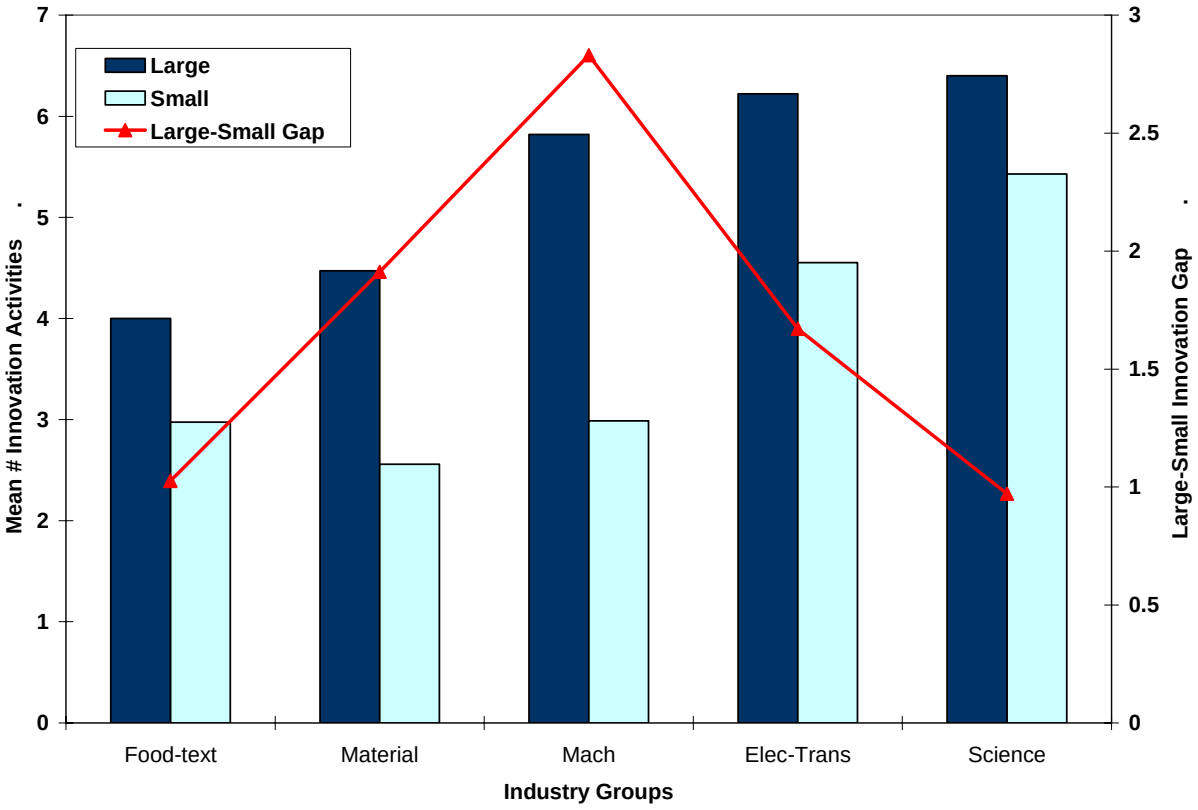


Figure 4.7. Number of Innovation Activities Used by Establishment Size within Industry Groups



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 invested nearly $90,000 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 means that exclude the top and bottom five percent of responses are reported)

	Mean	Mean (trimmed)*	Median
In-house R&D	$4,782	$1,177	$250
R&D capital investments	$5,464	$2,895	$1,231
Other R&D	$1,125	$233	$-

Purchased R&D	$374	$36	$-
All R&D Expenditures	$10,765	$5,177	$2,300

*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 2005, weighted responses of 494 manufacturers.

We did not see much difference in innovation expenditures by facility employment size, with the exception of capital expenditures being higher for medium and large manufacturers than for small ones. As one might expect, science-based establishments had the highest values for innovation expenditures in in-house R&D, purchased R&D from external sources, and other development work. However, innovation-related capital investments appeared rather higher for the food-text industry group, followed by the material group, and then science-based manufacturers. By region, the Northeast had the highest average R&D expenditures. (See Table 4.7.)

Table 4.6: Average Innovation Expenditures and Investments Per Employee
(The mean that would be obtained if the upper and lower 2.5 percent of the distribution were excluded)

	In-house R&D	Purchased R&D	R&D Capital Investments	Other R&D	All R&D Expenditures
Total	$1,177	$36	$2,895	$233	$5,177
Employment Size					
10-49	1,053	22	2,704	254	4,862
50-249	1,368	65	3,157	182	5,683
250+	1,401	50	3,450	316	5,691
Industry					
Science	5,966	790	3,825	1,138	12,864
Elec-Trans Mach	2,187	130	1,120	179	4,556
Material	891	33	1,363	111	3,066
Food-text	708	3	3,982	183	5,506
	1,054	6	3,561	184	5,660
Region					
Atlanta	1,388	86	2,778	300	5,615
Central	280	71	1,421	138	2,360
Coastal	1,387	3	2,020	118	4,067
Northeast	2,488	28	4,765	243	8,200
Northwest	635	19	2,468	194	4,219
South	1,152	4	2,084	173	4,008
West	1,047	6	4,400	234	5,952

Source: Georgia Manufacturing Survey 2005, weighted responses of 494 manufacturers.

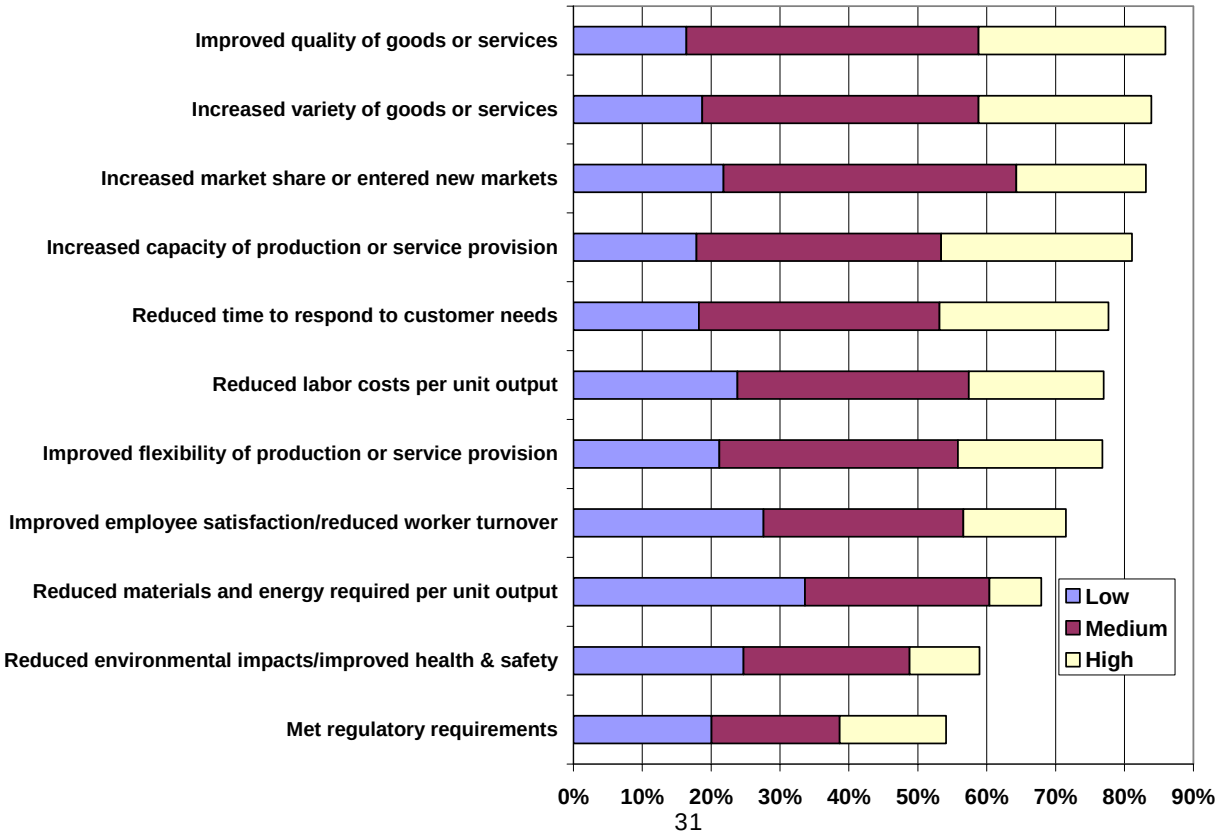
Benefits of Innovation

We asked respondents that undertook an innovation in the 2002 to 2004 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 4.8 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, increased market share, and increased production capacity 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 production capacity – 28 percent
- Improved quality – 27 percent
- Increased variety of goods and services – 25 percent
- Reduced time to respond to customer needs – 25 percent

The benefit area which received the lowest percentage of "high impact" ratings was reduced materials and energy required per unit output.

Figure 4.8. 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 2005, weighted responses of 467 manufacturers.

The incidence of high impacts from innovation was roughly the same regardless of facility employment size. Exceptions to this finding were impacts having to do with costs and environmental impacts, to which large manufacturers assigned a high rating more frequently than small manufacturers. The impacts of innovation appear to be available to any facility no matter its size. Wide variability across industry groups and regions continued to persist, however. (See Tables 4.8, 4.9, 4.10.) Impacts most commonly rated high by industry were:

- Science-based: Increased variety of goods and services, Increased market share, Improved quality, Ability to meet regulatory requirements, Increased production capacity
- Elec-trans: Increased variety of goods and services, Increased production capacity
- Mach: Reduced time required to respond to customer needs, Improved quality, Improved production flexibility, Increased production capacity, Reduced labor costs per unit
- Food-text: Increased production capacity, Increased variety of goods and services, Reduced labor costs
- Material: Improved quality, Increased production capacity, Reduced time required to respond to customer needs, Increased variety of goods and services, Improved production flexibility.

We also saw by region that high impact ratings were not necessarily dominated by Atlanta. Often the highest percentage was in another region. For example, increased variety of goods was most frequently given a high rating by establishments in the South and Central regions of the state. Increased production capacity registered highest among manufacturers in the Northwest and Central regions.

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

Innovation Impact	Total	10-49	50-249	250+
Increased capacity of production or service provision	27.7%	28.4%	26.5%	28.3%
Improved quality of goods or services	27.1%	27.3%	28.1%	22.6%
Increased variety of goods or services	25.1%	25.1%	23.9%	29.4%
Reduced time to respond to customer needs	24.6%	26.7%	21.9%	20.5%
Improved flexibility of production or service provision	21.0%	23.0%	17.6%	22.0%
Reduced labor costs per unit output	19.6%	16.9%	22.6%	24.7%
Increased market share or entered new markets	18.8%	19.0%	18.3%	19.3%
Met regulatory requirements	15.5%	14.4%	16.4%	18.8%
Improved employee satisfaction/reduced worker turnover	14.9%	17.9%	9.7%	14.3%
Reduced environmental impacts/improved health & safety	10.2%	7.6%	12.7%	15.7%
Reduced materials and energy required per unit output	7.5%	7.2%	6.5%	12.3%

Source: Georgia Manufacturing Survey 2005, weighted responses of 467 manufacturers.

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

Innovation Impact	Science	Elec-Trans	Mach	Food-text	Material
Increased capacity of production or service provision	22.5%	21.0%	25.5%	27.9%	31.8%
Improved quality of goods or services	27.3%	19.9%	27.9%	19.3%	32.6%
Increased variety of goods or services	37.5%	23.5%	18.8%	24.5%	25.8%
Reduced time to respond to customer needs	14.0%	15.2%	29.8%	20.4%	29.0%
Improved flexibility of production or service provision	10.3%	18.6%	26.4%	12.9%	25.8%
Reduced labor costs per unit output	14.0%	15.6%	21.6%	22.5%	19.7%
Increased market share or entered new markets	30.2%	19.5%	14.2%	15.6%	19.4%
Met regulatory requirements	23.8%	11.9%	12.9%	14.4%	16.1%
Improved employee satisfaction/reduced worker turnover	12.2%	9.6%	16.0%	14.3%	16.6%
Reduced environmental impacts/improved health & safety	7.5%	8.0%	6.7%	13.0%	11.7%
Reduced materials and energy required per unit output	9.8%	5.7%	8.9%	8.8%	6.0%

Source: Georgia Manufacturing Survey 2005, weighted responses of 467 manufacturers.

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

Innovation Impact	Atlanta	Central	Coastal	North-east	North-west	South	West
Increased capacity of production or service provision	28.1%	38.8%	29.9%	22.4%	34.8%	24.6%	18.0%
Improved quality of goods or services	32.8%	28.1%	25.6%	17.7%	22.8%	28.1%	23.8%
Increased variety of goods or services	27.3%	31.7%	24.6%	21.3%	22.4%	33.3%	13.2%
Reduced time to respond to customer needs	26.6%	34.3%	15.6%	17.2%	30.8%	26.1%	18.7%
Improved flexibility of production or service provision	21.1%	30.9%	18.6%	16.8%	23.3%	28.8%	11.4%
Reduced labor costs per unit output	15.2%	17.7%	28.0%	18.0%	27.1%	21.6%	23.9%
Increased market share or entered new markets	22.5%	12.4%	26.6%	9.2%	19.0%	19.5%	17.0%
Met regulatory requirements	13.0%	13.8%	17.9%	19.3%	18.1%	21.6%	9.9%
Improved employee satisfaction/reduced worker turnover	12.7%	19.1%	12.1%	15.2%	23.3%	19.1%	7.1%
Reduced environmental impacts/improved health & safety	6.4%	6.9%	10.1%	11.7%	18.1%	11.5%	14.1%
Reduced materials and energy required per unit	6.4%	5.9%	5.5%	11.7%	12.6%	5.3%	3.0%

output

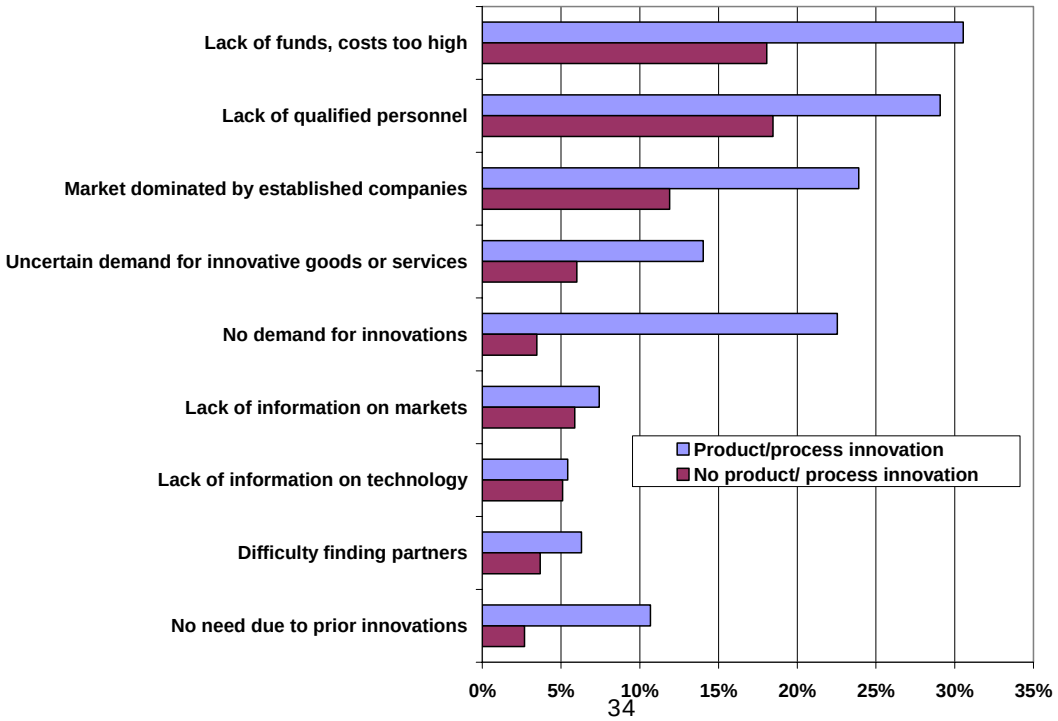
Source: Georgia Manufacturing Survey 2005, weighted responses of 467 manufacturers.

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, 62 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 papers, licensing intellectual property, 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. 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. The least important constraint on innovation was lack of need because of existing innovation activities.

Comparing establishments that have engaged in a product or process innovation with those that have not, Figure 4.9 shows that the top three barriers—lack of funds, lack of qualified personnel, and market dominated by established suppliers—serve as limitations for both these groups of establishments. However, lack of demand for innovation is a particularly more significant constraint on establishments engaged in product or process innovation than among those that have not engaged in these activities.

Figure 4.9. Limitations on Innovation: Product or Process Innovators vs. Establishments without Innovation Activity (% rating limitation of high degree of importance)



Source: Georgia Manufacturing Survey 2005, weighted responses of 584 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 costs—more important to small than to large manufacturers—but lack of qualified personnel is equally prevalent across all employment size classes. By industry, lack of qualified personnel was the most common barrier for metals and machinery firms and those in the elec-trans group. Costs were prominent in the material group, and the dominance of established firms in the food-text group.

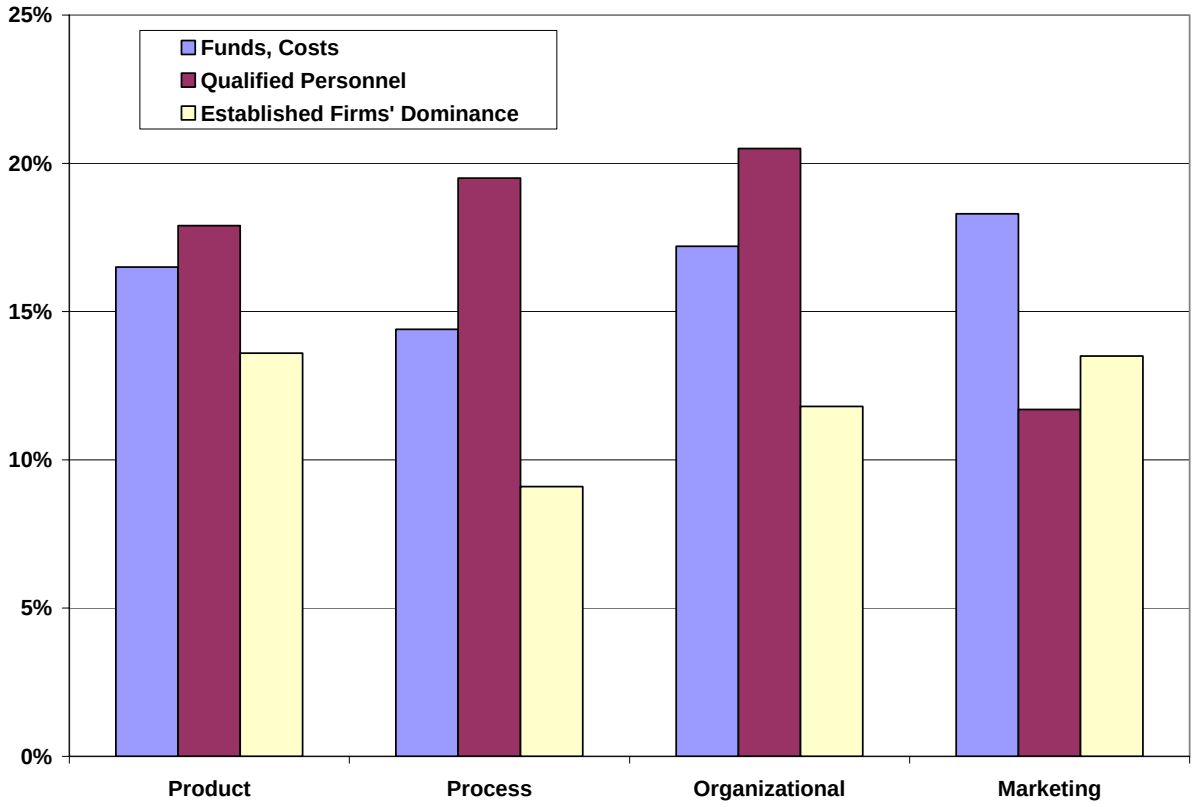
Table4.11 Top Three Most Prevalent Barriers to Innovation by Respondent Characteristics
(percentage of respondents rating barrier to be of high importance)

	Funds Costs	Qualified Personnel	Established Firms
Total	21.1%	20.2%	13.8%
Employment			
10-49	23.0%	20.6%	14.7%
50-249	17.1%	19.3%	12.8%
250+	10.7%	20.2%	11.6%
Industry			
Science	10.6%	14.9%	12.5%
Elec-Trans	19.0%	23.2%	13.9%
Material	23.1%	20.1%	10.4%
Food-text	19.0%	15.4%	24.6%
Mach	20.0%	26.7%	9.2%
Region			
Atlanta	17.9%	15.7%	13.1%
Central	26.9%	26.4%	16.8%
Coastal	15.7%	22.0%	12.1%
Northeast	25.7%	22.0%	12.1%
Northwest	19.4%	18.0%	18.8%
South	18.2%	32.9%	11.9%
West	21.1%	19.5%	12.9%

Source: Georgia Manufacturing Survey 2005, weighted responses of 584 manufacturers.

It is interesting that the prominence of one of the top three obstacles varied according to the type of innovation a company had introduced. Firms engaged in product innovation were almost equally likely to rate costs and qualified personnel to be barriers of high importance. Process innovations placed the most emphasis on lack of qualified personnel. For organizational innovations, lack of qualified personnel was the most common highly important obstacle, followed by high costs. Marketing innovations were most apt to be highly constrained by costs, followed by the dominance of established firms.

Figure 4.10. 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 2005, weighted responses of 584 manufacturers.

Chapter
5

Technology and Production Practices

Information technology (IT) and production practices are a further enabling factor in encouraging innovation-based competition. Manufacturing technologies and techniques have been the subject of much change over the past 10 years. The late 1990s saw the rise in adoption of Internet-related technologies and quality and workflow improvements on the shop floor. This chapter will profile the nature of technologies and production practices among Georgia manufacturers in 2005.

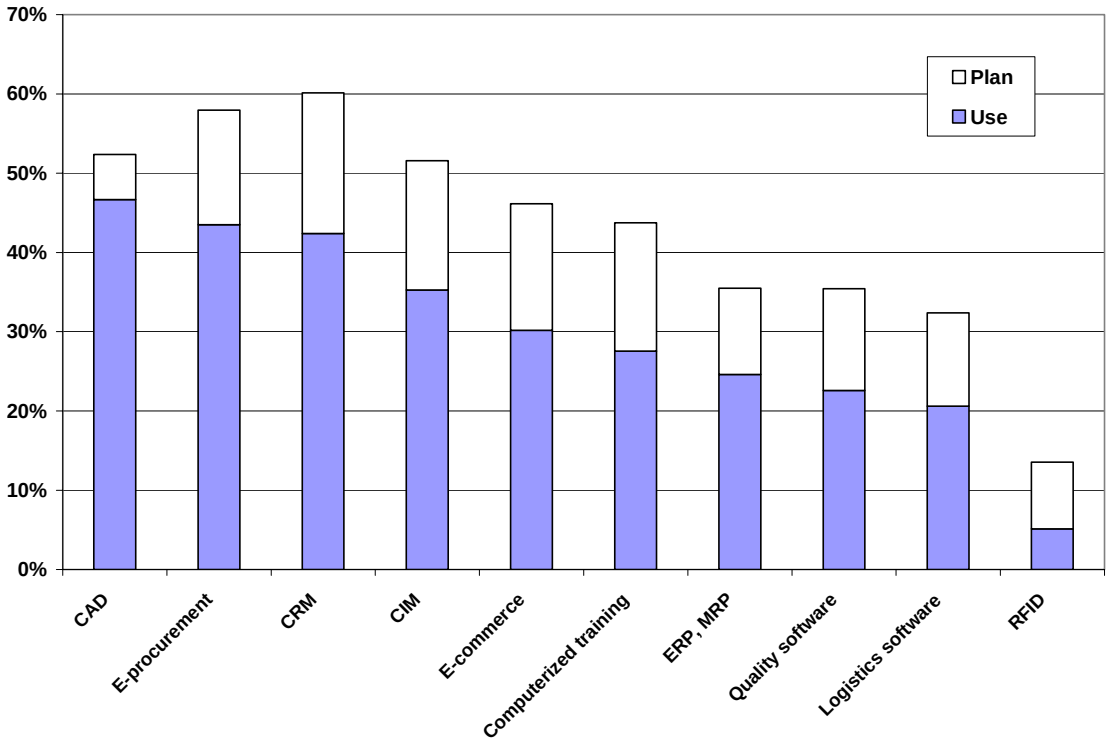
Information Technologies

We asked manufacturers about their adoption of 10 IT hardware and software applications. These applications included: sale of products via the Internet (e-commerce), supplier purchases via the Internet (e-procurement), supply chain, logistics management software, software for quality or standards (e.g., ISO), design software (e.g., computer-aided design), process control (e.g., computer-integrated manufacturing), customer information / relationship management (CRM), computer training systems for employees or customers[6], radio frequency identification (RFID), and integrated business management (e.g., enterprise resource planning). Computer-aided design (CAD) was the most prevalent IT application, used by nearly half of the manufacturers that responded to the survey. E-procurement and customer relationship management (CRM) were the next most common, used by more than 40 percent of respondents. At the other end, only 5 percent of respondents reported that their facility currently used RFID. (See Figure 5.1.)

Among non-users of these technologies, a segment reported that it planned to use the technology in the next two years. Based on the percentage of respondents indicating that they planned to adopt the technology, plans were most prominent for CRM (17 percent), CIM (16 percent), computerized training (16 percent), and e-procurement (15 percent). Only 6 percent of respondents planned to implement CAD in the next two years, suggesting that this technology may be nearer to its maturation point than the others we surveyed.

[6] We believe that respondents might have misunderstood the meaning of computer training systems for customers or employees, with more respondents indicating that they use these systems than actually do use them.

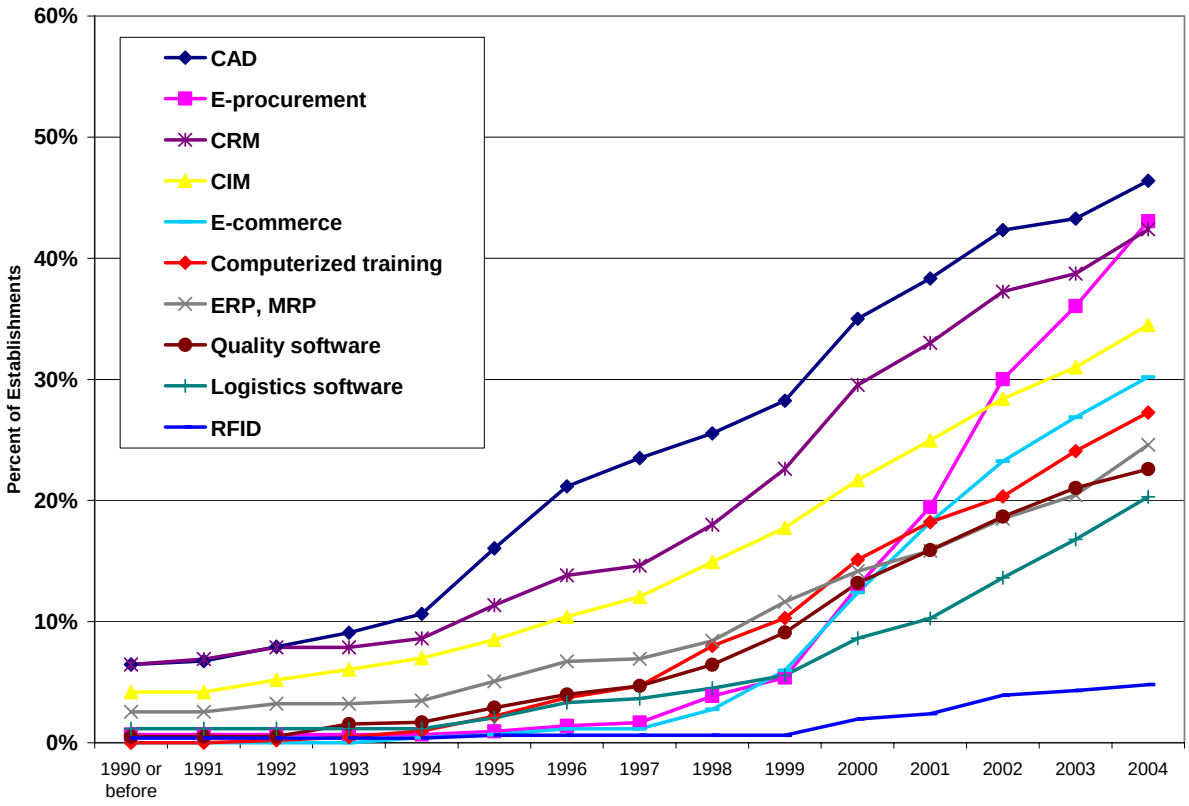
Figure 5.1. Current and Planned Use of Information Technology Applications
(Percentage of respondents that currently or plan to use an application)



Source: Georgia Manufacturing Survey 2005, weighted responses of 609 manufacturers.

We asked respondents to tell us the year they first used these information technologies. Figure 5.2 shows the percentage of respondents by year in which the information technologies were first used. The data suggests that the penetration of IT applications in Georgia shows the early adoption-to-early majority stage of the classic "S-curve" diffusion pattern, taking off after 1994. In the early 1990s, the most common technologies were oriented towards manufacturing design, integration, planning, and customers. These somewhat traditional applications were eclipsed in the 1990s and early 200s by rapidly-growing Internet technologies, particularly by e-procurement and, to a lesser extent, e-commerce. Even though a declining percentage of respondents indicate that IT issues are among the most significant problems or needs, it does seem that manufacturers are continuing to make investments in information technology, particularly Internet-related technologies.

Figure 5.2. Diffusion of Information Technologies: 1990 to 2004
(Percentage of establishments reporting the year that they first used a technology)



Source: Georgia Manufacturing Survey 2005, weighted responses of 609 manufacturers.

We examined the percentage of respondents that currently use these technologies by manufacturing establishment characteristics. (See Table 5.1.) As might be expected, many information technologies display increased use by facility employment size. However, the Internet technologies such as e-commerce and e-procurement show less of a size-based relationship. We also see that customer relationship technologies have a relatively similar penetration rate among the size classes. By industry, IT usage is most prominent among the science-based and elec-trans groups. However, some technologies such as CAD and RFID are typically associated with the metals/machinery and food/textiles industries, respectively. By region, IT usage tends to be more prominent among manufacturers in the Atlanta and Coastal regions and less prominent among those in the Northwest and Central regions.

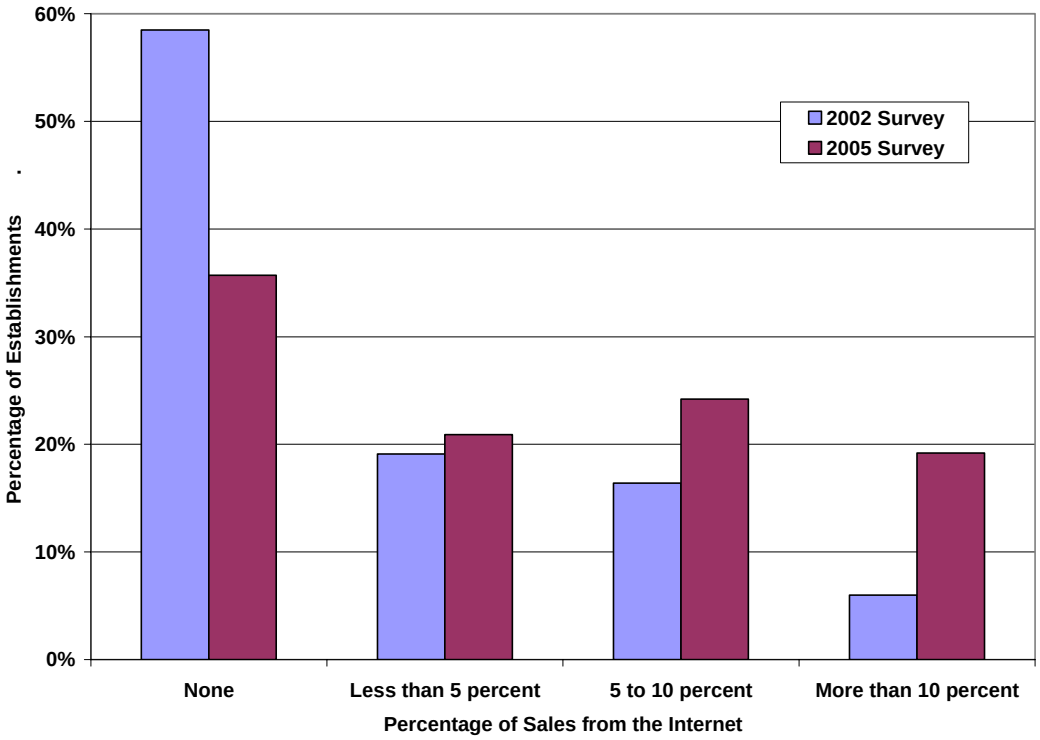
Table 5.1. Current Use of Information Technologies by Establishment Characteristics
(Percentage of establishments reporting that they currently use information technologies)

	CAD	E-procure-ment	CRM	Process control, CIM	E-com-merce	Compu-terized training	ERP, MRP	Quality soft-ware	Logistics software	RFID
Total	46.7%	43.5%	42.4%	35.3%	30.2%	27.5%	24.6%	22.6%	20.6%	5.1%
Employment										
10-49	42.2%	39.2%	40.3%	26.7%	30.9%	17.5%	14.3%	14.1%	11.0%	2.1%
50-249	49.9%	52.0%	44.1%	43.7%	29.1%	38.3%	33.6%	31.0%	32.1%	5.8%
250+	*67.9%*	42.9%	50.9%	*66.9%*	29.1%	*61.4%*	*66.9%*	*53.9%*	*48.4%*	*24.9%*
Industry										
Science	48.0%	*58.0%*	*58.0%*	*52.0%*	*38.0%*	*44.0%*	*50.0%*	*46.0%*	*34.0%*	2.0%
Elec-Trans	*66.2%*	47.2%	*57.5%*	39.8%	*40.7%*	*38.4%*	*49.8%*	*42.9%*	*38.4%*	*10.7%*
Mach	*59.4%*	44.9%	33.7%	36.7%	31.1%	21.3%	26.2%	18.8%	15.6%	2.5%
Material	46.9%	42.0%	39.1%	34.2%	26.0%	24.3%	15.1%	18.1%	13.4%	2.8%
Food-text	26.2%	37.9%	44.1%	27.4%	29.9%	28.5%	20.7%	17.1%	26.2%	*10.9%*
Region										
Atlanta	51.0%	45.7%	45.4%	36.8%	36.6%	28.0%	28.2%	25.1%	25.0%	5.3%
Central	41.0%	37.5%	35.2%	33.6%	26.0%	28.9%	26.2%	17.2%	5.9%	2.1%
Coastal	42.6%	50.9%	48.0%	43.8%	31.3%	26.6%	22.1%	27.3%	27.1%	2.1%
Northeast	52.1%	47.4%	45.8%	32.7%	27.5%	28.9%	18.7%	21.7%	17.3%	5.7%
Northwest	37.7%	38.9%	33.8%	29.6%	18.7%	23.7%	19.4%	8.8%	17.0%	4.2%
South	46.7%	31.9%	45.6%	34.8%	34.7%	30.9%	26.2%	26.4%	22.1%	7.5%
West	42.3%	47.3%	35.6%	36.9%	24.0%	25.0%	27.0%	32.0%	19.2%	7.0%

Source: Georgia Manufacturing Survey 2005, weighted responses of 609 manufacturers.

We also found that by 2005, more manufacturers are getting more of their sales through the Internet than they did in 2002. Figure 5.3 shows that nearly two-thirds of respondents that use the Internet are getting a portion of company sales through the Web site or e-mail, compared with only 41 percent in 2002. To some extent, differences in question wording may account for the greater prominence of the Internet in 2005. The 2002 and 2005 Georgia Manufacturing Survey questions were not quite comparable. The 2002 Georgia Manufacturing Survey asked about sales through the company Web site, whereas the 2005 Georgia Manufacturing Survey asked about sales through the Internet, including e-mail and Web. Nevertheless, we do note this increase between the three years as a possible rise in Web-based sales generation for Georgia manufacturing. We still found that the Internet generates a small share of sales for most respondents—the median percentage of sales through the Internet was 2 percent in the 2005 survey. Nevertheless, a segment of the manufacturing base in the state, comprising about one in five manufacturers, took in in excess of 10 percent of their sales through the Internet. (See Figure 5.3.)

Figure 5.3. Percentage of Company Sales Through the Internet
(Percentage of respondents reporting share of sales via the Internet)

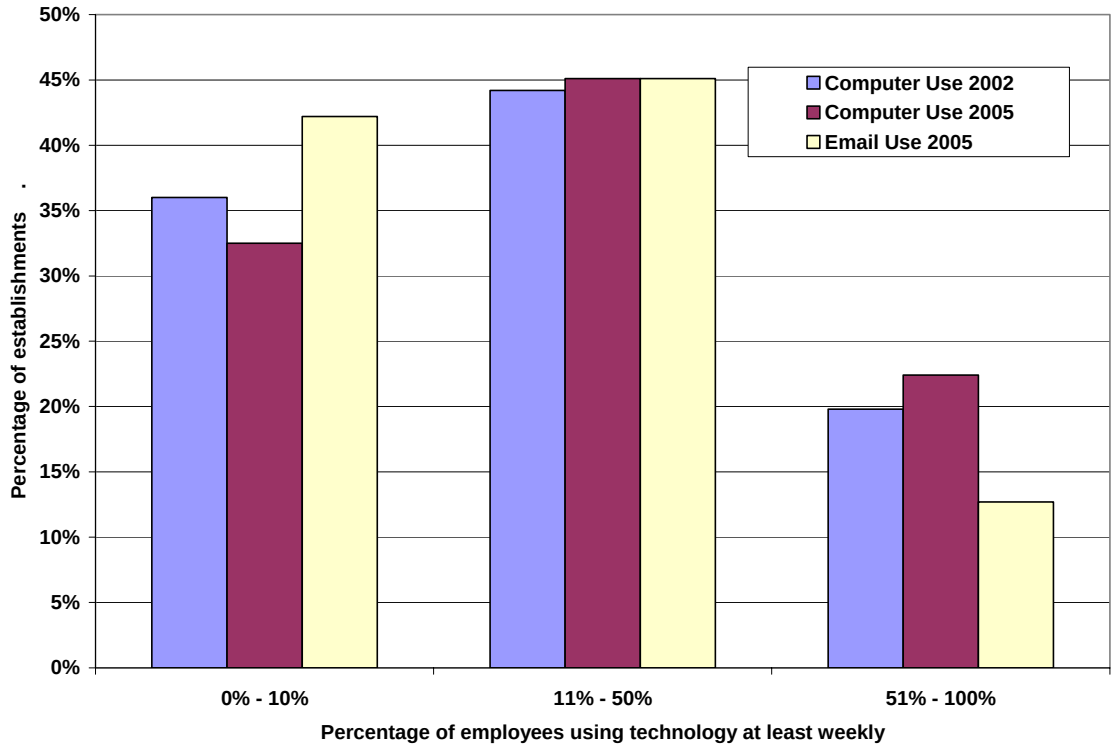


Source: Georgia Manufacturing Survey 2005, weighted responses of 261 manufacturers.

Another measure of the utilization of information technologies is the percentage of employees that regularly use them. We examined two information technologies along this dimension: computers and e-mail. 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 e-mail at least once a week as part of their job. In the case of computer use, we have information from the 2002 survey to serve as a benchmark of change. Figure 5.4 shows that the percentage of employees that regularly use a computer in 2005 has increased slightly, but not very much, over figures from the 2002 survey. E-mail usage in 2005 among manufacturing workers is considerably lower than computer usage. The average (median) manufacturer has about 20 percent of workers using computers and 15 percent using e-mail. Among the top 10 percent, these figures are 90 percent and 66 percent, respectively, but among the bottom 10 percent, the figures are only 2 percent for computers and 1 percent for e-mail. The adoption of information technologies does not demonstrate as much disparity as does the use of these technologies within the manufacturing workforce.

Figure 5.4. Percentage of Employees Using a Computer/programmable Controller or E-mail at Least Once a Week as Part of their Job

(percentage of establishments reporting portion of workers using technology)

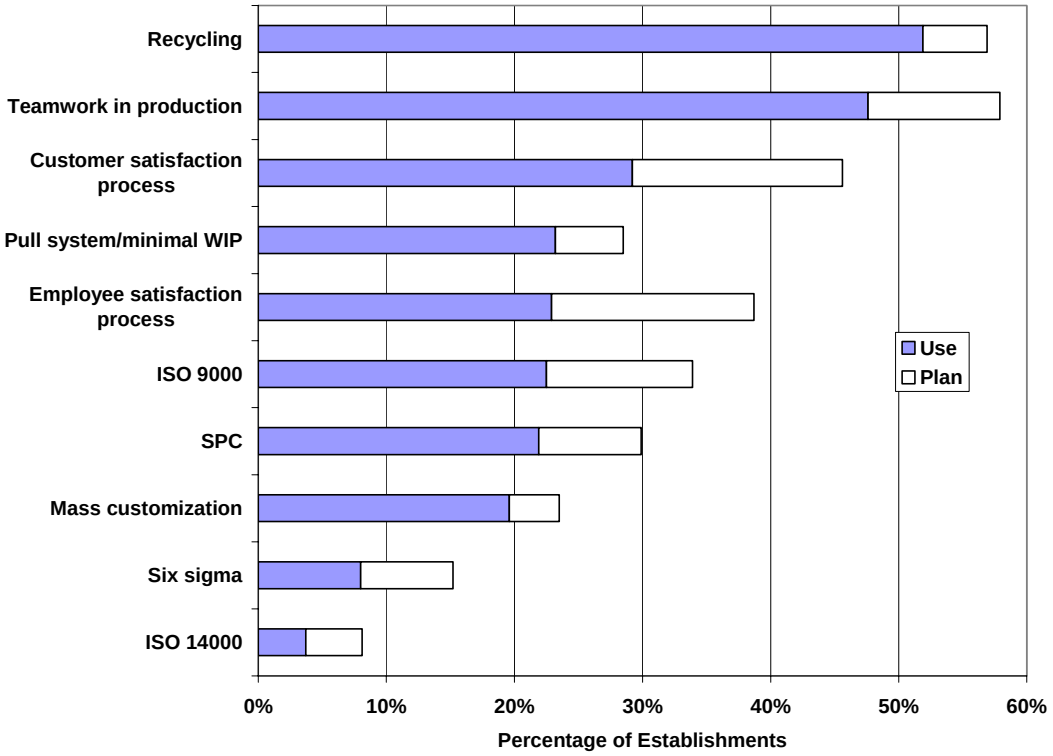


Source: Georgia Manufacturing Survey 2005, weighted responses of 632 manufacturers.

Organizational and Production Practices

The Georgia Manufacturing Survey 2005 asked manufacturers about their take-up of 10 manufacturing techniques: ISO 9000 or other standards certification, Six Sigma, statistical process control (SPC), pull system/ minimal work-in-process (WIP), recycling of materials, ISO 14000 certification, formal process/ survey to monitor customer satisfaction, formal process/ survey to monitor employee satisfaction, teamwork in production, and mass customization. Figure 5.5 shows that the most commonly used production and organizational techniques were recycling and teamwork. Six Sigma and ISO 14000 were least frequently implemented. Planned implementation was greatest for customer and employee satisfaction processes. Techniques with the smallest percentage of respondents planning to implement them were: mass customization, ISO 14000, recycling, pull systems, and Six Sigma. However, even the rather small percentages of planned adopters of ISO 14000 and Six Sigma would represent a doubling of the current penetration rates.

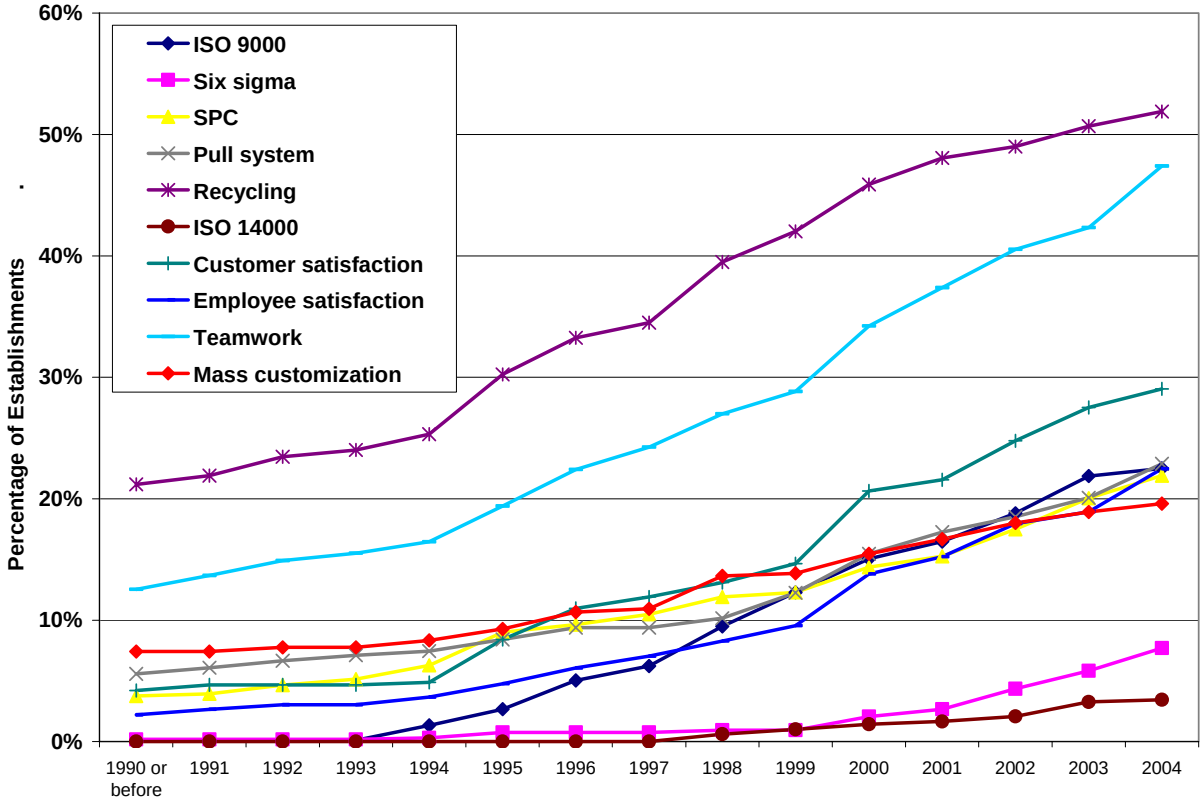
Figure 5.5. Current and Planned Use of Production and Organizational Techniques
(Percentage of respondents that currently or plan to use a technique)



Source: Georgia Manufacturing Survey 2005, weighted responses of 580 manufacturers.

As in the IT diffusion analysis, we asked manufacturers to tell us the year they first took up production and organizational techniques. Figure 5.6 presents the percentage of manufacturing establishments that reported using these techniques in a particular year from before 1990 to 2004-05. This figure displays a much less dramatic increase in adoption rates. The slope of the lines, for the most part, is significantly flatter. A few technologies, such as Six Sigma and teamwork in production, show somewhat of an upswing in adoption in the last four years. But on the whole, the results suggest that take-up of these practices is in a more mature phase than was the case with the IT area. This is somewhat curious given the previous findings that manufacturers consider their most significant problems and needs to be in the manufacturing process area rather than the IT area.

Figure 5.6. Diffusion of Production and Organizational Techniques: 1990 to 2004
(Percentage of establishments reporting the year that they first used a technology)



Source: Georgia Manufacturing Survey 2005, weighted responses of 580 manufacturers.

Exploring the use of manufacturing and organizational techniques by manufacturing attributes, we find as expected that virtually all the techniques are used to a greater extent by larger manufacturers than by smaller ones. (See Table 5.2.) Pull systems that aim for minimal WIP are as prevalent among mid-sized establishments with 50 to 249 employees as they are among large manufacturers with 250 or more employees. By industry, usage of production practices is most widespread among the elec-trans and science-based industry groups. Pull systems and SPC have a higher penetration rate in the elec-trans group, whereas Six Sigma's adoption rate is higher in the science-based industries. By region, the West possesses the highest use rate of manufacturing techniques and the Northwest has the lowest use rate.

Table 5.2. Current Use of Production and Organizational Techniques by Establishment Characteristics

(Percentage of establishments reporting that they currently use technique)

	Recycling	Teamwork	Customer satisfaction process	Pull system	Employee satisfaction process	ISO 9000	SPC	Mass customization	Six sigma	ISO 14000
Total	51.9%	47.6%	29.2%	23.2%	22.9%	22.5%	21.9%	19.6%	8.0%	3.7%
Employment										
10-49	41.1%	42.1%	19.3%	17.1%	14.8%	13.3%	9.9%	15.8%	2.7%	0.3%
50-249	66.8%	54.3%	41.1%	*32.2%*	29.8%	33.0%	36.3%	22.6%	13.4%	6.0%
250+	*75.2%*	*63.6%*	*57.6%*	*33.7%*	*56.4%*	*50.4%*	*55.7%*	*35.7%*	*26.2%*	*21.0%*
Industry										
Science	*62.0%*	*66.0%*	*48.0%*	34.0%	*46.0%*	*52.0%*	36.0%	*26.0%*	*24.0%*	*8.0%*
Elec-Trans	59.9%	57.3%	*48.5%*	*44.9%*	38.4%	*56.5%*	*50.0%*	*28.0%*	13.8%	*8.9%*
Mach	52.5%	46.8%	24.3%	26.9%	17.5%	21.8%	16.6%	18.2%	4.8%	2.0%
Material	54.2%	45.8%	25.6%	19.4%	18.6%	16.2%	17.2%	17.9%	6.3%	3.4%
Food-text	40.1%	40.7%	25.3%	13.7%	20.4%	9.4%	18.4%	18.0%	5.4%	2.2%
Region										
Atlanta	54.2%	48.6%	30.3%	25.4%	23.1%	26.6%	23.7%	22.2%	7.6%	4.6%
Central	56.8%	44.8%	26.0%	25.9%	20.4%	19.9%	18.0%	7.9%	11.7%	2.1%
Coastal	54.2%	55.7%	28.7%	11.1%	29.7%	27.9%	21.5%	14.2%	2.3%	1.3%
Northeast	48.0%	41.5%	28.2%	20.8%	17.0%	19.1%	18.5%	17.8%	6.2%	4.4%
Northwest	50.2%	42.2%	24.6%	17.5%	19.1%	10.3%	16.4%	16.5%	6.2%	1.4%
South	43.7%	42.3%	28.1%	23.3%	23.3%	19.9%	22.7%	22.0%	12.6%	3.5%
West	55.1%	*64.3%*	*38.5%*	*34.8%*	*34.0%*	31.0%	*31.3%*	*28.3%*	11.8%	6.8%

Source: Georgia Manufacturing Survey 2005, weighted responses of 580 manufacturers.

Workforce Organization and Training

Teamwork in production was pervasive among nearly half of respondents to the Georgia Manufacturing Survey. We asked several questions to further examine the use of teams and other workforce organization and training issues. We asked respondents to tell us what percentage of their production workers are in teams. As one might expect based on the above percentage of respondents that currently use teamwork in production, the majority of respondents (55 percent) report that none of their shop floor employees are in teams. We did find a group of about 15 percent of respondents that told us at least 9 out of 10 of their production employees work in teams.

We also asked respondents to tell us whether their employees worked in teams when dealing with customers in the last three years. More than a third of the respondents reported that their employees had worked in inter-firm teams with customers. This percentage was higher for large manufacturers (of which 55 percent worked in inter-firm teams) and the elec-trans industry group (of which 52 percent worked in inter-firm teams). Inter-firm teams with customers were more prominent in Atlanta (41 percent), the Northeast region (39 percent), and the West (37 percent). They were least prominent among respondents in the Central region (20 percent).

It has been increasingly found that bonuses and incentives are an organizational practice adopted to impact manufacturing production. We asked about three types of bonuses and incentives: (1) bonuses for productivity increases, (2) bonuses to reward new ideas suggested or implemented, and (3) bonuses paid for the acquisition of new skills or education. More than half of the manufacturers we surveyed offered some type of bonus to enhance their facility. The most common bonuses were paid for productivity increases, offered by 43 percent of respondents. Bonuses for new skills/education or ideas were much less prevalent, offered by 13 percent and 18 percent of respondents, respectively.

This type of bonus system is not consistent with previous employment size relationships. Incentives for new skills and productivity are more prevalent among small and medium-sized manufacturers than among large ones. Large manufacturers are more frequent users of bonuses for new ideas suggested. By industry, it still holds that science-based industries are the prominent users of bonuses for productivity increases (56 percent), skill acquisition (22 percent), and new ideas (32 percent). The top region in terms of productivity-related bonuses is the Central region (58 percent). The South is the top region for paying bonuses for skill acquisition, and the Northeast and Northwest regions lead all others based on percentage of respondents paying bonuses for new ideas.

In Chapter 2, we saw that concerns about worker skills were prominent among Georgia manufacturers. Upgrading educational levels and promoting more advanced skills through training are two ways to address these skills. Nearly all (85 percent) of manufacturers employed at least one worker with a high school degree. The average (median) workforce within a manufacturing facility had about eight of every 10 workers qualified to at least a high school degree or GED level. However, among respondents in the food-text industry, this percentage dropped to seven of every 10 workers having a high school degree or GED. Similarly, manufacturers in the South and Northwest reported percentages of their workforce with a high school degree in the 70 percent range.

We also asked about associates degrees, two or more years of technical college, vocational, school, or apprenticeship training. Nearly three-quarters of respondents had at least one worker with some technical, vocational, or apprenticeship training. However, these workers accounted for a small portion of the employees in the median manufacturing establishment—around 13 percent of employees. Four-year college degrees were least common, with only 22 percent of manufacturers reporting that they employed at least one worker with a four-year college degree.

In the training area, we asked companies how much they spent on all training activities in 2004. Somewhere in the range of 60 percent to 82 percent of respondents spent something on training activities. The average (median) respondent with an expenditure spent $200 per employee on training. Among establishments with training expenditures, facility employment size was not a consistent indicator of training expenditures per employee. However, industry group was, with science-based establishments spending the most on training and manufacturers in the food-text industry spending the least. Respondents in the Atlanta region spent the most on training on a per employee basis and those in the South spent the least. (See Figure 5.7.)

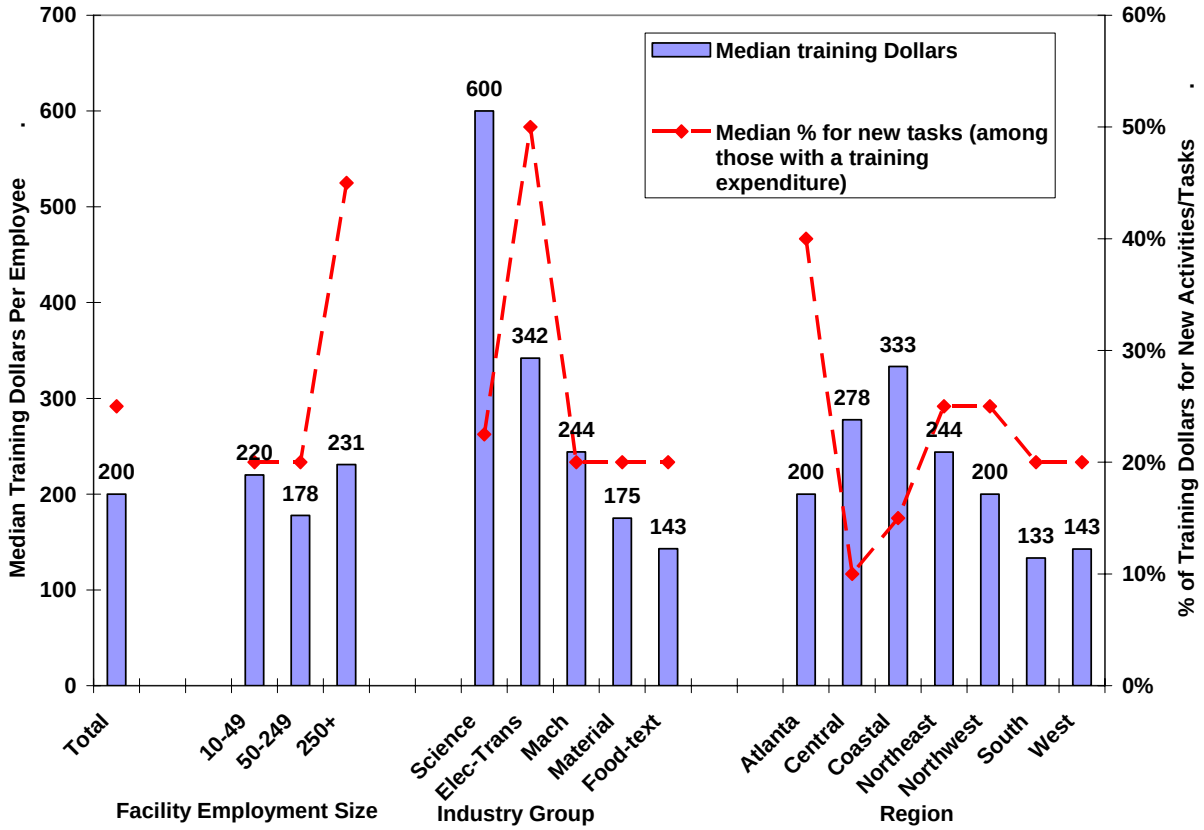
Table 5.3. Types of Bonuses, Incentives Paid to Employees
(Percentage of respondents that offer type of bonus)

	Productivity increases	New ideas	New skills
Total	43.2%	17.9%	13.4%
Employment			
10-49	42.0%	13.0%	12.0%
50-249	48.0%	23.0%	16.0%
250+	39.0%	31.0%	11.0%
Industry			
Science	56.0%	32.0%	22.0%
Elec-Trans	38.0%	21.0%	12.0%
Mach	36.0%	14.0%	15.0%
Material	48.0%	15.0%	13.0%
Food-text	37.0%	20.0%	10.0%
Region			
Atlanta	44.0%	20.0%	13.0%
Central	58.0%	16.0%	9.0%
Coastal	44.0%	9.0%	7.0%
Northeast	46.0%	20.0%	15.0%
Northwest	34.0%	21.0%	12.0%
South	41.0%	13.0%	22.0%
West	37.0%	15.0%	11.0%

Source: Georgia Manufacturing Survey 2005, weighted responses of 345 manufacturers.

We asked respondents that spent some money on training to tell us what percentage of these training dollars was related to new activities and tasks, rather than for routine training. Among manufacturers with training expenditures in 2004, the average (median) respondent said that about one-fourth of the facility's training dollars went for new activities and tasks. However, roughly 13 percent of respondents allocated 100 percent of their training dollars to new activities and tasks. The average large establishment spent more than twice what their small and medium-sized counterparts allocated to new training activities and tasks. In addition, the median respondent in the elec-trans group and in the Atlanta region reported the highest percentage of training allocated to non-routine activities and tasks.

Figure 5.7. Median Expenditures per Employee on All Training Activities in 2004 and Median Percentage of Training Dollars Related to New Activities and Tasks



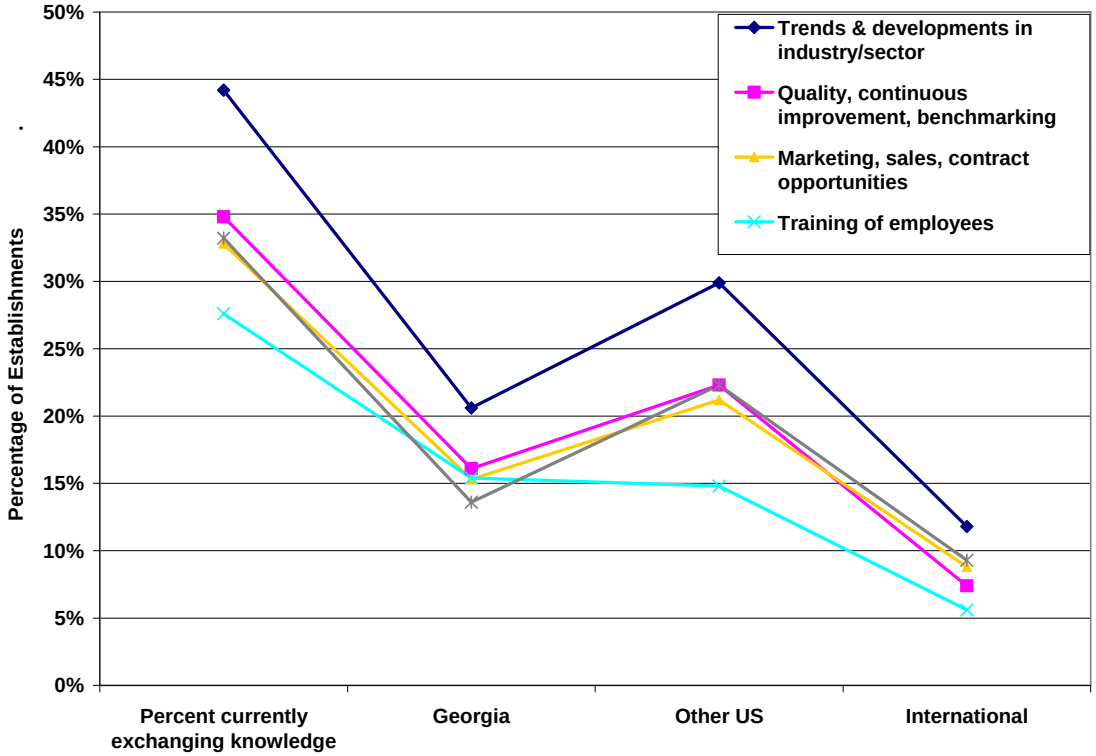
Source: Georgia Manufacturing Survey 2005, weighted responses of 512 manufacturers.

Knowledge Exchange

The encouragement of knowledge sharing and exchange is a hallmark of today's competitive environment. We asked respondents to tell us whether they exchange knowledge with other companies in five areas: (1) trends and developments in industry/sector; (2) quality, continuous improvement, benchmarking; (3) marketing, sales, contract opportunities; (4) training of employees; and (5) product development, process improvement, or research cooperation.

Figure 5.7a shows some variation in the incidence of knowledge sharing by area. Knowledge about trends and developments in industry/sector was the most pervasive, reported by 44 percent of respondents. The next group—quality, product development, and marketing knowledge—was exchanged by roughly one-third of respondents. Knowledge about training of employees was least popular, in that only 28 percent of respondents exchanged this information.

Figure 5.7a. Knowledge Exchange with Other Companies: Location of Corporate Knowledge Partners (of Those That Exchange Knowledge)



Source: Georgia Manufacturing Survey 2005, weighted responses of 388 manufacturers.

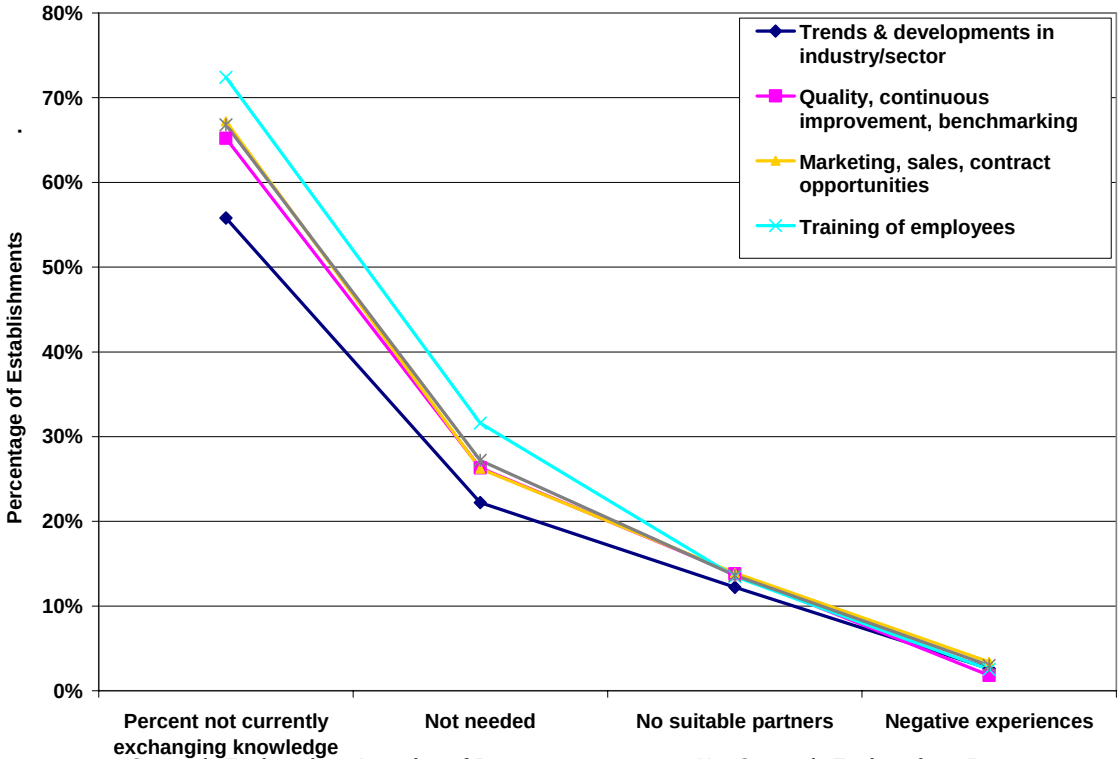
The location of corporate knowledge-sharing partners was asked of all respondents who said they engaged in knowledge exchange. U.S. partners outside of Georgia represented the most common location, used by 20 to 30 percent of respondents depending on the knowledge exchange area. Within-Georgia exchanges were next most prevalent, used by 15 to 20 percent of respondents. Exchanges with international corporate partners were used by about 5 to 10 percent of respondents. Most of the knowledge exchange areas followed this overall pattern with the exception of training of employees, which was as likely to involve Georgia partners as to involve U.S. partners outside the state.

We asked companies that did not exchange knowledge in a particular area why that was the case. Figure 5.7b shows that the most common reason was that such interchanges were not needed. This was particularly true for the employee training area, in which more than 30 percent of respondents said they did not exchange knowledge because of lack of need. Approximately 10 to 15 percent of respondents did not exchange knowledge because there were no suitable partners. Negative experience was rarely mentioned as a cause of failing to share knowledge.

Knowledge exchange practices were examined by facility employment size, industry group, and region. As expected, knowledge exchange was more frequent among large manufacturers than among smaller firms. The exception was exchange of marketing information, which was about the same across all size classes. By industry, the elec-trans group had the highest incidence of knowledge exchange, but the science-based group equalled this rate in the product development/process improvement/research cooperation

area. The materials group also had a relatively prominent rate of exchange of knowledge about industry trends, quality improvement, and marketing opportunities. Respondents in the Coastal region showed the highest frequency of knowledge exchange; again, those in the Northwest had the lowest rates.

Figure 5.7b. Reasons for Not Exchanging with Other Companies (of Those That Do Not Exchange Knowledge)



Source: Georgia Manufacturing Survey 2005, weighted responses of 388 manufacturers.

Table 5.3. Knowledge Exchange Areas by Respondent Characteristics
(percentage exchange knowledge in area)

	Industry/sector trends & developments	Quality, continuous improvement, benchmarking	Product development, process improvement, research cooperation	Marketing, sales, contract opportunities	Employee Training
Total	46.5%	37.5%	35.6%	35.2%	29.8%
Employment					
10-49	44.8%	32.9%	32.3%	36.4%	24.5%
50-249	46.4%	41.2%	37.4%	32.6%	32.4%
250+	*59.5%*	*58.2%*	*52.4%*	35.8%	*58.0%*
Industry					
Science	45.8%	39.6%	*44.9%*	34.7%	37.5%
Elec-Trans	*62.1%*	*51.3%*	*45.9%*	*57.8%*	*43.5%*

Mach	38.9%	31.4%	33.1%	31.7%	21.5%
Material	47.9%	39.3%	33.9%	36.3%	30.0%
Food-text	44.5%	33.4%	32.9%	27.1%	27.8%
Region					
Atlanta	49.4%	38.9%	39.7%	41.0%	31.1%
Central	61.5%	34.4%	41.0%	43.2%	25.7%
Coastal	55.8%	50.3%	42.2%	43.0%	28.4%
Northeast	40.4%	31.2%	28.8%	27.6%	31.0%
Northwest	32.1%	27.6%	21.9%	21.7%	22.6%
South	45.4%	39.5%	36.0%	34.7%	30.9%
West	47.7%	47.0%	41.3%	32.3%	36.4%

Source: Georgia Manufacturing Survey 2005, weighted responses of 388 manufacturers.

We asked respondents to tell us whether they plan to change the level of effort that they plan to put into exchanging and sharing of knowledge with other companies. Ninety percent of the companies either do not plan to change this level of effort or say that the practice is not relevant to them.

Chapter
6

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." [7] In this analysis, we used exporting activity (by value) as a measure of competitiveness.

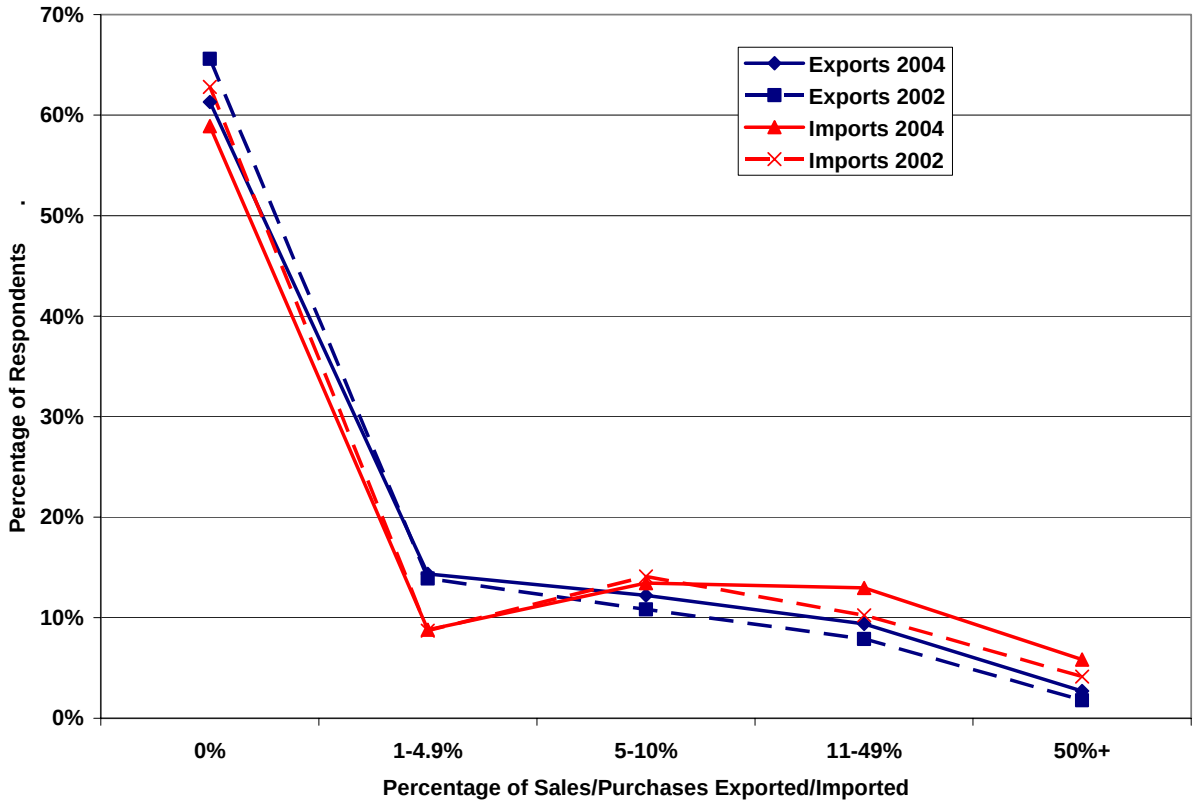
Responses to the Georgia Manufacturing Survey 2005 indicate that approximately 40 percent of respondents did some exporting of sales or some importing of materials, parts, and services. The mean percentage of export sales in 2004 was just under 6 percent; the mean percentage of purchases of materials, parts, and services from sources outside the United States was 9.7 percent. The top 10 percent of exporters accounted for 16 percent of their sales through exports. The top 10 percent of importers obtained 30 percent of their materials, parts, and services from non-U.S. sources.

Figure 6.1 compares exporting and importing figures in 2004 with those in 2002. The figure shows that the exports and imports levels in 2004 were somewhat higher than they were in 2002.

We focused on the segment of establishments that did any exporting or importing, regardless of the value of those transactions. Table 6.1 shows that the propensity to export increases as facility employment size rises. The food-text industry group has the largest percentage of firms with at least some export sales, whereas the science-based and electrans group has the smallest percentage. The prevalence of exporting firms is highest in the Atlanta and West regions and lowest in the Central region. These trends also apply to imports of materials, parts, and services from sources outside of Georgia, although the occurrence of firms doing some importing is as high (if not higher) among medium-sized establishments with 50 to 250 employees as it is among large establishments with 250 or more employees. We also see a higher rate of firms doing some importing in the Central region than was the case with exporting.

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

Figure 6.1. 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 2005, weighted responses of 552 manufacturers.

Table 6.1. 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
Total	38.7%	41.0%
Employment		
10-49	31.9%	35.3%
50-249	47.1%	50.6%
250+	57.2%	47.9%
Industry		
Science	30.3%	33.1%
Elec-Trans Mach	35.4%	40.3%
Material	41.3%	42.5%
Food-text	50.6%	53.7%
	68.0%	64.0%

Region		
Atlanta	41.1%	44.8%
Central	28.9%	44.3%
Coastal	39.5%	37.7%
Northeast	34.2%	34.0%
Northwest	39.6%	39.6%
South	36.3%	31.7%
West	45.0%	50.8%

Source: Georgia Manufacturing Survey 2005, weighted responses of 552 manufacturers.

The outsourcing trend in manufacturing has received much attention in recent years. We asked a series of questions 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.

Although most Georgia manufacturers (83 percent) did not report being impacted by outsourcing in the last two years, approximately 17 percent of Georgia facilities said that some work formerly performed at their Georgia facility had been transferred to another plant outside of Georgia. The most common outsourcing locations were to manufacturers elsewhere in the United States (reported by 9 percent of respondents), Asia (indicated by 7 percent of respondents), and Mexico or elsewhere in Central and South America (indicated by 5 percent of respondents). The transfer of work from Georgia manufacturers to manufacturers elsewhere in the United States was almost as likely to be given to another facility within the same company as it was to go to one at a separate company. However, work moved to Asia or Mexico/Central America/South America tended to go to a completely separate company rather than to one within the same corporate family. (See Table 6.2.)

Table 6.2. 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?			Yes: 17.4%	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
Another facility in your company	4.6%	.8%	1.0%	1.4%	.6%
A separate company	5.6%	4.4%	6.5%	.8%	1.0%
Has any work been transferred back to this facility in Georgia from outside the state within the last 2 years?			**Yes: 11.0%**	**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
Another facility in your company	6.0%	.4%	.3%	.6%	.7%
A separate company	3.2%	.6%	1.0%	.2%	.3%

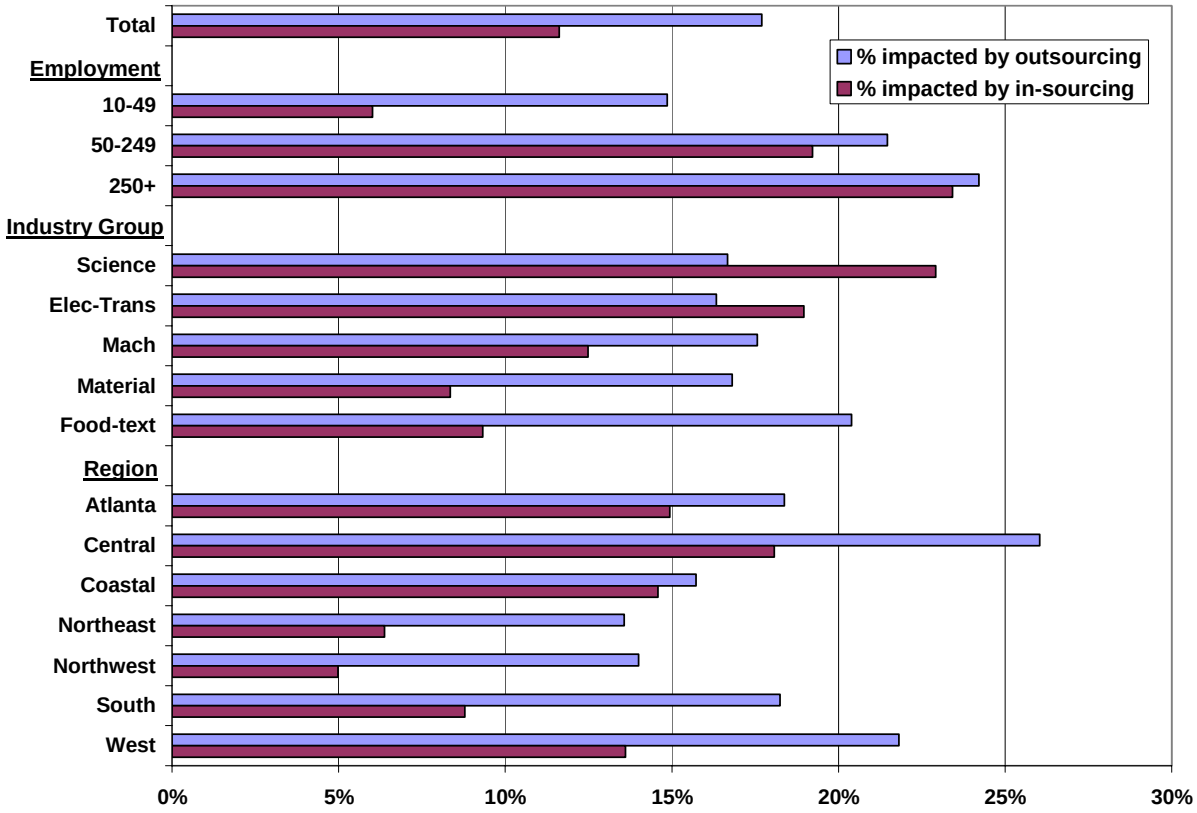
Source: Georgia Manufacturing Survey 2005, weighted responses of 617 manufacturers.

Some Georgia manufacturers, though by no means the majority, were clearly affected by outsourcing. At the same time, some "in-sourcing" also occurred during the same two-

year period. In-sourcing has affected a small percentage of manufacturers, with 11 percent of respondents reporting that some work had been transferred back to their Georgia facility from a location outside the state. This transfer typically came from another U.S. facility, largely within the same corporate structure.

Figure 6.2 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 was somewhat higher for large than for small companies, but the rate of in-sourcing was significantly higher among large companies and virtually non-existent among small establishments with fewer than 50 employees. The rate of in-sourcing was higher than the rate of outsourcing in the science-based industries. It was almost the same in the elec-trans industry, with in-sourcing being slightly more prevalent than outsourcing. Outsourcing was much more common than in-sourcing among respondents in the food-text group, the materials group, and (to a lesser extent) the metals/machinery group. The frequency of outsourcing was much higher than that of in-sourcing among manufacturers in the Central, Northeast, Northwest, South, and West regions. Those in the Atlanta and Coastal regions had much closer percentages of outsource- and in-source-impacted firms.

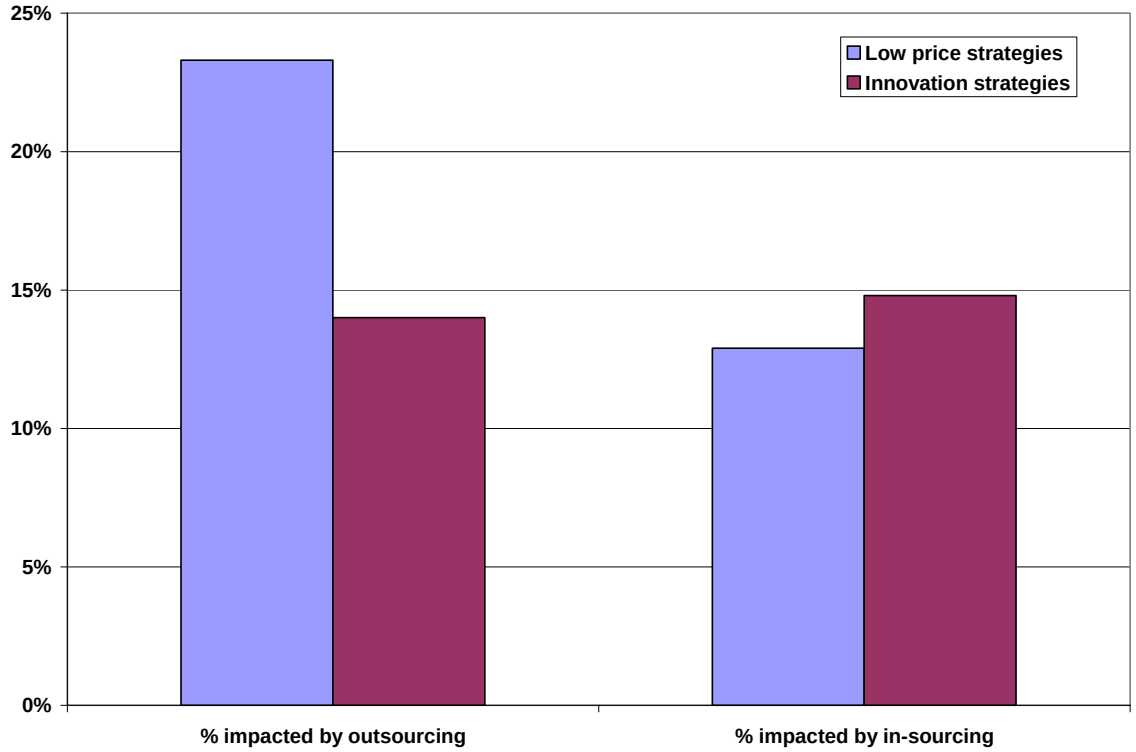
Figure 6.2. Percentage of Establishments Reporting That Their Facility Was Impacted by Outsourcing or by In-sourcing*



*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 2005, weighted responses of 617 manufacturers.

We also looked at outsourcing and in-sourcing rates by the primary competitive strategy of the facility, comparing low price strategies and innovation/new technology strategies. We found the rates of in-sourcing to be fairly similar between facilities with low price strategies and innovation/new technology strategies, with innovation exhibiting only a slightly higher rate. However, outsourcing affected a much higher percentage of facilities competing based on low price than competing based on innovation. Manufacturers that compete primarily based on innovation were much less apt to be impacted by outsourcing than those competing primarily through low price. More than 23 percent of establishments competing on low price reported that work was outsourced compared to 14 percent of establishments competing on innovation. (See Figure 6.3.)

Figure 6.3. Percentage of Establishments Reporting That Their Facility Was Impacted by Outsourcing or by In-sourcing by Facility Strategy



Source: 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. We will examine several of these measures and how Georgia manufacturers stack up on them.

One simple measure of manufacturing is improvement in delivery time, which is the difference between receipt of customer order and delivery. We found that delivery times for the average (median) manufacturer declined from 10 days in 2002 to eight days in 2004. The top 10 percent of establishments have delivery times in the two-day range. However, delivery times can vary widely depending on the product. Delivery times among manufacturers that responded to the survey ranged from less than a day to 240 days.

Although more than half of the establishments did not see any improvements in delivery times, some respondents did shorten this cycle time. Among those that decreased their delivery times, the average establishment shortened them by seven days. The most improvement was among the establishments with the longest delivery times. About one-fourth of the manufacturers with delivery times of more than 20 days shortened their delivery times by 10 days or more. (See Figure 6.4.)

Table 6.3 shows that the delivery times of small manufacturers are not that much different from those of large manufacturers and the percentage of firms in these size classes that have reduced their delivery times are about the same. However, the average large manufacturer reduced its delivery time by 11 days from 2002 to 2004 compared to around seven days for small and medium-sized manufacturers. By industry, science-based establishments have the shortest turnaround time of fewer than 10 days between customer order and delivery on average. Those in the elec-trans and metals/machinery industries are associated with the longest delivery times, averaging more than 30 days per order. The elec-trans industry ranks highest in terms of percentage of establishments that reduced their delivery time between 2002 and 2004, and in terms of the time reduction, which amounts to nearly 15 days. Regional differences point to a relatively high rate of delivery time reduction in all but the Coastal and Northeast regions.

Figure 6.4. Delivery Time (Between Receipt of Customer Order and Delivery) in 2004
(percentage of respondents reporting number of days delivery time)

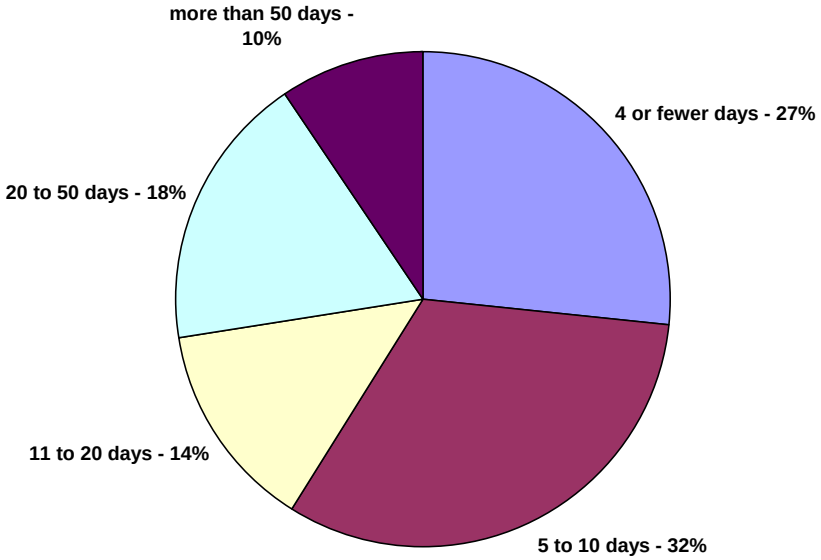


Table 6.3. Delivery Time and Improvements by Respondent Facility Employment Size, Industry Group, and Region

	Mean delivery days 2004	% with reduced delivery time	Mean days reduced*
Total	18.4	43.4%	7.1
10-49	18.7	41.4%	6.8
50-249	17.6	47.0%	6.9
250+	19.6	44.0%	11.1
Science	9.2	34.8%	5.5
Elec-Trans	32.9	46.4%	14.9
Mach	32.7	41.4%	9.0
Material	13.6	45.5%	5.4

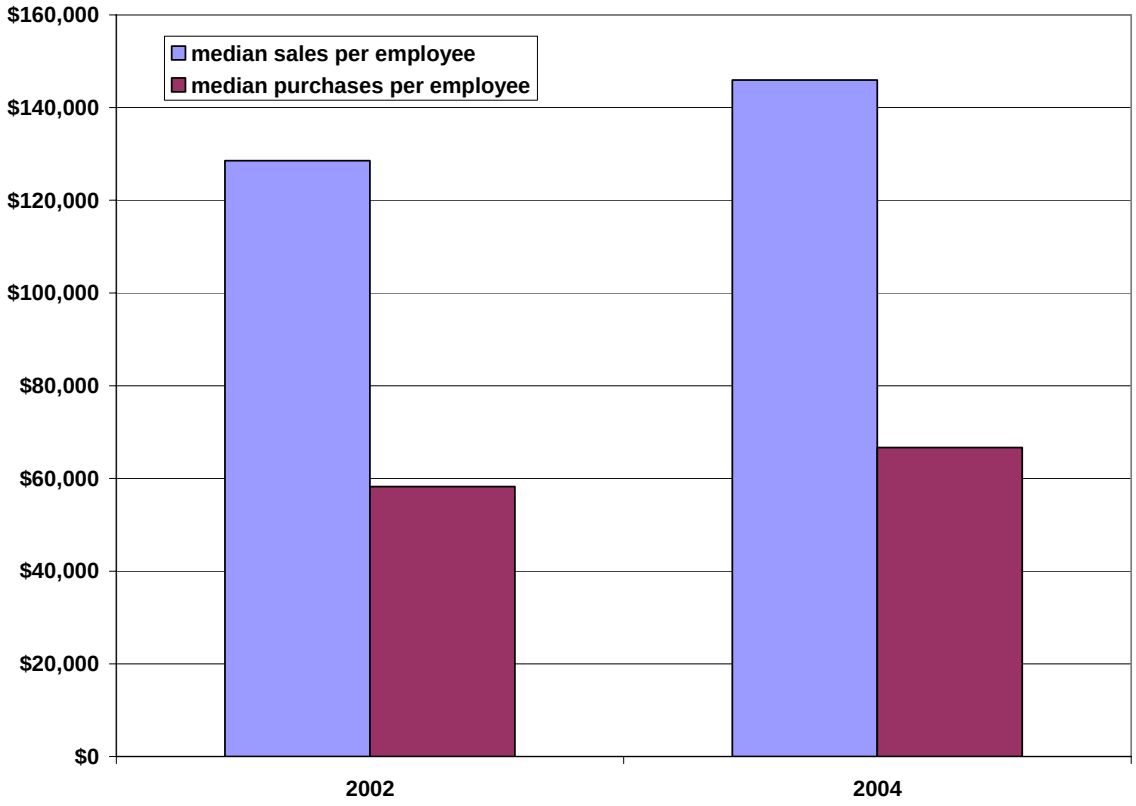
Food-text	12.5	43.5%	6.4
Atlanta	19.2	45.7%	7.4
Central	20.6	49.0%	7.8
Coastal	27.0	25.3%	8.1
Northeast	17.6	33.7%	7.3
Northwest	15.0	54.1%	6.0
South	15.8	41.6%	6.7
West	15.7	44.5%	7.2

*These means reflect establishments that have reduced their delivery times only.
Source: Georgia Manufacturing Survey 2005, weighted responses of 593 manufacturers.

Another way to look at productivity is by examining gross output (sales or revenue), or value-added (sales minus the purchase of intermediate goods and services). Seventy-three percent of the respondents to the Georgia Manufacturing Survey reported sales levels higher in 2004 than in 2002. Roughly one out of every five respondents lost money between the two years, and another 5 percent reported that their sales were unchanged. The typical (median) manufacturer had 20 percent more sales in 2004 than in 2002. The top 10 percent of respondents had approximately an 80 percent increase in 2004 sales over 2002 levels. These are much higher than our 2002 survey results, which were 5 percent sales increase from 1999 to 2001 for the median respondent and 36 percent sales increase during this time period for the top 10 percent of firms.

More than 60 percent of Georgia manufacturers experienced an increase in value-added per employee from 2002 to 2004. This is the same percentage as was reported in the 2002 survey. The median company raised value-added per employee by 8 percent, and the top 10 percent of manufacturers raised its value-added per employee by 75 percent. Among the median respondents with positive changes in value-added per employee, purchased materials grew by 20 percent or roughly $9,000 on a per employee basis from 2002 to 2004. However, sales grew faster, by about $25,000 per employee. (See Figure 6.5.)

Figure 6.5. Median Sales and Purchased Materials/Parts/Services Among Respondents with Positive Increases in Value-added Per Employee: 2002 to 2004



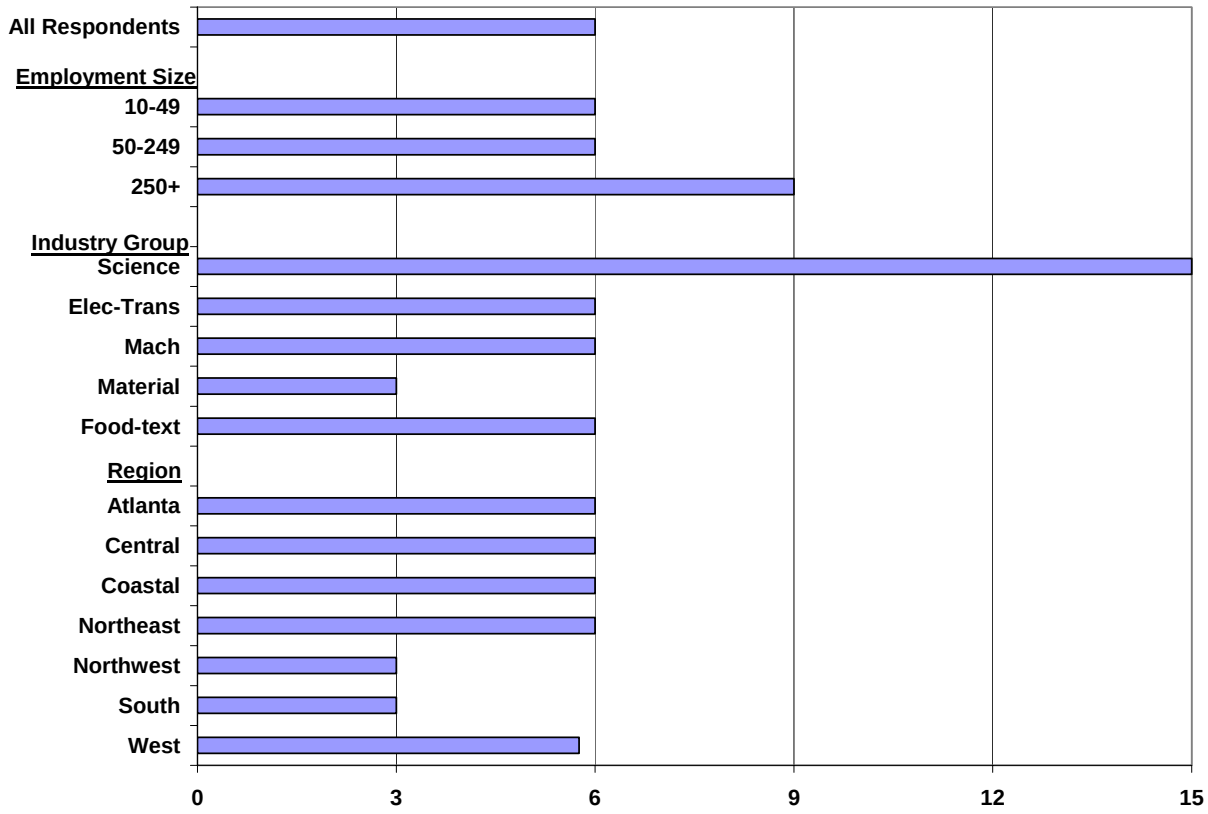
Source: Georgia Manufacturing Survey 2005, weighted responses of 476 manufacturers.

Profitability

Average annual return on pre-tax sales can be considered a measure of profitability. Over the 2002-to-2004 time period, the three-year average annual pre-tax return on sales for the median firm was 6 percent. The top 10 percent of firms had a 15 percent annual return on sales. Negative return on sales was reported by less than 5 percent of respondents. Median profitability was higher for large manufacturers than for small ones and for science-based establishments. Smaller establishments, those in the materials group, and those in the Northwest and South regions had the lowest median profitability. (See Figure 6.6.)

Figure 6.6. Profitability by Respondent Facility Employment Size, Industry Group, and Region

(Median Average Annual Pre-Tax Return on Sales Over the Last Three Years)



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 or export competitiveness. (We did not have a sufficient 2004 measure of profitability to model its relationship with innovation.) However, we note that knowledge-based economic performance is clearly not independent of general economic influences and other business strategies.

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 value-added per employee in 2004 is a function of the introduction of product, process, organizational, or marketing innovations in the 2002-to-2004 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, including the labor-to-capital ratio in 2002, facility employment size (coded "1" if the facility employment size was 100 or more in 2002 and "0" if it was less than 99 employees), location of facility head office (coded "1" if the facility head a head office outside Georgia and "0" if it was a single establishment/company group headquartered in Georgia). We also added dummy variables coded "1" if the manufacturer was in a specified industry group and "0" if it was not. We capped extreme

negative **outliers [use another term??]** associated with value-added per employee and capital expenditures per employee (that were 10 times lower than the next lowest value) so that they have the same number as the next lowest value.

Table 6.4 shows the results.

- Product innovations introduced in the 2002-to-2004 period were positively associated with value-added per employee in 2004. Product innovators had about $7,100 more value-added per employee than non-product innovators, with 95 percent confidence and all other variables being held constant. Marketing innovators also had about $6,500 more value-added per employee than non-marketing innovators, with 90 percent confidence and all other variables held constant. We did not find significant relationships between process innovation or organizational innovation and value-added per employee (and the sign was negative for organizational innovation).

- Product, process, and organizational innovations introduced in the 2002-to-2004 span were positively associated with percentage of sales exported outside of the United States in 2004. Product innovators had roughly 2.6 percent more export sales in 2004 than non-product innovators, with 99 percent confidence and all other variables held constant. Likewise, process innovators had about 2.4 percent more export sales in 2004 than non-process innovators, with 99 percent confidence and all other variables held constant. Organizational innovators had 1 percent more export sales in 2004 than non-organizational innovators, with 95 percent confidence and all other variables held constant.

Table 6.4. Regressions of Value-added Per Employee and Exports Sales (Percent) in 2004 with Innovation

1. Productivity		2. Competitiveness	
Explanatory Variables	Value-added per employee 2004	Explanatory Variables	Any exporting (Logistic) in 2004
Model	R^2=.17***	Model	R^2=.12***
Capital investment per employee	.03***	Product innovation	2.6%***
Product innovation	$7.1 (000)**	Process innovation	2.4%***
Marketing innovation	$6.5 (000)*	Organizational innovation	1.0%**
Headquarters not in Georgia	$57.0 (000)***	Headquarters not in Georgia	1.9%***
100 or more employees in 2002	$9.2 (000)***	100 or more employees in 2002	3.3%***
Electrical, electronics	$9.2 (000)	Electrical, electronics	1.8%**
Science-based	$67.8 (000)***	Science-based	7.0%***

***Significant at less than the 1%; **Significant at the 5%; *Significant at the 10%
Source: Georgia Manufacturing Survey, weighted responses of 457 manufacturers.

Despite non-availability of data from a longer time frame to estimate the influence of innovation on productivity growth, this analysis confirms the notion that innovation in product and marketing areas can lead to improvements in value-added per employee. In addition, the competitiveness analysis showed that product, process, and organizational innovation was significantly and positively associated with exporting.

Chapter 7

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

Almost four out of 10 Georgia manufacturers use some type of business assistance provider. This is down from the 70 percent rate of business assistance source use in 2002. Georgia Tech was used by 18 percent of all manufacturing survey respondents, followed by a private-sector consulting firm or vendor (17 percent), Georgia Department of Labor (15 percent), and a technical college/Quick Start program (10 percent). (See Table 7.1.)

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 Georgia Department of Labor, private-sector consulting firms/vendors, and technical colleges are most commonly used by the largest firms with 250 or more employees. Georgia Tech is the top service provider among small and medium-sized establishments, followed by private-sector firms. 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 seven out of every 10 establishments in this smallest employment size category have not obtained outside business assistance. (See Figure 7.2.)

Figure 7.1 Business Assistance Sources Used by Manufacturers
(Percentage of manufacturers using source in last two years)

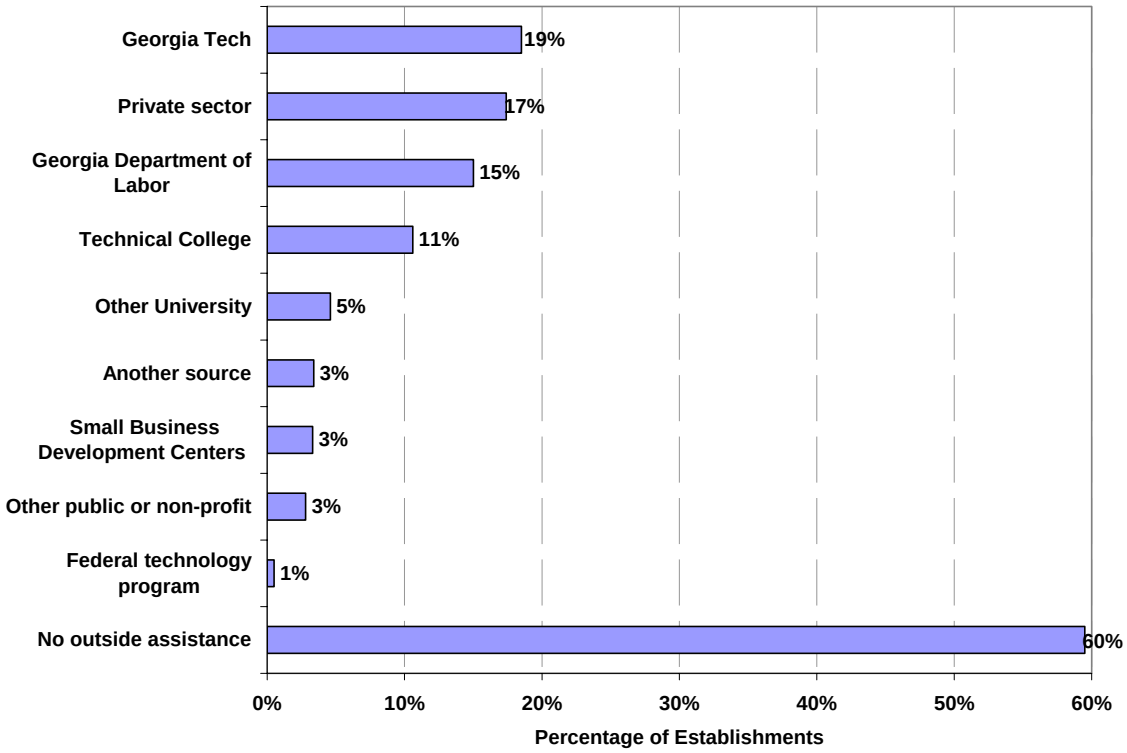
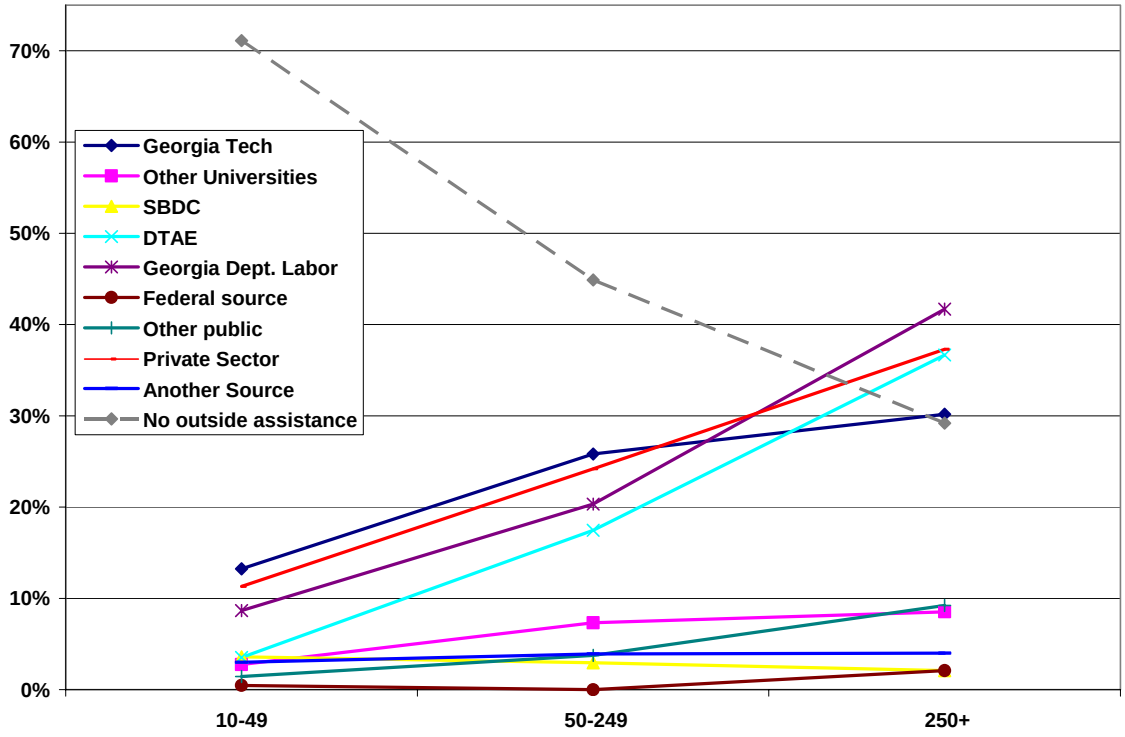


Figure 7.2. Business Assistance Sources Used by Facility Employment Size
(Percentage of manufacturers using source in last two years)



By industry, Table 7.1 shows that the elec-trans group is the most prominent user of outside assistance, followed by the food-text group. The science-based industry is more oriented toward assistance from Georgia Tech. The other industries are more apt to use a mix of Georgia Tech and private-sector sources. The elec-trans and the metals/machinery groups also use the Georgia Department of Labor and technical colleges at about the same rate. The materials and food-text group use the Georgia Department of Labor at a higher rate than they use the technical colleges. Georgia Tech's highest penetration is among electronics firms.

By region, establishments in the Central region are most apt to use outside assistance sources; those in the Atlanta and Northwest regions are the least apt to use outside assistance. (See Table 7.2.) Georgia Tech registers highly in the Central, South, West, and Northeast regions. The Georgia Department of Labor is also strong in the South and West regions. The technical colleges have the highest penetration rates in the Central, Coastal, and West regions.

Table 7.1 Business Assistance Sources Used by Industry
(Percentage of respondents using business assistance source in last two years)

	Science	Elec-Trans	Mach	Material	Food-text
Georgia Tech	22.0%	22.3%	17.6%	17.5%	18.4%
Other University	12.0%	8.3%	2.6%	2.1%	6.9%
Small Business Development Center	0.0%	1.8%	5.2%	3.1%	3.8%
Technical College	10.0%	20.5%	12.2%	7.2%	11.6%
Georgia Department of Labor	16.0%	20.3%	12.5%	13.0%	18.3%
Federal technology program	4.0%	0.0%	0.6%	0.0%	0.0%
Other public/non-profit source	4.0%	1.6%	1.3%	2.1%	5.4%
Private sector	14.0%	24.8%	17.6%	15.0%	20.2%
Another source	8.0%	5.1%	1.7%	3.4%	2.3%
No outside assistance	62.0%	49.7%	63.5%	62.2%	53.9%

Source: Georgia Manufacturing Survey 2005, weighted responses of 553 manufacturers.

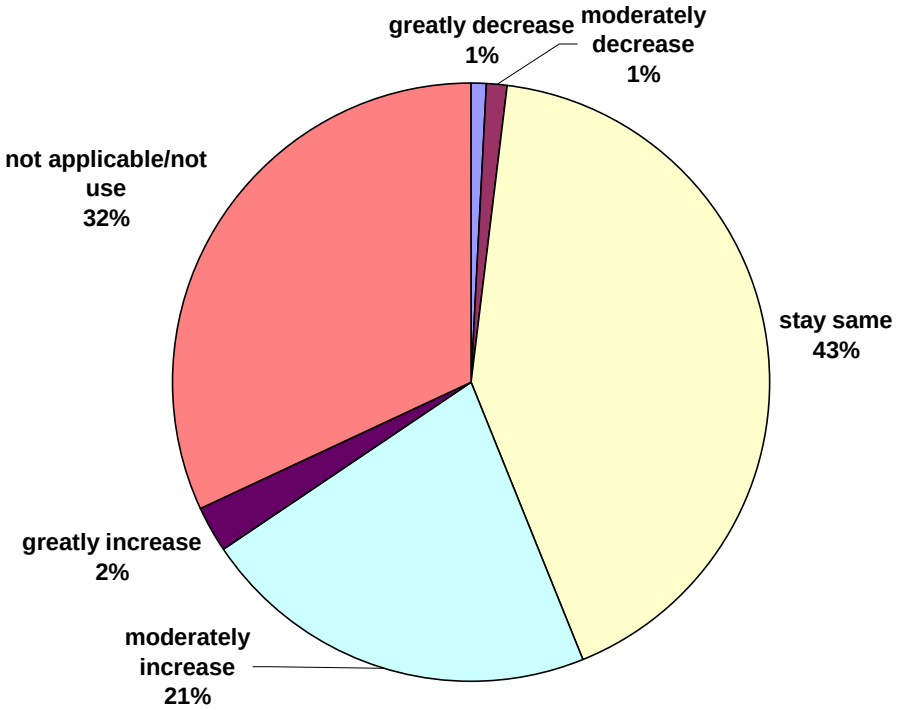
Table 7.2 Business Assistance Sources Used by Industry
(Percentage of respondents using business assistance source in last two years)

	Atlanta	Central	Coastal	North-east	North-west	South	West
Georgia Tech	14.3%	35.8%	14.9%	22.5%	9.9%	23.3%	25.9%
Other University	4.3%	9.3%	0.0%	6.9%	0.0%	9.2%	4.4%
Small Business Development Center	3.0%	4.8%	4.6%	2.9%	1.1%	3.1%	6.2%
Technical College	5.2%	19.3%	18.6%	9.9%	11.4%	11.6%	17.3%
Georgia Department of Labor	8.5%	15.3%	7.0%	18.8%	18.8%	25.4%	23.6%
Federal technology program	0.9%	0.0%	0.0%	0.0%	0.0%	0.0%	1.2%
Other public/non-profit source	2.7%	0.0%	6.5%	1.0%	1.1%	6.4%	4.0%
Private sector	18.7%	9.7%	15.4%	18.8%	17.5%	14.8%	21.0%
Another source	3.2%	1.5%	5.5%	4.1%	0.0%	3.2%	8.1%
No outside assistance	69.0%	48.6%	54.3%	55.3%	60.3%	51.3%	49.6%

Source: Georgia Manufacturing Survey 2005, weighted responses of 553 manufacturers.

Figure 7.3 shows that most respondents plan to keep their level of effort of getting knowledge from these external assistance sources at about the same level as currently indicated. Another 21 percent plan to moderately increase their level of usage. The percentage planning to increase their usage of external sources does not vary much by facility employment size. Science-based firms are slightly more likely to report plans to increase their usage of outside sources.

Figure 7.3. Plans to Change Level of Effort Put Into Using External Organizations
(Percentage of manufacturers reporting plans regarding external organizations)

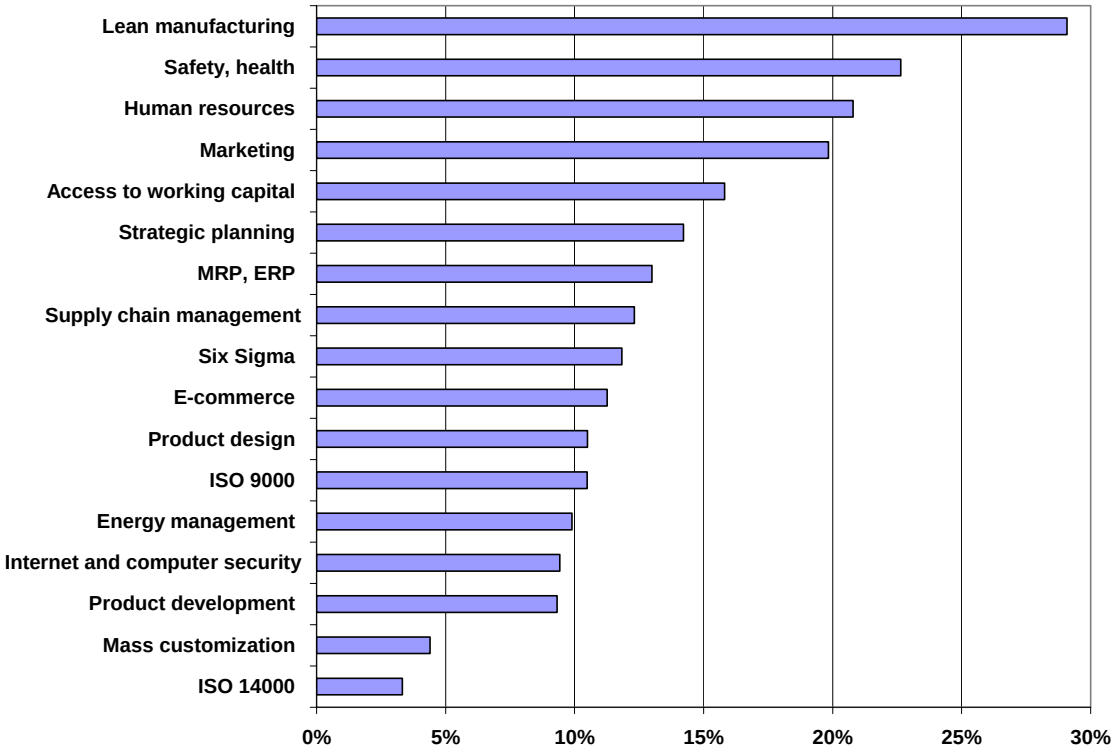


Source: Georgia Manufacturing Survey 2005, weighted responses of 620 manufacturers.

Areas of Interest in Training/Technical Assistance

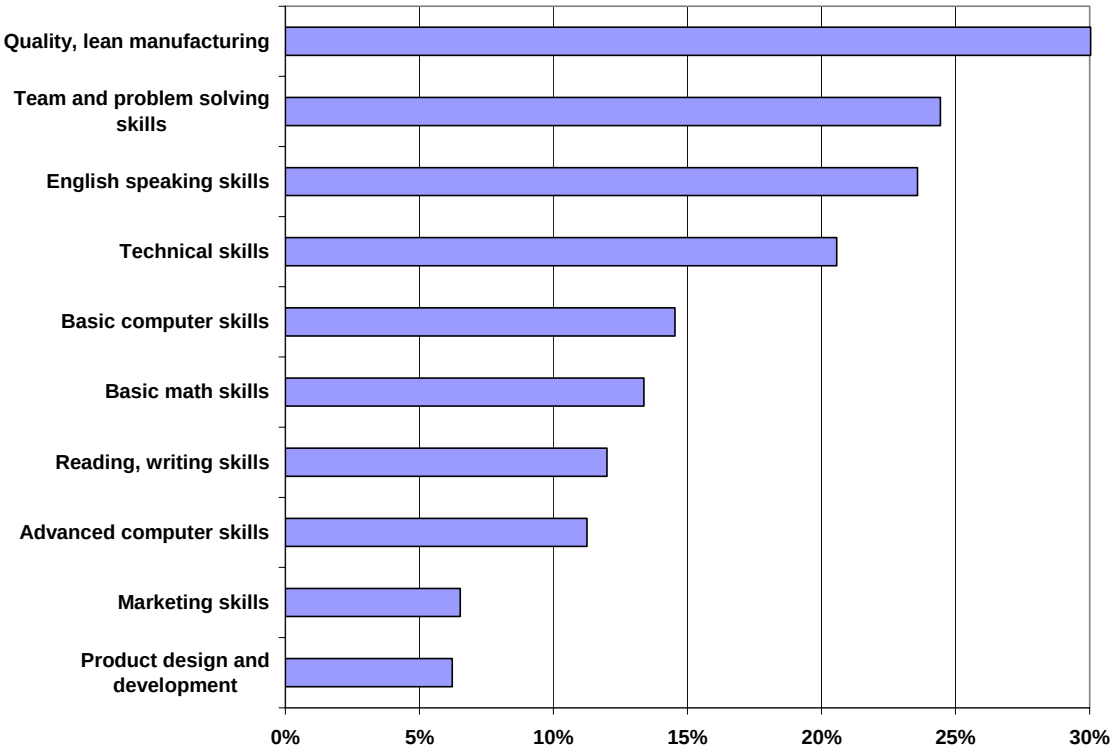
Six out of 10 of the companies responding to the Georgia Manufacturing Survey 2005 were interested in receiving training or technical assistance directed toward managers, and the same percentage was also interested in receiving training programs for non-managerial employees. The most frequently mentioned areas of managerial interest were lean manufacturing, safety and health, human resources/managerial development/team training/change management, and marketing. Lean manufacturing was also the top non-managerial interest area, followed by team and problem-solving skills, English-speaking skills, and technical skills. (See Figures 7.4 and 7.5.)

Figure 7.4. Areas of Interest for Training and Technical Assistance: Management
(Percentage of respondents indicating interest in area)



Source: Georgia Manufacturing Survey 2005, weighted responses of 393 manufacturers

Figure 7.5. Areas of Interest for Training and Technical Assistance: Non-managerial Employees
(Percentage of respondents indicating interest in area)



Source: 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, safety and health, human resource development/management development/team training/change management, and supply chain management were most directly and positively associated with facility employment size. Interest in marketing and e-commerce were actually more prevalent among small manufacturers. There was much commonality of interest in these managerial areas across industry groups. MRP, ERP and supply chain management were of greater interest to the elec-trans and science groups. Science-based industries showed the highest level of interest in Six Sigma. Product development and ISO 9000 were higher among metals/machinery, elec-trans, and science groups. Food-text industries expressed more of a need for energy management assistance than did the other groups. We also present regional breakdowns of the frequency of interest in these areas. In general, interest is highest among establishments in the Atlanta and Northeast regions and is lowest in the Northwest region. (See Tables 7.3a, 7.3b, 7.3c.)

Non-managerial training programs generally attracted higher levels of interest among larger manufacturers than among smaller ones. The exceptions were in some of the more advanced areas such as computer skills, marketing, and product development, which garnered equivalent if not higher interest among all facility employment size classes. By industry, science-based firms were most interested in programs that advance skills in quality and lean, team and problem solving, technical, and basic computer areas for their non-managerial employees. Quality/lean and team and problem-solving skill training programs also predominated among firms in the elec-trans group. The metals and machin-

ery industries targeted technical skills training programs as well as quality and lean. The food-text and materials industry groups most common indicated interest in quality and lean, team and problem solving, and English-speaking skill training programs. 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. (See Tables 7.4a, 7.4b, 7.4c.)

Table 7.3a. Interest in Managerial Training and Technical Assistance by Facility Employment Size
(percentage of respondents indicating interest in area)

Managerial Interest Area	10-49	50-249	250+	Total
Lean manufacturing	22.5%	38.0%	43.8%	29.1%
Safety, health	17.5%	29.1%	36.1%	22.6%
Human resources, team, change management	13.4%	32.7%	30.8%	20.8%
Marketing	25.0%	11.7%	12.2%	19.8%
Access to working capital	17.6%	13.1%	12.7%	15.8%
Strategic planning	14.3%	13.6%	16.2%	14.2%
MRP, ERP	9.7%	18.8%	15.7%	13.0%
Supply chain management	8.0%	17.3%	25.5%	12.3%
Six Sigma	5.7%	20.4%	24.6%	11.8%
E-commerce	12.6%	10.4%	4.4%	11.3%
Product design	10.2%	11.0%	11.2%	10.5%
ISO 9000	11.4%	9.8%	6.3%	10.5%
Energy management	7.3%	11.6%	22.8%	9.9%
Internet and computer security	10.3%	8.3%	7.1%	9.4%
Product development	9.9%	7.6%	11.5%	9.3%
Mass customization	4.0%	4.5%	6.8%	4.4%
ISO 14000	2.2%	4.6%	6.5%	3.3%

Source: Georgia Manufacturing Survey 2005, weighted responses of 393 manufacturers

Table 7.3b. Interest in Managerial Training and Technical Assistance by Industry Group
(percentage of respondents indicating interest in area)

Managerial Interest Area	Food-text	Materials	Mach	Elec-trans	Science
Lean manufacturing	29.0%	29.2%	29.6%	26.6%	30.0%
Safety, health	25.1%	22.3%	20.5%	21.7%	24.0%
Human resources, team, change management	22.1%	19.1%	20.4%	25.0%	22.0%
Marketing	21.3%	18.0%	20.6%	23.0%	20.0%
Access to working capital	10.7%	17.1%	18.1%	15.0%	18.0%
Strategic planning	11.7%	12.2%	15.2%	19.9%	22.0%
MRP, ERP	9.3%	11.6%	11.5%	23.2%	22.0%
Supply chain management	8.6%	11.1%	6.9%	29.9%	22.0%
Six Sigma	10.8%	12.4%	6.9%	15.2%	20.0%
E-commerce	9.4%	13.3%	8.0%	11.6%	14.0%
Product design	3.7%	9.5%	17.4%	15.0%	12.0%
ISO 9000	4.5%	8.3%	16.5%	16.1%	16.0%
Energy management	15.8%	8.8%	6.2%	10.5%	8.0%
Internet and computer security	8.6%	7.6%	7.4%	18.1%	16.0%
Product development	5.5%	8.2%	11.2%	13.2%	16.0%
Mass customization	1.5%	4.3%	5.2%	8.7%	6.0%
ISO 14000	0.8%	2.6%	4.2%	8.3%	6.0%

Source: Georgia Manufacturing Survey 2005, weighted responses of 393 manufacturers

Table 7.3c. Interest in Managerial Training and Technical Assistance by Region
(percentage of respondents indicating interest in area)

Managerial Interest Area	Atlanta	Central	Coastal	North-east	North-west	South	West
Lean manufacturing	32.3%	18.9%	29.1%	27.6%	30.6%	26.2%	28.0%
Safety, health	21.4%	19.3%	23.4%	23.2%	20.1%	26.5%	28.6%
Human resources, team, change management	20.1%	10.5%	24.4%	20.1%	22.4%	24.7%	23.5%
Marketing	23.5%	21.5%	18.5%	20.1%	14.6%	21.0%	11.2%
Access to working capital	17.0%	9.9%	10.7%	22.4%	11.8%	18.2%	12.6%
Strategic planning	18.8%	14.9%	9.3%	16.7%	3.6%	11.3%	15.2%
MRP, ERP	14.8%	14.5%	12.0%	10.0%	7.7%	17.1%	13.9%
Supply chain management	15.9%	5.9%	12.3%	14.5%	5.6%	12.8%	9.7%
Six Sigma	12.9%	5.9%	8.1%	11.8%	14.0%	12.0%	11.9%
E-commerce	10.5%	17.0%	16.7%	12.1%	9.2%	12.9%	5.1%
Product design	13.0%	14.5%	7.0%	10.7%	4.4%	6.4%	14.1%
ISO 9000	11.3%	8.5%	6.1%	13.7%	10.2%	11.7%	5.9%
Energy management	7.1%	3.8%	12.8%	13.5%	7.1%	13.1%	18.4%
Internet and computer security	12.5%	13.3%	8.7%	9.6%	3.9%	7.1%	5.5%
Product development	10.5%	14.0%	7.0%	9.4%	8.4%	3.9%	10.0%
Mass customization	6.4%	4.4%	2.3%	4.2%	2.8%	2.2%	3.0%
ISO 14000	2.9%	4.8%	4.4%	1.2%	3.4%	3.5%	6.0%

Table 7.4a. Interest in Non-managerial Training and Technical Assistance by Facility Employment Size
(percentage of respondents indicating interest in area)

Non-managerial Interest Area	10-49	50-249	250+	Total
Quality, lean manufacturing	24.1%	39.1%	39.7%	30.0%
Team and problem solving skills	18.5%	31.6%	41.5%	24.4%
English speaking skills	17.8%	30.5%	40.0%	23.6%
Technical skills	17.1%	23.5%	35.6%	20.6%
Basic computer skills	11.0%	17.0%	31.6%	14.5%
Basic math skills	10.6%	16.0%	23.9%	13.4%
Reading, writing skills	10.1%	13.3%	21.0%	12.0%
Advanced computer skills	11.6%	10.8%	10.6%	11.2%
Marketing skills	8.0%	3.8%	6.2%	6.5%
Product design and development	7.5%	4.3%	4.2%	6.2%

Source: Georgia Manufacturing Survey 2005, weighted responses of 529 manufacturers

Table 7.4b. Interest in Non-managerial Training and Technical Assistance by Industry Group
(percentage of respondents indicating interest in area)

Non-managerial Interest Area	Food-text	Materials	Mach	Elec-trans	Science
Quality, lean manufacturing	27.5%	28.6%	31.3%	34.5%	36.0%
Team and problem solving skills	23.3%	23.3%	22.2%	28.6%	34.0%
English speaking skills	30.0%	27.7%	15.1%	17.0%	14.0%
Technical skills	16.1%	17.1%	31.3%	18.3%	26.0%
Basic computer skills	16.1%	11.5%	16.1%	11.8%	24.0%
Basic math skills	11.4%	14.5%	12.8%	13.6%	14.0%
Reading, writing skills	11.7%	11.7%	8.9%	13.4%	20.0%
Advanced computer skills	14.2%	9.2%	9.5%	14.6%	14.0%
Marketing skills	8.1%	5.0%	5.3%	9.4%	10.0%
Product design and development	4.0%	5.0%	7.1%	8.1%	14.0%

Source: Georgia Manufacturing Survey 2005, weighted responses of 529 manufacturers

Table 7.4c. Interest in Non-managerial Training and Technical Assistance by Region
(percentage of respondents indicating interest in area)

Non-managerial Interest Area	Atlanta	Central	Coastal	North-east	North-west	South	West
Quality, lean manufacturing	30.3%	22.5%	26.9%	33.8%	26.4%	31.3%	36.0%
Team and problem solving skills	25.3%	19.8%	33.5%	25.9%	18.6%	23.6%	24.5%
English speaking skills	30.4%	4.9%	6.7%	29.8%	25.8%	22.4%	12.4%
Technical skills	25.3%	12.1%	17.1%	24.8%	8.4%	22.0%	21.7%
Basic computer skills	13.5%	13.8%	19.3%	15.4%	15.0%	14.7%	12.7%
Basic math skills	15.4%	4.8%	13.1%	10.8%	10.4%	21.2%	12.6%
Reading, writing skills	16.8%	4.8%	6.0%	15.3%	6.7%	12.1%	6.3%
Advanced computer skills	13.4%	10.1%	9.8%	11.1%	10.6%	11.2%	5.7%

Marketing skills	9.1%	11.0%	1.5%	5.5%	4.0%	6.5%	2.1%
Product design and development	9.0%	7.0%	5.8%	4.9%	4.6%	2.1%	4.0%

Source: Georgia Manufacturing Survey 2005, weighted responses of 529 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 2002-to-2004 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 2002 to 2004 (logged), as a function of receiving Georgia Tech services. We controlled for an array of facility characteristics, including:

- facility employment growth rate 2002-2004 (logged)
- change in the capital/labor ratio 2002-2004 (logged)
- whether this is the only facility in the company (dummy variable)
- industry classification (dummy variables)
- whether the facility is located in a metropolitan area (dummy variable)
- whether the facility is located in a county with a Georgia Tech extension office (dummy variable)
- whether the survey respondent reported using a private consultant (dummy variable)
- whether the survey respondent reported using a non-Georgia Tech public service
- provider (dummy variable)

[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).

- whether the survey respondent reported participating in a cooperative activity with other firms involving product or process development (dummy variable).

This model was estimated using ordinary least squares. Table 7.5 presents the results. Georgia Tech assistance is positively and significantly linked to productivity growth. Over the study period, Georgia Tech clients experienced a 0.4 percent logged growth rate in value-added per employee over non-clients. This coefficient is higher than we found in past surveys. It is equivalent to a value-added increase of $9,400 to $10,000 per employee, adjusting for what value-added per worker would have been if the company had not been a client.[9]

Table 7.5: Productivity is Significantly Higher for Georgia Tech Clients Than for Non-clients
Ordinary Least Squares – Value-Added per Employee Growth Rate 2002-2004

Variables	
% Change in labor inputs (employees)	-0.102 ***
% Change in capital/labor	0.018 ***
Georgia Tech client	0.004 *
Located in an urban county	0.001
Located in a county with a Georgia Tech regional office	-0.001
Used a private consultant	-0.003
Used a non-Georgia Tech public service provider	-0.002
Participates in inter-firm collaboration	0.003 *
The only facility in the company	-0.006 ***
Food-text	0.007 **
Materials	0.005
Machinery	0.001 ***
Elec-trans	0.014
Constant	1.009 ***
R-squared 0.082 ***	
NOTE: The dependent variable is percent change in value-added per employee 2002-2004 logged. All growth rates denote logged values for period. Preliminary analysis, subject to revision.	
***Significant at less than the 1%; **Significant at the 5%; *Significant at the 10%	
Source: Georgia Manufacturing Survey, weighted responses of 342 manufacturers.	

[9] Ronald S. Jarmin, Memo: Estimated Impact of Manufacturing Extension, February 12, 1997. The range is based on 90 percent confidence intervals.

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	Number Respondents	Modified Pavitt Taxonomy	GMS 2005 Grouping	Median Employment	Mean # Scientists, Engineers
Food – 311,2	47	Supplier dominated	Food-text	75	2
Textiles – 313,4	69	Supplier domi-	Food-text	38	3

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

		nated			
Apparel – 315,6	13	Supplier dominated	Food-text	20	1
Wood – 321	55	Supplier dominated	Materials	25	1
Furniture – 337	16	Supplier dominated	Materials	18	1
Paper – 322	26	Supplier dominated	Materials	80	8
Printing – 323	38	Supplier dominated	Materials	18	0
Chemicals – 325	42	Science-based	Science	37	14
Plastics – 326	59	Supplier dominated	Materials	42	6
Nonmetallic– 327	44	Scale intensive	Materials	33	3
Prim. Metals–331	11	Multiple	Metals/ Machine.	30	4
Fab. Metals–332	119	Specialized suppliers	Metals/ Machine.	29	2
Machinery–333	40	Specialized suppliers	Metals/ Machine.	20	5
Computer–334	16	Science-based	Elec-trans	60	4
Electrical–335	22	Science-based	Elec-trans	65	7
Transportation–336	23	Scale intensive	Elec-trans	78	3
Medical supply–3391	8	Science-based	Science	48	91

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 4,439 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 informa-

tion technology, manufacturing productivity and performance, workforce costs and training, and interest in technical assistance.

The 2005 survey specifically focused on two areas: (1) innovation, and (2) use of information technologies and production techniques. Questions in section 2 drew on the Community Innovation Survey IV.

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 February 2005 to July 2005 using four 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 4,439 manufacturing establishments. A similar second follow-up mailing was sent. A third wave of mailing was done with assistance provided by the Georgia Department of Technical and Adult Education's economic development offices (QuickStart). A fourth wave consisted of phone calls made to pulp and paper manufacturers. This entire process yielded a total response of 742 surveys.

The response to the survey was as follows:

Companies in initial database	4,437
Wrong address/undeliverable, out of business, not a manufacturer	432
Declared refusals	4
Non-respondents	3,259
Respondents with less than 10 employees	94
Complete surveys with manufacturers having 10+ employees	648
Response rate	16.2%

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 with 10 or more employees (648) was divided by the total number of manufacturing establishments, established as legitimate, in the target population (4,006). The response rate was 16.2 percent.

To evaluate the representativeness of the survey responses, Table 1.1 compares them to Georgia Department of Labor information. All manufacturing NAICS codes were grouped into five categories: food/apparel/textiles/leather, other materials related manufacturing (e.g., lumber, furniture, paper, stone, clay, glass and concrete), Machinery (metals, industrial machinery), Electronics (electronics, electrical, transportation), and Science-based (e.g., chemicals, medical supplies). Smaller establishments and those in the materials group are most noticeably underrepresented in the sample. Because of the importance

of scale and product characteristics in determining firm behavior such as technology use, the sample was stratified by industry and establishment size and an expansion weight was applied.[11] The Georgia Department of Labor database of 4,691 establishments was used to calculate these weights. Note that Table 1.1 has a total survey response of 648. 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 (2003) vs. Survey Respondents

	GA Dept. of Labor		Georgia Survey	
	# estab.	% estab.	# estab.	% estab.
Industry Group				
Food-text	1026	22%	129	20%
Materials	1909	41%	238	37%
Mach	939	20%	170	26%
IT-Trans	416	9%	61	9%
Science	401	9%	50	8%
Employment Size				
10-19	1503	32%	163	25%
20-99	2162	46%	306	47%
100+	73	2%	185	29%

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 73 percent rate for return on sales may reflect a preference not to disclose this information, whereas the 79 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 students with high school diplomas of 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).

[11] 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 2005 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, and 2002. We appreciate your cooperation in making the 2005 survey a success.

- Survey questions refer to this facility or plant.
- 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 are fine.
- In return for completing your survey, we will send a summary and customized report comparing your data with industry statistics.
- 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.

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

Jan Youtie
GMS 2005 – EDI Project Number [ID]
Economic Development Institute
Georgia Institute of Technology
Atlanta, Georgia 30332-0640

Questions about the survey?

Toll Free Telephone: (888) 272-2104 Fax: (404) 894-1447
e-mail: gms2005@edi.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

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

1.4. 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
- Product development/design
- Material failure, wear patterns, and other material-related issues
- Computer equipment and systems (either hardware or software)
- Quality assurance (e.g., ISO 9000, QS-9000, Six Sigma)
- Marketing, niche marketing, market planning, exporting
- Business strategy, financial analysis, competitiveness planning
- Basic workforce skills (e.g., reading, writing, math, keyboard skills)
- Technical skills (e.g., machining, electrical work)
- Management, team, and problem-solving skills
- Energy costs, conservation
- Waste products, pollution prevention
- 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 2002-2004, 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 2002-2004 *(check all that apply)*

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

Using the definitions above, please give the percentage of your total sales from goods and services introduced during the period 2002 to 2004.

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	%
All other sales	%
	100 %

2.3. How long did it take on average to develop a new or improved product? _____ months

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 2002-2004, 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 2002-2004, 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 2002-2004, 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 2002-2004, 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)
- ❑ 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 2002-2004, 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. **If you undertook any innovations in the period 2002-2004, what was the degree of impact on this facility 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. 2.11., WHETHER <u>YOU DID</u> OR <u>DID NOT</u> UNDERTAKE INNOVATIVE ACTIVITIES

2.11. **During 2002-2004, how important were the following factors in limiting innovation activities or influencing a decision not to innovate?**	**Degree of Importance**			
	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	❑	❑	❑	❑
No demand for innovations	❑	❑	❑	❑
Lack of funds, costs too high	❑	❑	❑	❑

3. TECHNOLOGY, PRODUCTION, AND ORGANIZATION

3.1. Which of the following **information technologies** are currently used at your facility? For each item, complete **either** Column A (check if use now and write-in year first used) **or** Column B (*check one box only*).

	A. USE NOW		**B. DO NOT USE AT PRESENT**			
	Use Now	*Year first used*	*Plan to use in next 2 years*	*No plan to use*	*Not applicable*	*Not familiar with this*
Sale of products via the Internet (e-commerce)	❑ ➔		❑	❑	❑	❑
Supplier purchases via the Internet (e-procurement)	❑ ➔		❑	❑	❑	❑
Supply chain, logistics management software	❑ ➔		❑	❑	❑	❑
Software for quality or standards (e.g. ISO)	❑ ➔		❑	❑	❑	❑
Design software (e.g. computer-aided design)	❑ ➔		❑	❑	❑	❑
Process control (e.g. computer-integrated manufacturing)	❑ ➔		❑	❑	❑	❑
Customer information / relationship management	❑ ➔		❑	❑	❑	❑
Computer training systems for employees or customers	❑ ➔		❑	❑	❑	❑
RFID (Radio Frequency Identification)	❑ ➔		❑	❑	❑	❑
Integrated business management (e.g. ERP, Enterprise Resource Planning & MRP, Materials Resource Planning)	❑ ➔		❑	❑	❑	❑

3.2. Does your design process use software that allows customers to visualize the product in advance before ordering it? ❑ No ❑ Not Applicable

3.3 If you sell products via the Internet, what percentage of your fiscal year 2004 sales was placed through the Internet? (including by email and through your Web site) _____ %

3.4. Which of the following **organizational and production** approaches are currently used at your facility? For each item, complete **either** Column A *(check if use now and write-in year first used)* **or** Column B *(check one box only)*.

	A. USE NOW		**B. DO NOT USE AT PRESENT**			
	Use Now	*Year first used*	*Plan to use in next 2 years*	*No plan to use*	*Not applicable*	*Not familiar with this*
ISO9000 or other standards certification	❑ ➔		❑	❑	❑	❑
Six sigma	❑ ➔		❑	❑	❑	❑
Statistical process control (SPC)	❑ ➔		❑	❑	❑	❑
Pull system/ minimal work-in-process	❑ ➔		❑	❑	❑	❑
Recycling of materials	❑ ➔		❑	❑	❑	❑
ISO 14000 certification	❑ ➔		❑	❑	❑	❑
Formal process/ survey to monitor customer satisfaction	❑ ➔		❑	❑	❑	❑
Formal process/ survey to monitor employee satisfaction	❑ ➔		❑	❑	❑	❑
Teamwork in production	❑ ➔		❑	❑	❑	❑
Mass customization/ volume manufacture of individualized products	❑ ➔		❑	❑	❑	❑

3.5. Please answer the following questions about lead times for your main product:

What percentage of orders is delivered on time? (against a confirmed delivery date) _____ %

What was the average time between receipt of customer order and delivery in 2004 and 2002?

2004	**2002**
days	days

3.6. Does your establishment **exchange knowledge with other companies** in any of the following areas?
If YES, please indicate their location. If NO, please indicate reasons why not.
3.6. Does your establishment **exchange knowledge with other companies** in any of the following areas?
If YES, please indicate their location. If NO, please indicate reasons why not.

Areas for knowledge exchange	**YES**	Location of Corporate Knowledge Partners			**NO**	Why not?		
	Currently exchange knowledge	Within Georgia	Other US partners outside Georgia	International Partners	Do not currently exchange knowledge	Negative experiences	No suitable partners	Not needed
Trends & developments in industry/sector	❑➔	❑	❑	❑	❑➔	❑	❑	❑
Quality, continuous improvement, benchmarking	❑➔	❑	❑	❑	❑➔	❑	❑	❑
Marketing, sales, contract opportunities	❑➔	❑	❑	❑	❑➔	❑	❑	❑
Training of employees	❑➔	❑	❑	❑	❑➔	❑	❑	❑
Product development, process improvement or research cooperation	❑➔	❑	❑	❑	❑➔	❑	❑	❑

3.7. In the next 2 years, do you plan to change the level of effort (i.e. more time or more money) put into exchanging and sharing of knowledge with other companies (not associated with your company)?

Not applicable	Level of effort				
	Greatly decrease	Moderately decrease	Stay about the same	Moderately increase	Greatly increase
❑	❑	❑	❑	❑	❑

4. MANUFACTURING PRODUCTION AND PERFORMANCE

4.1. For the following questions, use approximate numbers or give an estimate.
All estimates should be for this facility.

	2004	**2002**
What were your total annual sales or gross value of shipments at this plant in fiscal year 2004? In 2002?	$	$
Approximately how much did you spend at this location on purchased materials, parts, and services in fiscal year 2004? In 2002?	$	$
Approximately how much new capital investment was made at this location, including facility, equipment, machinery, and information systems in fiscal year 2004? In 2002?	$	$

	2004	**2002**
Approximate percentage of your facility's sales exported outside of the United States (by value)	%	%
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. 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
Another facility in your company	❑	❑	❑	❑	❑
A separate company	❑	❑	❑	❑	❑

4.3. 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
Another facility in your company	❑	❑	❑	❑	❑
A separate company	❑	❑	❑	❑	❑

4.4. Are any of the products manufactured at this plant shipped to the following?

- ❑ Federal defense agencies
- ❑ Prime contractors to federal defense agencies
- ❑ Subcontractors to federal defense agencies

IF ANY BOX ABOVE IS CHECKED, approximately what percentage of your total annual sales or value of shipments or production was shipped to defense agencies, prime contractors, or subcontractors in 2004?

❑ 1-9% ❑ 10-49% ❑ 50% or more

4.5. What was the approximate average annual return on sales (pre-tax) for this facility over the last 3 years?

(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

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.

	2004	2002
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 2004? In 2002? (Please include direct payroll plus indirect fringe benefit payroll expenses. Include payments to agencies for temporary workers.)	Payroll $	Payroll $

5.2. Do you provide bonuses or other incentives to employees based on *(check if apply)*

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

5.3. On average in 2004, what percentage of your workers used

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

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

5.4. In 2004, how many employees at this facility had 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:

Information technology (e.g. computer programming or networking , software development) ____

Science or engineering (excluding information technology) ____

5.5. In total, approximately how much did your company spend on all training activities in fiscal year 2004? $ ____

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

5.6. a. What percentage of employees in production work are in teams? *(if none, enter zero)* ____ %

b. Have your employees worked in teams when dealing with customers in the last 3 years? ❑ Yes ❑ No

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. In the next 2 years, do you plan to change the level of effort (i.e. more time or more money) put into the getting knowledge from external organizations such as those listed above?

	Level of effort				
Not applicable	Greatly decrease	Moderately decrease	Stay about the same	Moderately increase	Greatly increase
❑	❑	❑	❑	❑	❑

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

- ❑ Product design, rapid prototyping
- ❑ Product development, stage gate process
- ❑ Lean manufacturing, continuous flow manufacturing systems
- ❑ Mass customization, complexity management
- ❑ Supply chain management
- ❑ Electronic commerce, Internet applications
- ❑ Internet and computer system security
- ❑ MRP II, ERP, production scheduling, inventory management, accounting software
- ❑ ISO 9000, QS-9000 quality certification
- ❑ ISO 14000 environmental management certification
- ❑ Six Sigma
- ❑ Human resources development, management development, team training, change management
- ❑ Safety & health, ergonomics
- ❑ Energy purchasing strategies, energy management, energy certification
- ❑ Marketing, niche marketing, market planning
- ❑ Strategic planning and execution
- ❑ Access to working capital or capital for new technology/equipment
- ❑ Other topics *(please describe)*

_____

6.4. What new training programs would you like to have available to <u>non-managerial employees</u> 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 7/25/2005 648)

1. Facility-Industry and Needs

1.1 This facility is	
Single establishment enterprise	56.4%
An affiliate of a parent group or holding company	43.6%
	100.0%
Total respondents	640
1.1a. Is your company's head office located in Georgia	
Yes	34.9%
No	65.1%
	100.0%
Total respondents	298
1.1b. Head office located in	
another U.S. state	83.9%
country outside of the U.S.	16.1%
	100.0%
Total respondents	197
1.2 at what year did you begin manufacturing at this facility	
2000-2004	13.5%
1990-1999	32.1%
1980-1989	23.5%
1970-1979	14.0%
1960-1969	7.7%
1950-1959	4.8%
Before 1950	4.5%
	100.0%
Total respondents	599

1.3 Your facility's main product or manufacturing activity is:

Food beverages, feed	8.0%
Textiles	11.6%
Apparel,leather	2.1%
Lumber and wood, except furniture	9.8%
Furniture	2.8%
Pulp Paper and paper products	3.6%
Printing and publishing	7.5%
Chemicals and allied products	6.8%
Plastics or Rubber	9.4%
Stone, clay, glass or concrete	7.4%
Primary metals	1.2%
Fabricated metals	13.1%
Machinery (industry, nonindustrial)	4.9%
Computer and electronic products, Instruments	2.3%
Electrical or electronic equipment	3.2%
Transportation equipment	3.2%
Medical or laboratory supplies	1.4%
Other (please describe)	1.7%
	100.0%
Total respondents	648

1.4 Rank order of importance of the following factors facility competition for sales (percent ranking factor #1)	**%#1 Rank**
Low price	20.3%
High quality	53.4%
Innovation/new technology	8.0%
Quick delivery	12.8%
Adapting product to customer needs	14.7%
Customer service that adds value to products/processes	10.5%

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

Expansion planning, facility layout	20.6%
Lean manufacturing and workflow improvement	38.9%
Product development/design	12.5%
Material failure, wear patterns, and other material-related issues	5.6%
Computer equipment and systems (either hardware or software)	14.3%
Quality assurance (e.g., ISO 9000, QS-9000, Six Sigma)	14.7%
Marketing, niche marketing, market planning, exporting	25.2%
Business strategy, financial analysis, competitiveness planning	15.8%
Basic workforce skills (e.g., reading, writing, math, keyboard skills)	25.6%
Technical skills (e.g., machining, electrical work)	23.3%
Management, team, and problem-solving skills	15.6%
Energy costs, conservation	19.1%
Waste products, pollution prevention	10.3%
Safety compliance, health, workplace environment	15.0%
Other (please describe)	8.3%
Total respondents	623

2. Product, Process and Organizational Innovation

2.1 During the period 2002-2004, did your facility introduce:	
New or significantly improved goods	74.2%
New or significantly improved services	25.8%
	100.0%
Total respondents	372
2.2 Were any of your goods and service innovations during 2002-2004	
New to your market? (introduced before your competitors)	49.8%
New only to your facility? (already available from your competitors)	50.2%
	100.0%
Total respondents	421
2.2a. please give the percentage of your total sales from goods and services introduced during the period 2002 to 2004.	
2.2a.1. Sales from good and services that were **new to your market**	
0 - 5.0%	47.6%
5.1 - 10.0%	16.7%
10.1 - 15.0%	6.8%
15.1 - 20.0%	10.6%
20.1% +	18.2%
	100.0%
Total respondents	399
2.2a.2. Sales from good and services that were **new to your firm**, but NOT to your market	
0 - 5.0%	40.0%
5.1 - 10.0%	18.5%
10.1 - 15.0%	8.5%
15.1 - 20.0%	8.6%
20.1% +	24.4%
	100.0%
Total respondents	405
2.2a.3. All other sales	
0 - 5.0%	4.9%
5.1 - 10.0%	1.1%
10.1 - 15.0%	0.0%
15.1 - 20.0%	0.7%
20.1% +	93.3%
	100.0%
Total respondents	340
2.3. How long did it take on average to develop a new or improved product?	
0-6 months	54.8%
7-12months	23.6%
13-18 months	11.3%
18 months +	10.3%
	100.0%

Total respondents	321

2.4 During the period 2002-2004, did your facility introduce: *(please check if yes)*

Any new or significantly improved process or manufacturing technology	38%
Any new or significantly improved logistics, delivery, or distribution method	11%
Other processes not covered above, such as new or significantly improved purchasing, accounting, or maintenance processes	12%
Total respondents	327

2.5 During the period 2002-2004, 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	27%
Make a major change to the organization of work, such as changes in management or departmental structure	34%
New or significant changes in your relations with other firms, such as alliances, partnerships, outsourcing, or subcontracting	16%
Total respondents	352

2.6 During the period 2002-2004, did your facility engage in any of the following activities? *(please check if yes)*

Make significant changes to the design or packaging of a good or service (exclude routine or seasonal changes)	15%
New or significant changes to sales methods or distribution channels, such as Internet sales, franchising, direct sales or distribution licenses	18%
Total respondents	194

2.7. During the period 2002-2004, 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)	41.8%
Purchase R&D from research organizations or other branches of your company	6.9%
Purchase machinery, equipment, computers or software to implement innovations	58.2%
Planning, engineering, design, or other development work to implement an innovation	31.1%
Purchase or license patents, inventions, know-how, or other types of knowledge to implement an innovation	7.2%
Training staff to develop or introduce innovations	21.3%
Market research, advertising, and other marketing activities linked to implementing an innovation	15.7%
Total respondents	494

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	67.4%
50,000 - 100,000	8.4%
100,000 - 500,000	15.3%
500,000+	9.0%
Mean In-house R&D	$ 642,577
Median In-house R&D	$ 15,000
In-house R&D of Top 10%	$ 591,500
Mean In-house R&D/employee	$ 4,793
Median In-house R&D/employee	$ 302
In-house R&D of Bottom 10%	$ -
In-house R&D/employee of Top 10%	$ 7,950
In-house R&D/employee of Bottom 10%	-
Total respondents	402

2.8b Acquisition of external R&D

0 - 10,000	89.8%
10,000 -25,000	2.7%
25,000 - 100,000	3.9%
100,000+	3.6%
Mean external R&D	$ 105,842
Median external R&D	$ -
External R&D of Top 10%	$ 591,500
External R&D of Bottom 10%	-
Total respondents	338

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

0 - 25,000	42.1%
25,000 -100,000	22.7%
100,000 - 500,000	20.5%
500,000+	14.6%
Mean acquisition of machinery, equipment and software	$ 420,831
Median acquisition of machinery, equipment and software	$ 50,000
Acquisition of machinery, equipment and software of Top 10%	$

	1,000,000
	$
Acquisition of machinery, equipment and software of Bottom 10%	-
Total respondents	462

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

0 - 10,000	75.2%
10,000 -25,000	6.4%
25,000 - 100,000	10.7%
100,000+	7.7%
	$
Mean other development work	99,140
	$
Median other development work	-
	$
Other development work of Top 10%	100,000
	$
Other development work of Bottom 10%	-
Total respondents	338

2.8e Total (sum of above 4 categories)

0 - 50,000	39.4%
50,000 - 100,000	11.1%
100,000 - 500,000	27.6%
500,000+	21.8%
	$
Mean Total	1,237,344
	$
Median Total	120,000
	$
Total of Top 10%	1,910,000
	$
Mean Total/employee	10,708
	$
Median Total/employee	2,293
	$
Total of Bottom 10%	-
	$
Total/employee of Top 10%	17,757
	$
Total/employee of Bottom 10%	-
Total respondents	390

2.9. During the period 2002-2004, check if your facility

Ever worked with customers to create or design a product, process or other innovation	61.8%
Ever worked with suppliers to create or design a product, process or other innovation	43.3%
Applied for a patent or registered an industrial design	13.2%
Registered a trademark or assumed a copyright	10.3%
Signed a confidentiality agreement	37.9%

Staff published one or more papers or technical articles (in journals or conference proceedings)	7.3%
Total respondents	648

2.10. If you undertook any innovations in the period 2002-2004, what was the degree of impact on this facility in each of the following areas?	%High Importance
Increased variety of goods or services	25.1%
Increased market share or entered new markets	18.8%
Improved quality of goods or services	27.1%
Reduced time to respond to customer needs	24.6%
Improved flexibility of production or service provision	21.0%
Increased capacity of production or service provision	27.7%
Reduced labor costs per unit output	19.6%
Reduced materials and energy required per unit output	7.5%
Reduced environmental impacts/improved health & safety	10.2%
Met regulatory requirements	15.5%
Improved employee satisfaction/reduced worker turnover	14.9%

2.11. During 2002-2004, how important were the following factors in limiting innovation activities or influencing a decision not to innovate?	%High Importance
Lack of qualified personnel	14.9%
Lack of information on technology	5.2%
Lack of information on markets	6.1%
Difficulty finding partners	4.1%
Market dominated by established companies	13.8%
Uncertain demand for innovative goods or services	7.3%
No need due to prior innovations	3.9%
No demand for innovations	6.7%
Lack of funds, costs too high	20.1%

3. Technology, Production, and Organization

3.1. Which of the following information technologies are currently used at your facility?

3.1a. Sale of products via the Internet (e-commerce)	
Used Now	32.1%
Plan to Use in next 2 years	17.0%
No Plan to use	36.4%
Not applicable	13.1%
Not familiar with this	1.4%
	100.0%
Total Respondents	609

Year first used

2000-2004	80.2%
1995-1999	18.4%
1990-1994	1.4%
Before 1990	0.0%
	100.0%
Total Respondents	131

3.1b. Supplier purchases via the Internet (e-procurement)

Used Now	46.4%
Plan to Use in next 2 years	15.4%
No Plan to use	27.7%
Not applicable	8.2%
Not familiar with this	2.2%
	100.0%
Total Respondents	608
Year first used	
2000-2004	87.7%
1995-1999	10.8%
1990-1994	0.0%
Before 1990	1.5%
	100.0%
Total Respondents	181

3.1c. Supply chain, logistics management software

Used Now	23.8%
Plan to Use in next 2 years	13.6%
No Plan to use	44.2%
Not applicable	14.7%
Not familiar with this	3.7%
	100.0%
Total Respondents	566
Year first used	
2000-2004	73.1%
1995-1999	21.3%
1990-1994	1.7%
Before 1990	3.9%
	100.0%
Total Respondents	70

3.1d. Software for quality or standards (e.g. ISO)

Used Now	25.1%
Plan to Use in next 2 years	14.2%
No Plan to use	43.0%
Not applicable	13.5%
Not familiar with this	4.2%
	100.0%
Total Respondents	585

Year first used	
2000-2004	59.7%
1995-1999	32.8%
1990-1994	5.2%
Before 1990	2.2%
	100.0%
Total Respondents	80

3.1e. Design software (e.g. computer-aided design)

Used Now	52.3%
Plan to Use in next 2 years	6.3%
No Plan to use	25.4%
Not applicable	13.5%
Not familiar with this	2.4%
	100.0%
Total Respondents	579

Year first used	
2000-2004	39.5%
1995-1999	37.7%
1990-1994	14.3%
Before 1990	8.4%
	100.0%
Total Respondents	196

3.1f. Process control (e.g. computer-integrated manufacturing)

Used Now	39.9%
Plan to Use in next 2 years	18.4%
No Plan to use	28.7%
Not applicable	10.3%
Not familiar with this	2.6%
	100.0%
Total Respondents	577

Year first used	
2000-2004	49.7%
1995-1999	30.5%
1990-1994	10.0%
Before 1990	9.9%
	100.0%
Total Respondents	143

3.1g. Customer information / relationship management

Used Now	47.1%
Plan to Use in next 2 years	19.7%
No Plan to use	19.7%
Not applicable	7.3%
Not familiar with this	6.2%
	100.0%
Total Respondents	584

Year first used	
2000-2004	46.6%
1995-1999	33.1%
1990-1994	10.0%
Before 1990	10.3%
	100.0%
Total Respondents	142

3.1h. Computer training systems for employees or customers

Used Now	30.4%
Plan to Use in next 2 years	17.8%
No Plan to use	36.8%
Not applicable	11.4%
Not familiar with this	3.6%
	100.0%
Total Respondents	588

Year first used	
2000-2004	60.7%
1995-1999	32.8%
1990-1994	4.0%
Before 1990	2.5%
	100.0%
Total Respondents	107

3.1i. RFID (Radio Frequency Identification)

Used Now	5.9%
Plan to Use in next 2 years	9.7%
No Plan to use	50.4%
Not applicable	19.0%
Not familiar with this	15.0%
	100.0%
Total Respondents	566

Year first used	
2000-2004	87.9%
1995-1999	4.4%
1990-1994	0.0%
Before 1990	7.7%
	100.0%
Total Respondents	15

3.1j. Integrated business management (e.g. ERP, Enterprise Resource Planning & MRP, Materials Resource Planning)

Used Now	27.1%
Plan to Use in next 2 years	12.0%
No Plan to use	36.0%
Not applicable	13.4%
Not familiar with this	11.5%

	100.0%
Total Respondents	589
Year first used	
2000-2004	52.8%
1995-1999	33.0%
1990-1994	4.8%
Before 1990	9.4%
	100.0%
Total Respondents	98

3.2. Does your design process use software that allows customers to visualize the product in advance before ordering it?

Yes	40.3%
No	33.9%
No Applicable	25.8%
	100%
Total Respondents	630

3.3 If you sell products via the Internet, what percentage of your fiscal year 2004 sales was placed through the Internet?

0-5%	68.9%
5-10%	11.9%
10%+	19.2%
Mean	8.2%
Median	2.0%
Top 10%	25.0%
Botom 10%	0.0%
Total Respondents	261

3.4. Which of the following organizational and production approaches are currently used at your facility?	**Use now**	**Do not use at present**
ISO9000 or other standards certification	24.6%	75.4%
Six sigma	9.1%	90.9%
Statistical process control (SPC)	25.2%	74.8%
Pull system/ minimal work-in-process	27.6%	72.4%
Recycling of materials	58.4%	41.6%
ISO 14000 certification	4.4%	95.6%
Formal process/ survey to monitor customer satisfaction	32.5%	67.5%
Formal process/ survey to monitor employee satisfaction	25.8%	74.2%
Teamwork in production	53.5%	46.5%
Mass customization/ volume manufacture of individualized products	22.6%	77.4%

3.4a ISO9000 or other standards certification

Used Now	24.6%
Plan to Use in next 2 years	12.5%
No Plan to use	46.9%
Not applicable	9.7%
Not familiar with this	6.2%

	100.0%
Total Respondents	593
Year first used	
2000-2004	45.4%
1995-1999	48.6%
1990-1994	6.0%
Before 1990	0.0%
	100.0%
Total Respondents	88
3.4b Six sigma	
Used Now	9.1%
Plan to Use in next 2 years	8.2%
No Plan to use	54.3%
Not applicable	10.4%
Not familiar with this	18.0%
	100.0%
Total Respondents	608
Year first used	
2000-2004	88.4%
1995-1999	7.9%
1990-1994	1.6%
Before 1990	2.1%
	100.0%
Total Respondents	34
3.4c Statistical process control (SPC)	
Used Now	25.2%
Plan to Use in next 2 years	9.2%
No Plan to use	39.5%
Not applicable	10.4%
Not familiar with this	15.7%
	100.0%
Total Respondents	566
Year first used	
2000-2004	43.0%
1995-1999	26.9%
1990-1994	14.7%
Before 1990	15.4%
	100.0%
Total Respondents	89
3.4d Pull system/ minimal work-in-process	
Used Now	27.6%
Plan to Use in next 2 years	6.3%
No Plan to use	38.7%
Not applicable	12.0%

Not familiar with this	15.4%
	100.0%
Total Respondents	546
Year first used	
2000-2004	47.2%
1995-1999	20.8%
1990-1994	13.4%
Before 1990	18.6%
	100.0%
Total Respondents	88
3.4e Recycling of materials	
Used Now	58.4%
Plan to Use in next 2 years	5.6%
No Plan to use	21.7%
Not applicable	10.8%
Not familiar with this	3.5%
	100.0%
Total Respondents	578
Year first used	
2000-2004	19.0%
1995-1999	32.2%
1990-1994	14.6%
Before 1990	34.2%
	100.0%
Total Respondents	199
3.4f ISO 14000 certification	
Used Now	4.4%
Plan to Use in next 2 years	5.2%
No Plan to use	63.2%
Not applicable	13.8%
Not familiar with this	13.3%
	100.0%
Total Respondents	549
Year first used	
2000-2004	72.6%
1995-1999	27.4%
1990-1994	0.0%
Before 1990	0.0%
	100.0%
Total Respondents	14
3.4g Formal process/ survey to monitor <u>customer</u> satisfaction	
Used Now	32.5%
Plan to Use in next 2 years	18.2%
No Plan to use	38.6%

Not applicable	6.9%
Not familiar with this	3.8%
	100.0%
Total Respondents	583
Year first used	
2000-2004	49.8%
1995-1999	33.5%
1990-1994	8.4%
Before 1990	8.2%
	100.0%
Total Respondents	102
3.4h Formal process/ survey to monitor employee satisfaction	
Used Now	25.8%
Plan to Use in next 2 years	17.8%
No Plan to use	43.5%
Not applicable	8.4%
Not familiar with this	4.5%
	100.0%
Total Respondents	575
Year first used	
2000-2004	58.3%
1995-1999	25.6%
1990-1994	7.7%
Before 1990	8.4%
	100.0%
Total Respondents	85
3.4i Teamwork in production	
Used Now	53.5%
Plan to Use in next 2 years	11.6%
No Plan to use	22.8%
Not applicable	7.6%
Not familiar with this	4.5%
	100.0%
Total Respondents	580
Year first used	
2000-2004	39.4%
1995-1999	26.0%
1990-1994	14.0%
Before 1990	20.6%
	100.0%
Total Respondents	175
3.4j. Mass customization/ volume manufacture of individualized products	
Used Now	22.6%

Plan to Use in next 2 years	4.5%
No Plan to use	40.4%
Not applicable	22.3%
Not familiar with this	10.2%
	100.0%
Total Respondents	562

Year first used	
2000-2004	29.2%
1995-1999	28.2%
1990-1994	13.2%
Before 1990	29.3%
	100.0%
Total Respondents	67

3.5a. What percentage of orders is delivered on time? (against a confirmed delivery date)

0-50%	3.3%
50%-90%	30.7%
90%+	66.0%
Mean	91.2%
Median	95.0%
Top 10%	99.5%
Botom 10%	80.0%
Total Respondents	626

3.5b. What was the average time between receipt of customer order and delivery in 2004 and 2002?	**2004**	**2002**
Mean	18.4	20.1
Median	10.0	10.0
Top 10%	2.0	2.0
Botom 10%	55.8	60.0
Total Respondents	593	575

3.6. Does your establishment exchange knowledge with other companies in any of the following areas?

Areas for knowledge exchange	Yes	No
Trends & developments in industry/sector	46.5%	53.5%
Quality, continuous improvement, benchmarking	37.5%	62.5%
Marketing, sales, contract opportunities	35.2%	64.8%
Training of employees	29.8%	70.2%
Product development, process improvement or research cooperation	35.6%	64.4%

3.6a. Trends & developments in industry/sector

Location of Corporate Knowledge Partners	
Within Georiga	46.7%
Other US partners outside Georgia	67.7%
International Partners	26.7%

Total Respondents	288
Why not?	
Negative experiences	5.0%
no suitable partners	23.9%
Not needed	43.7%
Total Respondents	327

3.6b. Quality, continuous improvement, benchmarking

Location of Corporate Knowledge Partners	
Within Georiga	46.1%
Other US partners outside Georgia	63.9%
International Partners	21.3%
Total Respondents	230
Why not?	
Negative experiences	3.1%
no suitable partners	23.8%
Not needed	45.2%
Total Respondents	372

3.6c. Marketing, sales, contract opportunities

Location of Corporate Knowledge Partners	
Within Georiga	46.5%
Other US partners outside Georgia	64.5%
International Partners	27.0%
Total Respondents	214
Why not?	
Negative experiences	5.7%
no suitable partners	23.1%
Not needed	43.4%
Total Respondents	388

3.6d. Training of employees

Location of Corporate Knowledge Partners	
Within Georiga	55.7%
Other US partners outside Georgia	53.6%
International Partners	20.2%
Total Respondents	188
Why not?	

Negative experiences	3.8%
no suitable partners	20.7%
Not needed	48.6%
Total Respondents	413

3.6e. Product development, process improvement or research cooperation

Location of Corporate Knowledge Partners	
Within Georiga	40.9%
Other US partners outside Georgia	67.0%
International Partners	28.0%
Total Respondents	222
Why not?	
Negative experiences	4.8%
no suitable partners	22.7%
Not needed	45.3%
Total Respondents	382

3.7. In the next 2 years, do you plan to change the level of effort (i.e. more time or more money) put into exchanging and sharing of knowledge with other companies (not associated with your company)?

Greatly decrease	0.2%
Moderately decrease	1.0%
Stay about the same	46.9%
Moderately increase	9.8%
Greatly increase	0.7%
Not applicable	41.4%
	100.0%
Total Respondents	615

4. Manufacturing Production and Performance

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

	2004	2002
0 - 1,000,000	9.7%	15.5%
1,000,001 - 10,000,000	57.7%	56.4%
10,000,001 - 20,000,000	11.3%	10.9%
20,000,001 +	21.3%	17.2%
Mean sales	$20,090,926	$26,830,391
Median sales	$6,000,000	$4,600,000
Sales of Top 10%	$50,600,000	$39,800,000
Sales of Bottom 10%	$1,200,000	$956,800
Mean sales/employee	$194,843	$430,481
Median sales/employee	$146,063	$128,571
Sales/employee of Top 10%	$400,000	$349,767

Sales/employee of Bottom 10%	$62,500	$52,637
Total Respondents	535	513

4.1b. How much did you spend on materials, parts and services?	**2004**	**2002**
0 - 1,000,000	35.6%	40.9%
1,000,001 - 10,000,000	43.1%	40.9%
10,000,001 - 20,000,000	7.7%	7.7%
20,000,001 +	13.6%	10.4%
Mean spending on direct inputs	$9,595,740	$8,071,818
Median spending on direct inputs	$2,758,636	$1,900,000
Spending on direct inputs of Top 10%	$27,500,000	$23,700,000
Spending on direct inputs of Bottom 10%	$350,000	$250,000
Mean spending/employee on direct inputs	$105,567	$92,668
Median spending/employee on direct inputs	$67,333	$58,667
Spending/employee on direct inputs of Top 10%	$240,690	$200,000
Spending/employee on direct inputs of Bottom 10%	$14,426	$9,193
Total respondents	476	456

4.1c. How much new capital investment was made at this location?	**2004**	**2002**
0 - 50,000	37.1%	44.5%
50,001 - 250,000	30.7%	28.6%
250,000 +	32.2%	27.0%
Mean new capital investment	$1,093,715	$886,901
Median new capital investment	$150,000	$100,000
New capital investment of Top 10%	$2,000,000	$1,480,000
New capital investment of Bottom 10%	$2,050	$0
Mean new capital investment/employee	$17,280	$12,614
Median new capital investment/employee	$2,815	$2,302
New capital investment/employee of Top 10%	$19,102	$16,667
New capital investment/employee of Bottom 10%	$128	$0
Total respondents	502	472

4.1d. What percentage of sales in 2001 was exported outside the U.S.?	**2004**	**2002**
0 - 1	62.9%	66.1%
2 - 5	14.8%	14.6%
6 +	22.1%	19.3%
Mean percentage of sales outside the U.S.	5.9%	4.9%
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	552	529

4.1e Approximate percentage of your facility's purchases of materials, parts, and services imported or acquired from sources outside of the United States (by value)	**2004**	**2002**
0 - 1	55.4%	58.4%
2 - 5	12.3%	12.5%

6 +	32.3%	29.2%
Mean percentage of purchases outside the U.S.	9.8%	8.4%
Median percentage of purchases outside the U.S.	1.0%	0.0%
Percentage of purchases outside the U.S. of Top 10%	35.6%	29.2%
Percentage of purchases outside the U.S. of Bottom 10%	0.0%	0.0%
Total respondents	535	519

4.2. Has any work that was formerly performed at this facility been moved outside of Georgia within the last 2 years?	
Yes	17.7%
No	82.3%
Total Respondents	639

4.2a.If YES, this work was moved from Georgia to:	Same Company	Separate Company
Elsewhere in USA	26.1%	31.8%
Mexico, other Central or South America	4.8%	25.0%
Asia (including China, India)	6.0%	37.0%
Europe	7.9%	4.5%
Elsewhere in world	3.2%	5.8%
Total Respondents		120

4.3 Has any work been transferred back to this facility in Georgia from outside the state within the last 2 years?	
Yes	11.6%
No	88.4%
Total Respondents	617

4.3a If YES, this work was transferred back to Georgia from:	Same Company	Separate Company
Elsewhere in USA	54.0%	29.1%
Mexico, other Central or South America	3.6%	5.4%
Asia (including China, India)	3.0%	9.3%
Europe	5.3%	1.5%
Elsewhere in world	6.7%	2.3%
Total Respondents		82

4.4. Are any of the products manufactured at this plant shipped to the following?	
Federal defense agencies	28.74%
Prime contractors to federal defense agencies	32.28%
Subcontractors to federal defense agencies	38.98%
Total Respondents	144

4.4a approximately what percentage of your total annual sales or value of shipments or production was shipped to defense agencies, prime contractors, or subcontractors in 2004?	
1-9%	73.2%
10-49%	21.4%
50%+	5.3%
	100.0%
Total Respondents	138

4.5. What was the average annual return on sales over the last 3 years?	
25% or more	1.7%
-15%	2.5%
-9%	3.1%
-6%	5.2%
-3%	4.8%
0%	6.8%
+3%	19.6%
+6%	17.1%
+9%	17.8%
+15%	17.2%
+25% or more	4.1%
Average return on sales - mean	5.2%
Average return on sales - median	6.0%
Average return on sales over the last 3 years of Top 10%	15.0%
Average return on sales over the last 3 years of Bottom 10%	-6.0%
Total respondents	475

5. Workforce and Training

5.1a. How many employees worked at this location in 2001?	**2004**	**2002**
10-20	34.8%	10.1%
21 - 100	44.8%	69.2%
101 and above	20.5%	20.7%
Mean number of employees	88.1	79.3
Median number of employees	40	40
Number of employees of Top 10%	232.9	230
Number of employees of Bottom 10%	13	12
Total respondents	648	623

5.1b. What was total payroll?	**2004**	**2002**
0 - 1,000,000	49.5%	53.7%
1,000,001 - 2,000,000	19.8%	19.5%
2,000,001 +	30.7%	26.8%
Mean payroll	$3,195,804	$2,751,451
Median payroll	$1,310,000	$1,100,000
Payroll of Top 10%	$9,000,000	$8,520,000
Payroll of Bottom 10%	$350,000	$279,889
Mean payroll/employee	$34,590	$32,700
Median payroll/employee	$32,000	$31,250
Payroll/employee of Top 10%	$55,288	$52,060

Payroll/employee of Bottom 10%	$19,121	$16,636
Total respondents	472	449

5.2. Do you provide bonuses or other incentives to employees based on *(check if apply)*

New skills or education acquired	13.4%
Productivity increases	43.2%
New ideas suggested or implemented	17.9%
Total respondents	345

5.3a. On average in 2004, what percentage of your workers used A computer or programmable controller at least once a week as part of their job?

0% - 10%	30.7%
11% - 50%	46.3%
51% - 100%	23.0%
Mean percentage of workers using computers	35.1%
Median percentage of workers using computers	25.0%
Percentage of workers using computers in Top 10%	90.0%
Percentage of workers using computers in Bottom 10%	5.0%
Total respondents	632

5.3a. On average in 2004, what percentage of your workers used Email at least once a week as part of their job?

0% - 10%	40.2%
11% - 50%	46.6%
51% - 100%	13.2%
Mean percentage of workers using computers	25.9%
Median percentage of workers using computers	15.0%
Percentage of workers using computers in Top 10%	70.0%
Percentage of workers using computers in Bottom 10%	3.0%
Total respondents	627

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

0-20	47.6%
21-50	21.7%
50+	30.7%
Mean number of workers with 4 year college degrees	58.1
Median number of workers with 4 year college degrees	29.5
Number of workers with 4 year college degrees in Top 10%	159.5
Number of workers with 4 year college degrees in Bottom 10%	8.0
Total respondents	512

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

0-10	73.0%
11-50	20.6%
50+	6.4%
Mean number of workers with 4 year college degrees	15.2
Median number of workers with 4 year college degrees	6.0
Number of workers with 4 year college degrees in Top 10%	40.0

Number of workers with 4 year college degrees in Bottom 10%	1.0
Total respondents	544

5.4c. How many persons had a 4 year college degree or higher?

0-10	81.6%
11-50	15.0%
50+	3.3%
Mean number of workers with 4 year college degrees	11.4
Median number of workers with 4 year college degrees	4.0
Number of workers with 4 year college degrees in Top 10%	25.0
Number of workers with 4 year college degrees in Bottom 10%	0.0
Total respondents	577

5.4c1. How many persons majored in information technology?

0-1	81.9%
2-5	14.1%
5+	4.0%
Mean number of workers with IT degrees	1.3
Median number of workers with IT degrees	0.0
Number of workers with 4 year college degrees in IT. in Top 10%	3.0
Number of workers with 4 year college degrees in IT. in Bottom 10%	0.0
Total respondents	434

5.4c2. How many persons majored in science or engineering (excl IT)?

0-1	55.7%
2-5	28.1%
5+	16.2%
Mean number of workers with science or engineering degrees	5.9
Median numbers of workers with science or engineering degrees	1.0
Number of workers with 4 year college degrees in Science/Eng. in Top 10%	10.0
Number of workers with 4 year college degrees in Science/Eng.in Bottom 10%	0.0
Total respondents	450

5.5a. How much did the company spend on training in 2001.

$0 - $1,000	31.4%
$1,001 - $50,000	22.4%
$50,001 +	46.2%
Mean spending on training	$60,194
Median spending on training	$5,869
Spending on Training of Top 10%	$100,000
Spending on Training of Bottom 10%	$0
Mean spending/employee on training	$396
Median spending/employee on training	$133
Spending/employee on Training of Top 10%	$833
Spending/employee on Training of Bottom 10%	$0
Total respondents	512

5.5b. What percentage was related to new activities and tasks?

0% - 1%	23.1%
2% - 50%	48.6%
51% - 100%	28.3%
Mean percentage training related to new activities	36.3%
Median percentage training related to new activities	25.0%
Training related to new activities - Top 10%	100.0%
Training related to new activities - Bottom 10%	0.0%
Total respondents	372

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

None	55.3%
1% - 50%	18.6%
51% - 100%	26.1%
Mean percentage of employees in teams	28.0%
Median percentage of employees in teams	0.0%
Employees in teams - Top 10%	100.0%
Employees in teams - Bottom 10%	0.0%
Total respondents	648

5.6b. Have your employees worked in teams when dealing with customers in the last 3 years?

Yes	35.3%
No	64.7%
	100.0%
Total respondents	564

6. Business Assistance Resources

6.1. Have you received business assistance from

Georgia Tech (main campus or regional office)	18.5%
Other university (not Georgia Tech)	4.6%
Small Business Development Centers	3.3%
Technical college (Georgia Department of Technical and Adult Education, Quick Start)	10.6%
Georgia Department of Labor's recruitment, labor market information, or welfare-to-work services	15.0%
Federal laboratory, NASA, or other federal technology program	0.5%
Other public or non-profit business assistant source	2.8%
A private-sector business assistance source, such as a private consultant, vendor	17.4%
Another source not included in the above	3.4%
Facility has not received outside business assistance	44.6%
Total Respondents	553

6.2. In the next 2 years, do you plan to change the level of effort (i.e. more time or more money) put into the getting knowledge from external organizations such as those listed above?

Greatly decrease	0.9%
Moderately decrease	1.2%

Stay about the same	43.9%
Moderately increase	22.5%
Greatly increase	2.6%
Not applicable	28.8%
	100.0%
Total Respondents	620

6.3. Is your company interested in receiving training or technical assistance in any of the following areas:

Product design, rapid prototyping	10.5%
Product development, stage gate process	9.3%
Lean manufacturing, continuous flow manufacturing systems	29.1%
Mass customization, complexity management	4.4%
Supply chain management	12.3%
Electronic commerce, Internet applications	11.3%
Internet and computer system security	9.4%
MRP II, ERP, production scheduling, inventory management, accounting software	13.0%
ISO 9000, QS-9000 quality certification	10.5%
ISO 14000 environmental management certification	3.3%
Six Sigma	11.8%
Human resources development, management development, team training, change management	20.8%
Safety & health, ergonomics	22.6%
Energy purchasing strategies, energy management, energy certification	9.9%
Marketing, niche marketing, market planning	19.8%
Strategic planning and execution	14.2%
Access to working capital or capital for new technology/equipment	15.8%
Other topics	2.7%
Total Respondents	393

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

English speaking skills	23.6%
Reading, writing skills	12.0%
Basic math skills	13.4%
Technical skills (e.g., machinist)	20.6%
Product design and development	6.2%
Marketing skills	6.5%
Team and problem solving skills	24.4%
Quality, lean manufacturing	30.0%
Basic computer skills (e.g., keyboarding, word processing, email)	14.5%
Advanced computer skills (e.g., database, ERP, Web design)	11.2%
Other topics	3.4%
Check here if facility does not need/would not use	18.7%
Total Respondents	529