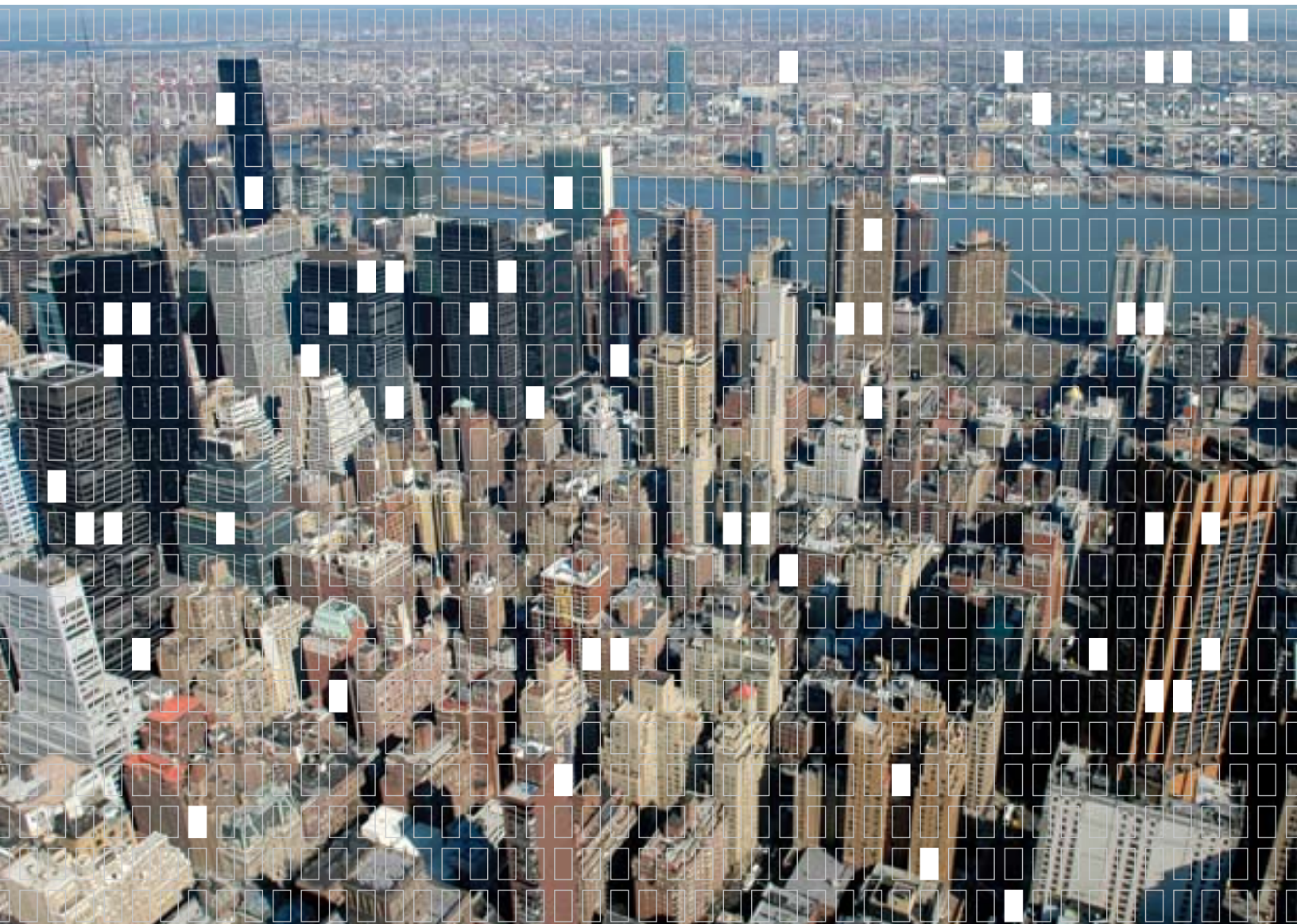


BURIED TREASURE

NEW YORK CITY'S HIDDEN TECHNOLOGY SECTOR □ 2007

FULL REPORT



2007 ITAC BOARD OF DIRECTORS

Joyce Healy (Chairperson), *Chief Executive Officer*
Visual Graphic Systems, Inc.

Carolyn Everett, *Executive Director*
CUNY Economic Development Corporation

Vicki R. Keenan, *Vice President*
Printing Industries Alliance (NY/NJ Metro Office)

Richard Kennedy, *Senior Director*
Cushman & Wakefield Inc.

Arthur Kressner, *Director*
Power Supply Research and Development
Consolidated Edison Company of New York, Inc.

Oliver Lednicer, *Chairperson*
Manufacturers Association of New York City

Richard Loiacono, *President*
Kruysman, Inc.

Albert Mangels, *President*
Lee Spring Company

Joe McDermott, *Executive Director*
Consortium for Worker Education

Alex Neuburger, *President*
Magic Novelty Company, Inc.

Timothy G. Noble (Treasurer), *Vice President*
JPMorgan Chase

Nigel Pearce (Chairman of Audit Committee),
Managing Director
Finance NYC, LLC

Mal Schuster (Secretary), *Sr. Project Manager*
Pfizer, Inc.

ACKNOWLEDGEMENTS

The Industrial and Technology Assistance Corporation (ITAC) is a not-for-profit economic development organization dedicated to increasing New York City jobs by helping companies grow here. We commissioned the studies presented in our report to further our mission, and we wish to thank the many individuals and institutions whose assistance made the report possible. We extend special thanks to NYSTAR® for providing funding for the project and to our consultants, Mt. Auburn Associates and Bayer Consulting, Inc., for their hard work gathering and analyzing the data and conducting interviews in order to obtain a better view of the New York City technology sector. We also acknowledge our Technology Advisory Council, whose guidance and counsel during the project was so valuable. We are grateful to the many small, mid-size and large company executives who so generously gave of their time to participate in the survey and without whose input this report would not have been possible. Finally, we acknowledge the hard work of the ITAC Technology Team, who collectively, spent hours organizing, coordinating, writing, editing, and shepherding this report into its final form. They are all listed alphabetically in the next column.

Funding for this project was provided by the New York State Foundation for Science, Technology and Innovation (NYSTAR®). ITAC serves as a NYSTAR® Designated Regional Technology Development Center for New York City and is one of nearly 350 Manufacturing Enterprise Partner (MEP) locations across the country. ITAC works directly with regional companies to increase their competitiveness and profitability.

CONSULTANTS

Daniel Sandy Bayer, *President*
Bayer Consulting

Verlee Prybyloski, *Senior Consultant*
Bayer Consulting

Beth Siegel
Mt. Auburn Associates

Arthur Kressner, *Director*
Power Supply Research and Development
Consolidated Edison Company of New York, Inc.

Sharon Rutter, *Director*
Technology Policy Development
Empire State Development Corporation

Saul T. Shapiro, *Vice President*
NYC Economic Development Corporation

TECHNOLOGY ADVISORY COUNCIL

Jonathan Bowles, *Director*
Center for an Urban Future

Alan Doctor, *Deputy Director*
New York State CAT in Photonics Applications
The City University of New York (CUNY)

David Hochman, *Consultant in*
Technology-based economic development

Michael Indergaard, *Associate Professor*
Department of Sociology, St. John's University

ITAC TECHNOLOGY TEAM
Rose-Anne Angus, *Communications Coordinator*

Leah Archibald, *former Marketing Manager*

Colleen Gibney, *Project Manager*

Franklin Madison, *Technology Program Director*

Sonia Moin, *Technology Program Specialist*

Veronica Price, *Marketing Coordinator*

Jane Tabachnick, *Business Development Manager*

Elizabeth Taylor, *Communications Manager*

ABOUT THIS REPORT

The Industrial and Technology Assistance Corporation (ITAC) helps early-stage technology firms to grow, to launch innovative products and to attract clients and capital in our city. As the New York State Regional Technology Development Center for New York City, ITAC is also involved with commercializing cutting-edge technology in partnership with the area's world-class academic and research institutions. This work has given us the opportunity to experience the city's deep research and development capacity as it relates to sectors such as healthcare, higher education and homeland security.

After two decades of working closely with technology researchers and developers in New York City, ITAC can attest to the great variety of businesses and jobs created by the NYC technology sector. We have also identified limitations in technology sector measurements that hide the sector's key role in the city's economy. Simply put, while technology contributes heavily to our economy and to the city's status as a high-powered research and development (R&D) center, it isn't recognized as such. This, we hypothesized, was due to the fact that the sector itself was far too complex and disaggregated to be sufficiently defined. Current measures of economic activity do not accurately reflect its nature, size or depth. The sector's potential to contribute to economic growth, to provide a foundation for advancing the development of new products and services or to support New York City as the nation's premier technology center, has not been fully realized.

As an organization committed to helping New York technology firms succeed, ITAC wanted to better understand the true size and breadth of the New York City technology sector. Realizing that information about the sector's real nature and reach—necessary to inform public opinion and influence public policy—was not available, we undertook a detailed analysis. We retained Mt. Auburn Associates and Bayer Consulting to conduct three independent studies. Mt. Auburn, a consulting firm that focuses on economic development analysis and strategy, was commissioned to analyze economic and occupational data related to high-tech activity in our region. Bayer Consulting is a research firm that helps companies and nonprofit organizations improve their strategies and gain greater insight into their customers and clients. We engaged them to survey executives at small and mid-size firms. We also asked Bayer to conduct in-depth interviews with a selected number of research and development executives at larger firms, to gain a deeper understanding of their needs and the challenges faced by technology firms in New York City.

This report summarizes the results of those studies. It includes findings and recommendations for the public and academic sectors, as well as for a Regional Technology Partnership for the New York City region, soon to be designated by New York State.

KEY FINDINGS

To achieve the full potential of a regional economy, all assets and players in knowledge industries, scientific advancement, and technological innovation must be connected. These assets include researchers, institutes, companies, investors, business leadership and government officials[†].

—Richard Bendis, Economic Development Policy Advisor

The technology workforce is a significant presence in New York City. The city's technology workforce comprised 226,000 people in 2004 (the most recent data available from all sources) and represents a substantial employment group.

Technology employment in New York City is complex and often miscalculated. Approximately 131,000 of the city's technology jobs were in the city's 12,100 high-technology enterprises, while an additional 34,000 high-tech workers were sole practitioners or self-employed. An additional 60,900 people worked at high-tech jobs that were “embedded” in other industries, such as financial services, higher education, media or healthcare. Assessments of high-tech employment and activity often overlook self-employed and “embedded” workers. (See Exhibit 1)

High-technology jobs generate well above average earnings. New York City high-tech jobs generated earnings of almost \$12.5 billion in 2004, inclusive of wages and self-employment income, accounting for 5.6% of the city's total private employer wages and self-employment income. Technology jobs pay more, too, averaging \$75,458 in 2004—21% above average private employer earnings of \$62,545.

The New York metropolitan statistical area (MSA) is the nation's largest center of high-technology employment.

Our region employs close to 620,000 people in technology jobs. In addition, as of 2003, the New York MSA had 2.47 times as many jobs in high-technology industries as the best known tech center in the country—Silicon Valley (the San José region)—and almost twice as many as the Boston MSA.

New York City leads the country in students enrolled in graduate science programs. In 2004, 18,446 students were enrolled in graduate science and engineering programs, significantly more than the Boston and San Francisco areas. Yet despite the proximity of these resources, many small technology firms express difficulty in finding employees with ideal skill sets.

Proximity to customers and to markets are among the top reasons for locating businesses in New York City, but almost one-third of executives had contemplated or are seriously considering relocating outside of New York due to challenges associated with high business costs and complex regulations here. (Exhibit 20)

Assistance seen as especially helpful to executives for growth fell into three main categories: finding skilled workers (63%), securing access to capital (56%) and forming strategic partnerships (54%). (Exhibit 17)

80% of executives at small to mid-size technology firms are unfamiliar with government financial assistance programs. Only one-fifth or fewer claimed familiarity with government programs providing working capital financing, capital equipment financing, research grants, tax credits or real estate assistance.

†. Richard Bendis, et al., “Applied Research in Economic Development,” Vol. 4, No. 2, 2007, p. 26.

CONCLUSIONS AND RECOMMENDATIONS

What kind of city should we become?

In all our conversations, one core [idea] emerged: the strengths of the city are in concentration, efficiency, density, diversity; in its people, but above all in its unending sense of possibility. We must reinforce these strengths.‡

—Mayor Michael R. Bloomberg, 2007

A Hearty Technology Sector

This research reveals a large, intricate and very vibrant sector and confirms that it mirrors our larger economy with its complex and ever-changing array of enterprises and human resources. We see employees who weave comfortably through organizations of different sizes with varying areas of focus throughout their careers. Scientists conduct advanced research in educational, medical, and cultural institutions as well as in small and large biotechnology firms. Software engineers develop sophisticated applications working for small and large firms in the service sector, media, financial services, the public sector, manufacturing and non-profits. Technologists and knowledge workers may spend their entire careers working for large firms like IBM, Goldman Sachs or Con Edison. Or they may migrate into small firms and start-ups or become self-employed subcontractors for multiple firms across several industries.

The complex nature of our city, its size and its density creates fertile ground for the cross-fertilization of ideas, resulting in new products, services and markets. Because the use of technology increasingly drives business success, opportunities for technology developers are growing, as are the possibilities for new business partnerships.

Missed Opportunities

Our sophisticated marketplace attracts technology firms, like Yahoo! and Google, that want to locate research activities closer to their sales force so that new products and services can be developed and tested in appropriate markets. New York City's high-tech sector is robust but fragmented and hidden. It is, therefore, dwarfed by the sheer size of other sectors within our economy. Much to our disadvantage, we simply haven't recognized the city's potential as a technology leader, and because we do not see ourselves as a technology leader, we do not behave as one.

An Agenda for the Public Sector

The public sector has done a great deal to improve the economy of New York City. City government has focused on improving the quality of life here attracting both workers and businesses and has renewed its focus on kindergarten through university education to create a stronger workforce pipeline. It has invested in developing biotechnology facilities to attract world class science-based businesses and to provide space for increased activity based on university research. New York State has made efforts to improve the business environment with an innovative R&D tax credit program and investments in university research centers and incubators to nurture innovative start-ups. But have the city and the state also overlooked the sizeable opportunities that can be found in the high-technology sector?

State and city government could do so much more to recognize and leverage New York City as the technology center that it is. And both must do so for the city to claim its rightful position and bring associated benefits into New York. Clearly, there is much more to be done. We recommend the following:

‡. Mayor Michael R. Bloomberg, "PlaNYC: A Greater, Greener New York City," The City of New York, 2007.

Brand New York City as a leading technology center. Recognizing the city as a leading technology center and investing in its potential is a critical task for local government. Embracing the sector's complexity, uniqueness and contribution to our economic success, would go a long way towards "branding" New York City as the technology center that it actually is and would enhance our ability to attract talent, venture capital investment and global firms. Not doing so has already cost us dearly. Ironically, the city's greatest potential for job loss in the high-tech sector occurs when a company is growing. Typically, as a firm expands from 10 employees to 20—with the potential to grow to 500—a major investor may recommend relocation to a more "tech-friendly" area. Or, the company cannot find appropriate real estate to accommodate growth. Economic development agencies may also lack programs geared towards helping a company at this critical stage. But we don't have to lose these companies.

Create an Office of Science and Technology Enterprises. We recommend that New York City create an Office of Science and Technology Enterprises, much like the Mayor's Office of Industrial and Manufacturing Businesses, which would fall under the Deputy Mayor for Economic Development. Its focus would be to address the needs of local technology businesses and to coordinate policies and services across multiple agencies in order to spur growth in the sector. New York firms are eligible for a number of economic development initiatives, but locating and understanding these programs presents a significant hurdle for small firms. So, we also urge government at all levels to simplify program information and make these initiatives easier to find and more accessible to companies.

Reduce the costs of doing business in New York City. State and local governments need to continue identifying and evaluating policies, laws and incentives that support technology company creation and growth. To echo a study conducted by the Rochester Institute of Technology[§], reducing the costs of doing business in the state must become a priority for the legislature and the governor. This can include simplifying existing R&D tax credit programs, enacting sales tax exemptions and creating tax credits for investors, among other reforms.

Conduct workforce development research. Our research shows that New York City has a huge and multifaceted technology sector, which must be studied further if we are to fully mine its riches. Skill requirements change rapidly along with business needs. Research that identifies and predicts trends in these requirements is critical. We recommend that the Workforce Investment Board (WIB) support research and analysis of workforce needs across the sector, and disseminate resulting data and findings to science, technology, engineering and math (STEM) educators, employers and other change agents so that adaptations can be made swiftly. The WIB should also help ensure an ongoing pipeline of skilled workers through mechanisms that foster public/private partnerships and those that link evolving employer needs to the city's workforce system.

Determine and address infrastructure needs. Another key issue identified by the study is access to reasonably-priced and flexible real estate, especially for very small firms. During the last few years, we have seen a growth in incubator and accelerator space developed by CUNY, SUNY, Polytech and other universities and organizations. Larger firms expressed concern about the city's energy and telecommunications infrastructure, a key focus of the mayor's PlaNYC. We encourage the mayor's planning team to reach out to technology executives of larger firms to assess their current and future infrastructure needs.

§. "Roadmap for the Revitalization of Upstate New York Manufacturing," Center for Integrated Manufacturing Studies, Rochester Institute of Technology, December 2006.

An Agenda for the Academic Sector

Create interfaces for university-industry partnerships. The research showed that on the whole, neither large nor small firms currently participate significantly in university-industry research partnerships. However, these partnerships often represent tremendous opportunities for both parties. Companies can reach out to universities for state-of-the-art inventions, as well as for prototyping, technology validation and testing assistance. Feedback from industry concerning current and future employment demand trends can inform curriculum decisions. Research institutions can work with industry partners to commercialize intellectual property and to offer greater opportunities for faculty and students to generate sponsored research for their institutions. But the prospect of working with universities and participating in university contracts can prove intimidating to companies. Universities must therefore work to create business-friendly policies and mechanisms to promote collaboration with industry.

An Agenda for the Regional Technology Partnership

New York State is in the process of designating Regional Technology Partnerships. In collaboration with academic institutions, city government, trade associations, and private industry, ITAC has co-submitted a proposal to create a Regional Technology Partnership for the New York City region. If designated, this partnership would bring stakeholders together regularly to address issues raised by this study.

Organize and disseminate information about assistance programs. While the federal, state and local governments have created incentives and programs to support early stage technology firms, it is clear that small firms in particular are not sufficiently aware of the resources available to them. These programs include tax incentives, financing and R&D grants such as Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR). We recommend that information about these opportunities be gathered, published and disseminated electronically to potential applicants. We also recommend that ongoing program education be offered to local firms.

Create a “one-stop” assistance center for technology firms. Many organizations provide economic development assistance at little or no cost but are not fully prepared to work with technology firms. Help is often spread out across so many providers that it is very difficult to find and confusing to access. The Regional Technology Partnership would create a “one-stop” center for early stage technology firms. This center would link existing resources and encourage collaborations among service providers.

Provide access to pre-seed funding. There is little early stage (pre-seed) high-risk capital available to enable entrepreneurs to ready their products for market. Without this stage of funding, the probability for enterprise success is low. Without pre-seed funding, many firms are unable to attract key personnel, solve technical problems, secure intellectual property rights or conduct market research. Although inevitably high-risk, we recommend that this stage of funding be assisted through the creation of a pool of “recoverable grants” able to be matched with other investments. These funds could be repaid from future sales or second round investment funding. Sources could include public funds and venture capitalists willing to dedicate small sums to seed future projects.

Create a mechanism for connecting technology users with technology developers. Our research also highlights opportunities for an unusually high degree of R&D collaborations between businesses and their customers or supply chains in New York City. A supportive mechanism would help companies that need innovative technology to grow or to compete in order to find firms that either have or can develop the technology to assist them. Increasing these synergies would be advantageous for partnered firms, for the growth and success of the technology sector and for the City of New York.

CONTENTS

I. Profile of New York City’s Technology Economy	1
The Big Picture: A New Framework for Assessing the Technology Economy in New York	1
Size and Characteristics of New York’s Technology Enterprises.....	5
New York City versus Other High-Technology Regions.....	10
New York City’s Technology Workforce	13
Size and Characteristics of New York’s Technology Workforce.....	16
The Technology Talent Pipeline: Training the Next Generation of New York’s Technology Workforce.....	19
II. What New York Technology Firm s Need to Grow	20
Summary of Survey Findings	20
Small Technology Firms Looking for Organizational Capabilities.....	21
Seeking Talent	23
The Quest for Capital.....	23
Opportunities to Leverage Strategic Partnerships.....	24
Beneficial Synergies Derived from a New York City Location	26
Overcoming Challenges of a New York City Location	27
III. Appendices	28
A. Methodologies	28
B. Graduate Science Students by Institution, Region and State	41
C. Academic Research and Development Centers, New York City	43

I. A PROFILE OF NEW YORK CITY'S TECHNOLOGY ECONOMY

The Big Picture: A New Framework for Assessing the Technology Economy in New York City

When one thinks about the New York City economy images arise of Wall Street, Broadway, the fashion industry and the media giants. On the other hand, when one thinks about the regions that boast cutting-edge technology, the list will usually include the Silicon Valley region in California, the Boston region, Austin, Texas and perhaps Chicago, Seattle and Los Angeles.

Rarely is New York City and its surrounding metropolitan area defined as one of the nation's top technology centers. Comparative studies of "high-tech" metropolitan areas often do not even include New York City in their analysis. For example, a 2001 Brookings Institution study, "High-Tech Specialization: A Comparison of High-Technology Centers," compared 14 "high-tech" centers based upon "those most frequently mentioned in the popular literature."¹ New York was not included. This study is not alone. A review of the literature comparing high-technology centers in the United States finds that New York is rarely considered in most discussions of regions with a strong technology sector.

This report provides evidence that this conventional view is inaccurate. New York City and the surrounding New York metropolitan statistical area (MSA) have one of the largest technology sectors in the nation. However, its strengths in technology often have been missed for a number of reasons:

1. **Most economic studies compare regions primarily on the basis of the relative concentration of a particular industry, not on its scale.** Given how large the New York economy is and the importance of other sectors such as financial services, tourism and the creative economy, the technology industry is a smaller percentage of total employment, as compared to other industries and other regions. However when looked at in terms of absolute size, New York has strengths in areas such as:
 - the number of skilled technology workers
 - the level of research and development (R&D) activity and
 - employment in technology-intensive enterprises.
2. **Traditional economic studies exclude an important component of the technology sector—*sole proprietorships and the self-employed*.** Many highly skilled individuals in the technology sector work as individual contractors. The number of these individuals earning their income through their technology-based work is often missed.
3. **Much of the technology employment in the New York City economy is "embedded" in other sectors and is not counted in traditional assessments.** Most notably the city and the metropolitan area have large concentrations of technological activities in higher educational institutions and research hospitals. For example, jobs in the research and development centers at Columbia University, Memorial-Sloan Kettering and New York University, just to name a few, are counted under employment in the education and health-care sectors, and not included in traditional assessments of technology employment. Moreover, many of the city's large non-profit institutions and large businesses operate significant R&D facilities. Few think of the Museum of Natural History or the New York Botanical Garden as R&D centers. Yet these institutions support important technology-related research. Similarly, the city's financial and media sectors employ many skilled technologists.

1. Joseph Cortwright and Heike Mayer, "High-Tech-Specialization: A Comparison of High-Technology Centers," The Brookings Institution, Washington DC, January 2001.

We believe our assessment to be a more comprehensive accounting of the *economic size* of the technology industry in New York City and the larger region. Key to this accounting are the following.

First, like most other studies, it counts “wage” employment in enterprises that are considered “technology intensive.” (See Exhibit 1). These data are from employers that operate in commonly defined technology industries.

Second, unlike conventional economic analyses, our assessment of total employment in technology-related activity in New York City counts self-employment in sole-proprietor enterprises. (See Exhibit 1). Our data capture the growing number of individuals who operate a sole proprietorship, earning their income by contracting out their services to multiple enterprises. As the economy evolves there are a growing number of individuals who work on their own, earning a living by operating their own very small business or piecing together multiple contracts. For some the transition from employee to “consultant” or “contractor” is not out of choice, but a response to shifting opportunities and changing workforce practices on the part of larger companies. For others, and for many in New York City, it is a lifestyle choice. In either case, in certain sectors—such as the creative industries and the technology industries—self-employment has become an economic imperative. We include this important component of the technology industry in our assessment.

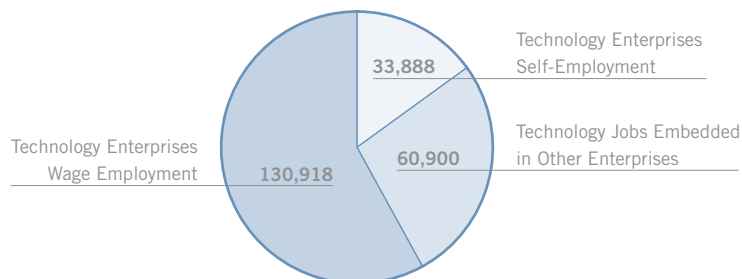
Third, we count technology workers “embedded” in non-technology industries in our assessment. (See Exhibit 1). This is particularly important in New York City where a relatively large proportion of its technology activity is embedded in industries such as education, financial services and healthcare. Thus, our methods capture the thousands of highly skilled scientists, engineers and skilled technology workers who are employed outside of the technology sector.

Utilizing this methodology, we estimate that there are approximately 226,000 jobs in New York City’s technology enterprises and in the city’s tech-related research and development activity. This makes New York one of the largest technology-related centers in the United States.

Sections that follow examine in more detail how we arrived at these numbers and present a full picture of New York’s technological employment, its size and its position relative to other “tech” regions.

EXHIBIT ONE

TOTAL EMPLOYMENT RELATED TO TECHNOLOGY ACTIVITIES IN NEW YORK CITY (2004)*
APPROXIMATELY 226,000 JOBS



* Most recent data available from all sources

New York City's Technology Enterprises

Defining technology enterprises

Some studies of technology industries have used a narrow definition that focuses on technology sectors, such as biotechnology or information and communications technology. For this study, we employ the view of technology used by most economists that defines technology industries based on the intensive use of research, science and engineering. Although economic measures and thresholds used to indicate technology industries vary, they are typically based on R&D expenditures or the share of scientists, engineers and technical workers employed by the industry or a combination of these.

Daniel Hecker, in a 1999 article in the *Monthly Labor Review*², defined high-technology industries as employing a share of workers in R&D and technology occupations that is at least twice the national average. His definition, developed under the earlier Standard Industry Classification (SIC) system, resulted in 29 industries at the four-digit level—25 of which were in manufacturing and four in services. These were later updated to correspond to North American Industry Classification System (NAICS) codes in a 2003 study of Louisville's high-technology sector.³

Jerry Paytas and Dan Berglund⁴ defined two types of high-technology industries:

- *technology employers* - industries in which employment in scientific and technical occupations exceeds three times the national averages.
- *technology generators* - industries that exceed the national average for both R&D expenditures per worker and the percentage of R&D scientists and engineers in their workforce.

Their definition encompasses 22 industries at the four-digit NAICS level (one in mining, 11 in manufacturing industries, one in wholesale, five in information industries and four in the service industries).

For this study, we used a definition of technology that includes industries under either Hecker's or Paytas and Berglund's definitions. The result is a technology industry comprised of 32 sub-industries. Most of the 32 sub-industries are in manufacturing (21, or almost two-thirds of the list), followed by five in information systems, four in services and one each in the mining and wholesale sectors. (See Exhibit 2)

2. Daniel Hecker, "High-Technology Employment: A Broader View," *Monthly Labor Review*, Vol. 122, 1999, p. 18-28.

3. Ted Strickland, Ph.D., Paul Coomes, Ph.D., Barry Kornstein, Lyda Sanchez, and Doug Shultz, "The Size, Characteristics and Performance of Technology-intensive Industries in Louisville," University of Louisville, July 2003.

4. Jerry Paytas and Dan Berglund, *Technology Industries and Occupations for NAICS*, Carnegie Mellon University Center for Economic Development & State Science and Technology Institute, March 2004.

EXHIBIT TWO

LIST OF TECHNOLOGY INDUSTRIES USED IN STUDY**MINING**

2111 Oil and gas extraction

MANUFACTURING

3241 Petroleum & coal products mfg
3251 Basic chemical mfg
3252 Resin, synthetic rubber, & artificial synthetic fibers & filaments mfg
3253 Pesticide, fertilizer, & other agricultural chemical mfg
3254 Pharmaceutical & medicine mfg
3255 Paint, coating & adhesive mfg
3259 Other chemical products & preparation mfg
3329 Other fabricated metal product mfg
3332 Industrial machinery mfg
3333 Commercial & service industry machinery mfg
3336 Engine, turbine & power transmission equipment mfg
3339 Other general purpose machinery mfg
3341 Computer & peripheral equipment mfg
3342 Communications equipment mfg
3343 Audio & video equipment mfg
3344 Semiconductor & other electronic component mfg
3345 Navigational, measuring, medical, & control instruments mfg
3353 Electrical equipment mfg
3359 Other electrical equipment & component mfg
3364 Aerospace product & parts mfg
3391 Medical equipment & supplies mfg

WHOLESALE

4234 Professional & commercial equipment & supplies

SOFTWARE PUBLISHING, INFORMATION SYSTEMS, & DATA PROCESSING

5112 Software publishers
5161 Internet publishing & broadcasting
5179 Other telecommunications
5181 Internet service provider & Web portals
5182 Data processing & related services

PROFESSIONAL, MANAGERIAL, TECHNICAL CONSULTING, RESEARCH SERVICES

5413 Architectural, engineering, & related services
5415 Computer systems design & related services
5416 Management, scientific, & technical consulting services
5417 Scientific research & development services

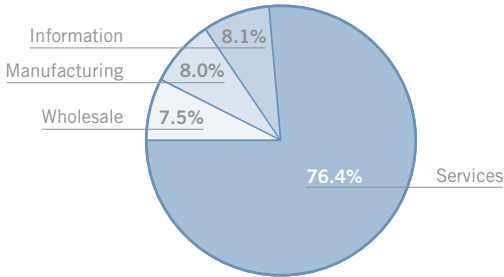
Size and Characteristics of New York City’s Technology Enterprises

New York City employed almost 165,000 people in high-technology enterprises in 2004, 130,918 among private wage employers and 33,888 among the self-employed. Technology services comprised the vast majority of these jobs.

Over three-quarters of the city’s high-technology industry jobs (125,944) exist in the services sector, with the remaining quarter split almost evenly between the manufacturing, wholesale and information sectors (See Exhibit 3). High-technology industry employment represented 4.6% of the city’s private sector jobs in 2004 (including self-employment) and 4% of total private and public sector employment.

EXHIBIT THREE

COMPOSITION OF THE NEW YORK CITY TECHNOLOGY INDUSTRIES
PERCENT OF TOTAL EMPLOYMENT: EMPLOYER AND SELF-EMPLOYMENT DATA 2004



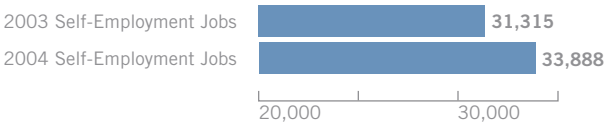
Source: Bureau of Labor Statistics ES-202 Covered Employment Data and US Census Non-employer Statistics.
Note: Definition of the high-technology industry is detailed in Exhibit 2, “List of High Technology Industries Used in Study.”
Note: The latest available data for the US Non-employer statistics is 2004.

Self-employment jobs (33,888) represented 21% of total high-technology employment and that number is growing rapidly.

A growing number of corporations outsource technology services. As a result, many technologists operate as free agents. This transition from wage employment to contract employment is particularly strong in the technology area. (See Exhibit 4). Technology self-employment increased by 8% between 2003 and 2004.

EXHIBIT FOUR

SELF-EMPLOYMENT IN THE NYC TECHNOLOGY INDUSTRY, 2003 AND 2004



Source: US Census Non-employer Statistics.

High-technology jobs generated earnings of almost \$12.5 billion in 2004, inclusive of employer wages and self-employment income.

This total accounted for 5.6% the city's total private employer wages and self-employment income. With 4.6% of all private employment, high-technology industries contributed more income to New York City than job creation measures indicate. This earnings contribution from sole proprietors explains higher pay levels in high-technology industries averaging \$75,458 in 2004—21% above the average private employer earnings of \$62,545. Among high-technology sectors, the highest average salaries were in wholesale and information at \$82,488 and \$83,775, respectively. (See Exhibit 5).

EXHIBIT FIVE

AVERAGE EARNINGS OF THE NEW YORK CITY TECHNOLOGY INDUSTRY BY MAJOR SECTOR COMPONENT, 2004
(EMPLOYER AND SELF-EMPLOYMENT DATA)



Source: Bureau of Labor Statistics ES-202 Covered Employment Data and US Census Non-employer Statistics.

Information and Computer Technology (ICT) Make Up the Largest Segment of New York City's High-Technology Economy.

Management and technology consulting services and computer systems design are by far the largest segments of New York's technology industries. When the 13,413 information sector jobs and 4,022 jobs in computer and electronics manufacturing are included, at least 35% of high-technology jobs in 2003 were in the ICT segment.

The table below details New York City's high-technology employment according to four-digit NAICS industry definitions. (See Exhibit 6). According to NAICS classifications, the city's three largest technology industries, each with over 25,000 jobs in 2004 employment, were:

- NAICS 5416 management & technology consulting services
- NAICS 5415 computer systems design & related services
- NAICS 5413 architecture & engineering services

These three industries combined to supply 108,490—66% of the city's high-technology employment in 2004.

Moreover, all three of these industries experienced the largest job growth among formal employers from 2003 to 2004.

EXHIBIT SIX

NEW YORK CITY'S LARGEST TECHNOLOGY INDUSTRIES BY EMPLOYMENT 2003 AND 2004
(EMPLOYER AND SELF-EMPLOYMENT DATA)

INDUSTRY	2003		2004	
	EMPLOYMENT	% TOTAL	EMPLOYMENT	% TOTAL
Management & technology consulting services	35,552	22%	41,106	25%
Computer systems design & related services	41,031	26%	40,672	25%
Architecture & engineering services	25,666	16%	27,612	17%
Scientific R&D services	16,808	11%	16,554	10%
Commercial equipment merchant wholesalers	13,108	8%	12,310	7%
Data processing & related services	5,904	4%	5,750	3%
ISP & Web search	3,079	2%	3,296	2%
Pharmaceutical manufacturing	2,237	1%	2,478	2%
All other technology industries	15,920	10%	15,028	9%
Total technology	159,303	100%	164,806	100%

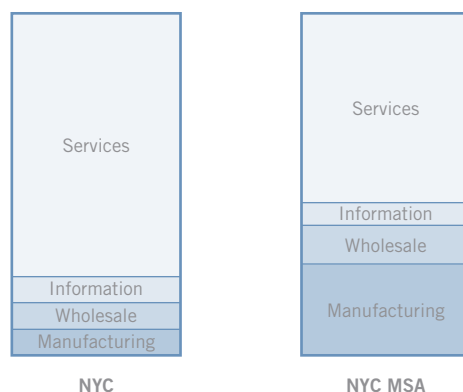
Source: Bureau of Labor Statistics ES-202 Covered Employment Data and US Census Non-employer Statistics.

Within the New York metropolitan region, New York City is largely a center of high-technology services.

As shown in the chart below, service industries comprised a much larger share of 2004 high-technology industry employment for New York City than for the region—76% versus 55%. (See Exhibit 7). Consequently, New York City supplied 37% of the metropolitan statistical area's (MSA's) jobs in high-technology services for 2004 compared to 26% of the region's total employment in high-technology industries.

EXHIBIT SEVEN

SHARE OF EMPLOYMENT BY MAJOR SECTOR COMPONENT OF THE TECHNOLOGY INDUSTRY IN NEW YORK CITY AND THE NEW YORK MSA 2004 (EMPLOYER AND SELF-EMPLOYMENT DATA)



Source: Bureau of Labor Statistics ES-202 Covered Employment Data and US Census Non-employer Statistics.

New York City's strengths in the life sciences industry is not fully represented in standard employment data.

The New York region is one of the nation's most important life science centers. A 2005 study by the Milken Institute⁵ concluded that the greater New York region ranked second in the nation in terms of economic impact derived from life sciences industries. The region does not rank high in terms of relative concentration. Milken ranked the New York region first in number of jobs, with a total of 74,592 jobs in life sciences. A Brookings Institution study on biotechnology centers⁶ also ranks the New York region as first in pharmaceutical employment and life sciences R&D.

The strength of life sciences in New York City is related to the city's large number of premier medical research centers. These include Columbia University Medical Center, Memorial Sloan-Kettering Cancer Center, New York University Hospital, Rockefeller University and Weill Medical College of Cornell University. Life science-related jobs in these centers are "embedded" in the NAICS codes of those institutions. Thus there are significant numbers of employees in life science-related economic activities that are counted under the NAICS codes of hospitals and higher education. Data on workforce and R&D capacity, discussed in later sections of this report, are better indicators of the city's strengths in this area.

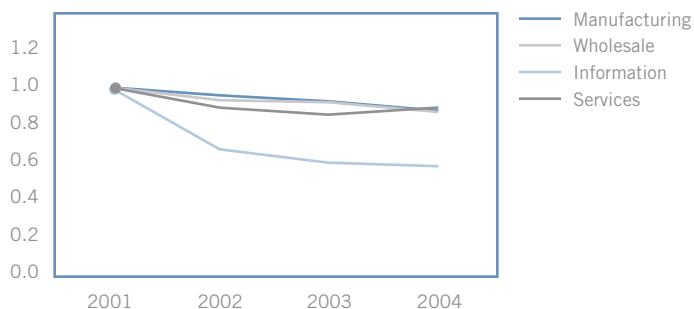
Growth trends show that among enterprise employment in new york city's technology industry, not including self-employment, only technology services-related jobs have rebounded since the 2001 recession. Employment growth appears strongest in the scientific r&d segment of technology services.

Technology jobs in manufacturing, wholesale and information systems declined in every year from 2001 to 2004. Technology service jobs, on the other hand, added over 4,500 jobs in 2004 and offset losses in the other sectors to generate a net gain of almost 2,000 high-technology jobs. The chart below tracks employment growth using an index in which 2001 employment equals 1.0. (See Exhibit 8).

5. Ross DeVol, Rob Koepf, Lorna Wallace, Armen Bedroussian and Daniela Murphy, "The Greater Philadelphia Life Sciences Cluster," The Milken Institute, June 2005.

6. Joseph Cortright and Heike Mayer, "Signs of Life: The Growth of Biotechnology Centers in the US," The Brookings Institution, June 2002.

EXHIBIT EIGHT

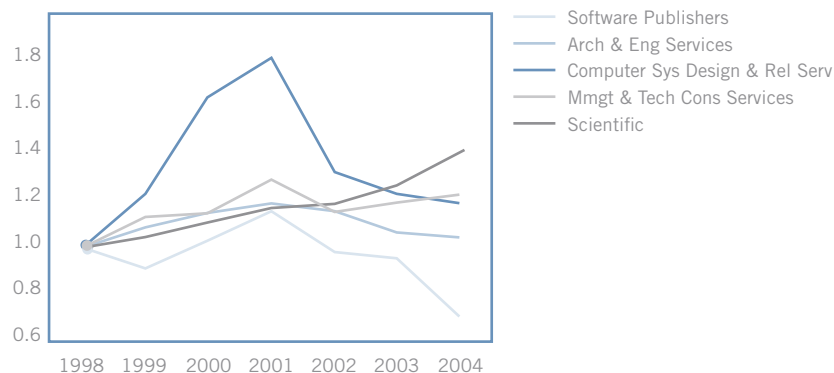
EMPLOYMENT BY MAJOR SECTOR COMPONENTS OF THE NYC TECHNOLOGY INDUSTRY, 2001-2004
(EMPLOYER ESTABLISHMENTS ONLY)

Source: Bureau of Labor Statistics ES-202 Covered Employment Data.
Note: Data do not include self-employed employment.

More detailed trends in the components that make up technology services were analyzed using County Business Patterns (CBP) data, which provide a longer time series under the new NAICS code system than other sources. The chart below tracks employment growth using an index in which 1998 employment equals 1.0. (See Exhibit 9). Employment in all but one industry peaked in 2001, with computer-based industries suffering the steepest declines since. Computer systems design and related services have been highly volatile—increasing jobs by 80% from 1998 to 2001 and then declining by one-third over the next three years with 2004 employment below that of 1999. Software publishing showed the slowest growth from 1998 to 2001 with the greatest relative decline and is the only industry in which 2004 employment dropped below that of 1998. Architectural and engineering services declined slowly but steadily after the 2001 peak while the management and technology consulting industry has been rebounding since 2002 and grew close to its 2001 apex by 2004. An exception is scientific R&D services, which has shown consistent job growth over six years accelerating since 2002.

EXHIBIT NINE

NYC EMPLOYMENT GROWTH IN SOFTWARE AND HIGH-TECHNOLOGY SERVICES 1998-2004
(EMPLOYER ESTABLISHMENTS ONLY)



Source: US Census County Business Patterns
Note: Data does not include self-employed employment.

New York City Versus Other High-Technology Regions

Is the scale of technology employment in New York City and the metropolitan region competitive with metropolitan regions that are commonly considered the nation's major high-technology industry centers? The chart below (see Exhibit 10) summarizes 2003 results based on both firms and self-employment.⁷ Findings from these data demonstrate **the New York region's position as the nation's largest hub of high-technology employment:**

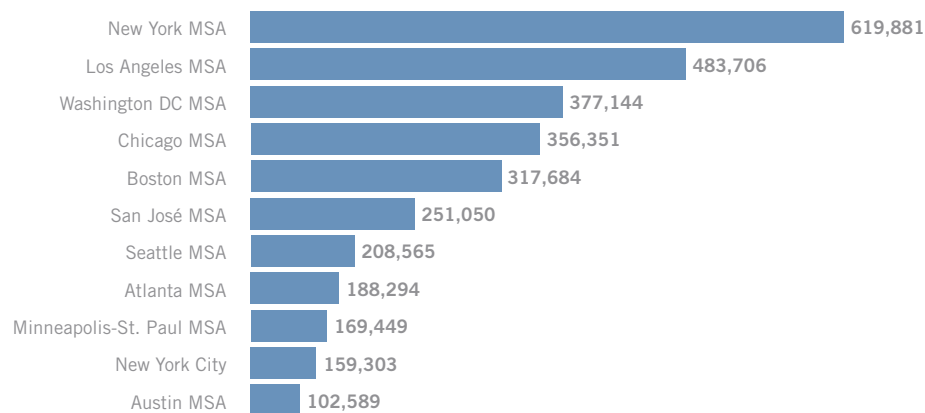
- The New York MSA had, by far, the largest number of total high-technology jobs exceeding the second largest MSA (Los Angeles) by over 136,000 jobs.
- The New York MSA ranked first in high-technology employment for every sector except manufacturing.
- In six of the nine comparison MSAs, the New York MSA had two to four times the number of jobs in high-technology industries. This includes 2.47 times as many jobs as the San José region and almost twice as many as the Boston MSA, which are considered two of the nation's leading high-technology regions.
- The Washington, DC MSA ranked a close second to New York for both high-technology services and employment in combined information and service industries. This MSA is New York's primary competitor for future high-technology development and exceeds the New York MSA in employment for two key industries for New York: computer systems design services and management and technology consulting services industries—the core of New York City's technology base.

7. At the time of this report, 2003 was the latest year available for comparable non-employer statistics across comparison MSAs.

The chart below (See Exhibit 10) indicates that the largest MSAs, New York, Los Angeles and Chicago, are three of the four largest employment centers for high-technology industries. The focus on industry concentration and location quotients in many studies of technology-based economic development has obscured this fact and minimized the importance of these large metropolitan regions as major high-technology employment centers.

EXHIBIT TEN

TOTAL EMPLOYMENT IN TECHNOLOGY FOR NYC, NY MSA AND COMPARISON MSAS, 2003
(EMPLOYER AND SELF-EMPLOYMENT DATA)



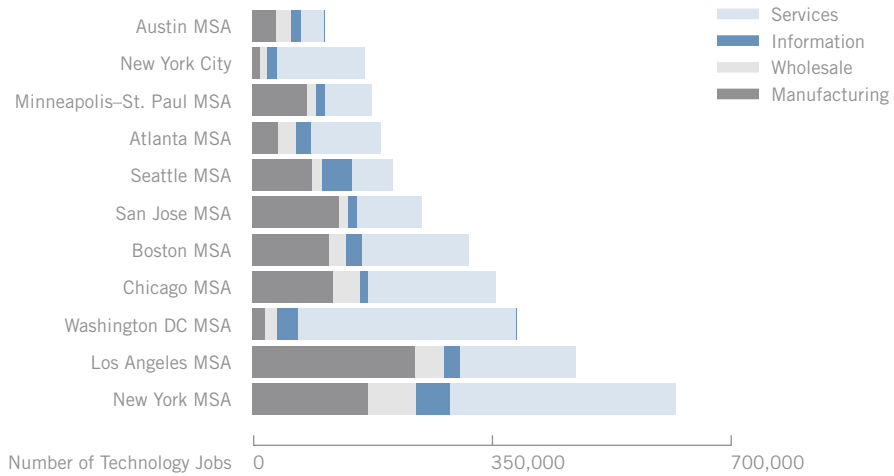
Source: Bureau of Labor Statistics ES-202 Covered Employment Data and US Census Non-employer Statistics.
Note: At the time of this report, 2003 was the latest year available for comparable non-employer statistics across comparison MSAs.

Moreover, while New York City is smaller in its total high-technology employment relative to competing centers (ranking 9th), it is a major employment center for both high-technology services and the combined (and inter-related) information and technology services sectors. The data in the charts below (see Exhibits 11 and 12) demonstrate that:

- New York City, by itself, ranked fifth (excluding the NY MSA) in 2003 employment for both high-technology services and for combined information and services.
- New York City exceeded several traditional technology regions in high-technology information and service industry jobs, including Silicon Valley, and the Seattle, Minneapolis-St. Paul and Atlanta MSAs.
- New York City had close to 1.7 times as many jobs in the high-technology information and service industries as the Minneapolis-St. Paul region (almost 54,000 more) and close to three times that of the Austin MSA (over 85,000 more).

EXHIBIT ELEVEN

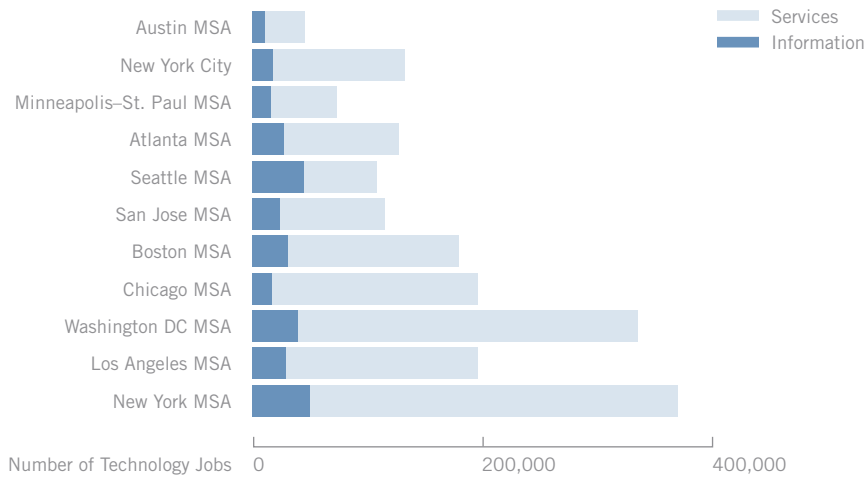
EMPLOYMENT IN MAJOR SECTOR COMPONENTS OF THE TECHNOLOGY INDUSTRY FOR NYC, NY MSA AND NINE COMPARISON MSAS, 2003 (EMPLOYER AND SELF-EMPLOYMENT DATA)



Source: Bureau of Labor Statistics ES-202 Covered Employment Data and US Census Non-employer Statistics.
 Note: 2003 is the latest year available for comparable non-employer statistics across MSAs.

EXHIBIT TWELVE

EMPLOYMENT IN INFORMATION & SERVICES COMPONENTS OF THE TECHNOLOGY INDUSTRY, NYC, NY MSA AND NINE COMPARISON MSAS, 2003 (EMPLOYER AND SELF-EMPLOYMENT DATA)



New York City's Technology Workforce

“The technical and scientific workforce of a region propels its technological sophistication, innovation and economic growth, not only for technology firms, but for all firms where innovation is a key competitive advantage.... For state and local economic development, the message is this: the quality of scientists, engineers, physicists, system engineers and other creative technical workers that states train and retain and attract from other locations will profoundly impact a region's future technology industry development.”⁸

A region's strength as a technology center is defined solely on the depth and scale of related employment. Over the longer term, the strength of a community's technology sector will depend upon the strength and scale of the technological knowledge and skills of its people. In assessing the technology strengths of a region's workforce there are two related dimensions:

- 1) What are the occupational strengths of today's workforce?
- 2) Is there a strong pipeline of skilled workers for the future?

This section looks at these two dimensions of New York City's technology workforce by examining the current occupational mix within the city and assessing the pipeline—the number of individuals being trained in science and engineering in New York City.

The current workforce: technology occupations in New York City

There are two steps in measuring the current technology workforce in New York City. First, as in the case of technology enterprises, one must develop a definition of what occupations to include. Second, one must understand where technology workers are employed. (See Exhibit 13)

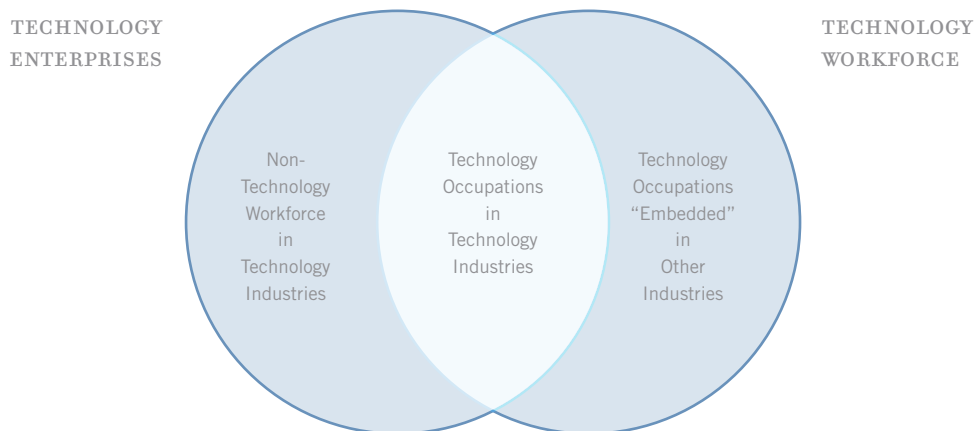
A considerable number of highly-skilled technology workers are not employed within the technology industry. This analysis seeks to measure the total number of individuals in New York City employed in technology occupations, and then further divide the technology workforce into those working within the technology sector and those working in technology outside the defined sector.

This analysis helps to better quantify some of the technology-based activity “embedded” in other industries, and includes the number of highly-skilled technology workers employed in financial services, media, healthcare, government and higher education in New York City.

8. Ross DeVol and Rob Koepp with Junghoon Ki, “State Technology and Science Index: Enduring Lessons for the Intangible Economy,” Milken Institute, March 2004.

EXHIBIT THIRTEEN

TECHNOLOGY OCCUPATIONS IN NEW YORK CITY



Defining the Technology Workforce

The definition of the technology workforce is at least as complex and controversial as the issue of defining high-tech industries. There is no single definition that is used in the field, and the definition has been evolving as the technology economy changes. Some of the definitions focus on occupations that require a certain level of education within a specific technology field. Other definitions emphasize those occupations that require individuals to utilize new technologies. While there is a core of information technology occupations that seem to be common to all definitions, beyond this core, definitions vary widely. Even within the Bureau of Labor Statistics there are two different definitions that are currently being used.

Daniel Hecker, an economist in the Office of Occupational Statistics and Employment Projections, uses a broad definition of scientific, engineering and technician occupations. These occupations are used as the basis of the definition of high-technology industries. According to Hecker:

“Workers in these occupations need an in-depth knowledge of the theories and principles of science, engineering and mathematics underlying technology.... Some technology-oriented workers are engaged in R&D, increasing scientific knowledge and using it to develop products and production processes. Others apply technology in other activities, including the design of equipment, process and structures, computer applications, sales, purchasing and marketing, quality management and the management of these activities.”⁹

Hecker’s definition includes all occupations in the following categories:

- SOC 15-000 Computer and mathematical scientists
- SOC 17-2000 Engineers

9. Daniel E. Hecker, “High-Technology Employment: A NAICS-based Update,” *Monthly Labor Review*, July 2005.

SOC 17-3000 Drafters, engineering and mapping technicians
 SOC 19-1000 Life scientists
 SOC 19-2000 Physical scientists
 SOC 19- 4000 Life, physical and social science technicians
 SOC 11-3020 Computer and information system managers
 SOC 11- 9040 Engineering managers
 SOC 11- 9120 Natural science managers

Patrick Kilcoyne, also economist in the Division of Occupational and Administrative Statistics in the Bureau of Labor Statistics, defines high-tech occupations as those “consisting of workers who typically or necessarily utilize new technologies—those that are changing the ways in which people live and work—in order to perform their duties.”¹⁰

Kilcoyne’s definition includes 34 occupations that use new technologies intensively.

SOC 15-1011 Computer and information scientists, research
 SOC 15-1021 Computer programmers
 SOC 15-1031 Computer software engineers, applications
 SOC 15-1032 Computer software engineers, systems software
 SOC 15-1051 Computer systems analysts
 SOC 15-1061 Database administrators
 SOC 15-1081 Network systems and data communications analysts
 SOC 17-2011 Aerospace engineers
 SOC 17-2031 Biomedical engineers
 SOC 17-2041 Chemical engineers
 SOC 17-2061 Computer hardware engineers
 SOC 17-2071 Electrical engineers
 SOC 17-2072 Electronics engineers, except computer
 SOC 17-2151 Mining and geological engineers
 SOC 17-2161 Nuclear engineers
 SOC 17-2171 Petroleum engineers
 SOC 17-3021 Aerospace engineering and operations technicians
 SOC 17-3023 Electrical and electronic engineering technicians
 SOC 17-3024 Electro-mechanical technicians
 SOC 19-1021 Biochemists and biophysicists
 SOC 19-1022 Microbiologists
 SOC 19-1041 Epidemiologists
 SOC 19-1042 Medical scientists, except epidemiologists
 SOC 19-2011 Astronomers
 SOC 19-2012 Physicists
 SOC 19-2021 Atmospheric and space scientists
 SOC 19-2031 Chemists
 SOC 19-4021 Biological technicians
 SOC 19-4031 Chemical technicians
 SOC 19-4041 Geological and petroleum technicians

10. Patrick Kilcoyne, “Research and Technology Occupational Employment,” presentation at National Science Foundation Workshop: Advancing Measures of Innovation: Knowledge Flows, Business Metrics and Measurement Strategies, Arlington, VA, June 6–7, 2006.

SOC 27-1014 Multi-media artists and animators
 SOC 29-2011 Medical and clinical laboratory technologists
 SOC 29-2033 Nuclear medicine technologists
 SOC 29-2034 Radiologic technologists and technicians

Kilcoyne also developed a broader definition incorporating approximately 100 occupations including all occupations within computer and mathematical sciences, architecture and engineering, life, physical and social science occupations and healthcare practitioner and technical occupations. He calls this wider class “technology group” occupations.

The major differences between the two definitions are:

- Hecker includes a number of occupations that some would label ‘technology support’ in nature such as operations research analysts, statisticians, drafters and actuaries. Kilcoyne’s framework centers on those involved in R&D activity.
- Hecker includes managers of R&D activities such as computer and information system managers, engineering managers and managers in the natural sciences. These occupations are not included by Kilcoyne.
- Kilcoyne adds a selection of occupations that he believes are specifically related to concept and process innovation—multimedia animators and some technologist occupations in the biotechnology industry.

In terms of the high-technology workforce in New York City, we are utilizing Kilcoyne’s occupational categorization. This framework, with its inclusion of new media and biotechnology occupations was determined to be of greater relevance to the characteristics of the local technology industry. In addition, Kilcoyne has recently completed an analysis of high-technology workers by metropolitan area, affording some comparisons with New York.

Unfortunately, secondary data on occupations at the city level is extremely limited. For the purposes of this analysis two sources of data were used: First, New York State staffing patterns released by the New York State Department of Labor provide 2002 estimates of occupational employment in New York City, as well as an industry/occupation matrix allowing analysis of industries employing high-technology workers. For the US as a whole, the 2002 national cross-industry occupational data released by the Bureau of Labor Statistics¹¹ is used.

Size and Characteristics of New York’s Technology Workforce

There are a very large number of individuals with strong technology skills working in technology-related occupations in New York City.

According to the most recent occupational data available for New York City there were approximately 96,000 individuals employed in core technology occupations in the city. This represents about 2.5% of the total workforce in New York City.¹²

Within technology-based occupations, the city’s technology workforce is highly concentrated in the information technology area.

11. 2002 National Industry-Specific Occupational Employment and Wage Estimates, US Department of Labor Bureau of Labor Statistics Web site: http://www.bls.gov/oes/2002/oes_ind.htm

12. This is a relatively conservative measure of technology occupations. Using the broader technology definition developed by the US Bureau of Labor Statistics, there were approximately 126,360 individuals in technology-related occupations, representing 3.3% of the city’s workforce.

A large segment of the technology workforce in New York City is comprised of computer programmers, system analysts and computer software engineers. Computer programmers alone account for about 21% of all technology workers in New York, with computer system engineers making up another 17% of the technology workers. (See Exhibit 14).

EXHIBIT FOURTEEN

LARGEST TECHNOLOGY OCCUPATIONS IN NEW YORK CITY

SOC 15-1021	Computer programmers	20,060	20.9%
SOC 15-1051	Computer systems analysts	16,610	17.3%
SOC 15-1031	Computer software engineers, applications	11,480	12.0%
SOC 15-1032	Computer software engineers, systems software	7,440	7.8%
SOC 15-1081	Network systems and data communications analysts	6,680	7.0%
SOC 15-1061	Database administrators	4,700	4.9%
SOC 29-2011	Medical and clinical laboratory technologists	4,590	4.8%
SOC 29-2034	Radiologic technologists and technicians	3,730	3.9%
SOC 27-1014	Multi-media artists and animators	3,590	3.7%
SOC 19-1042	Medical scientists, except epidemiologists	3,190	3.3%
	Other	13,774	14.4%

Relative to the us as a whole, New York City has a high concentration of individuals with skills in key information and life science occupations.

Location quotients measure the proportion of total employment in an occupation for a designated area as compared to the overall proportion in the US workforce. A location quotient over “1” indicates a relatively high concentration. The two occupations with the highest location quotients in New York City were multi-media artists and medical scientists, illustrating the city’s core strength in new media and the biosciences.

EXHIBIT FIFTEEN

NEW YORK CITY'S OCCUPATIONS WITH STRONG RELATIVE CONCENTRATION

	Location Quotient
SOC 15-1021 Computer programmers	1.5
SOC 15-1051 Computer systems analysts	1.2
SOC 15-1031 Computer software engineers, applications	1.1
SOC 15-1032 Computer software engineers, systems software	1.0
SOC 15-1081 Network systems and data communications analysts	1.7
SOC 19-1042 Medical scientists, except epidemiologists	2.0
SOC 27-10142 Multi-media artists and animators	3.5

By contrast, the city lacks a high concentration of skilled engineers, technicians and general science workers.

A large number of New York City's skilled technology workers are employed outside of high-technology industries—working in the financial services, healthcare and government sectors.

We estimate that 60,900 of the 96,000 technology workforce or 63% exist outside of the high-technology industries as defined in the previous section. For example:

While by far the largest proportion of computer programmers are employed in information technology enterprises, about 5% are employed in companies classified under the NAICS code for management of companies, 5% are employed by employment services (e.g., temporary services), 14% are employed in the financial services industry and another 4% are employed by colleges and universities.

About 16% of computer software engineers are employed in the financial services industry and another 15% are employed by state and local government.

About one quarter of computer system analysts in New York City are employed in the financial services industry. A large number of individuals in this occupation are also employed by hospitals (5%), the federal government (4%) and colleges and universities (3%).

In the area of bioscience, much of the skilled workforce is found in its hospitals and educational institutions, rather than in biotechnology companies. Overall, we estimate that about 68% of the individuals working in occupations in the biosciences work outside of the defined high-technology industries. For example, 21% of medical scientists are employed by hospitals and 10% by colleges and universities.

The Technology Talent Pipeline: Training the Next Generation of New York’s Technology Workforce

According to National Science Foundation data¹³, New York City leads the country in students enrolled in graduate science programs. Within the New York City region in 2004 there were 18,446 students enrolled in graduate science and engineering programs, significantly more than the Boston and San Francisco areas, with 11,739 and 11,239 students respectively.

The chart below (Exhibit 16) demonstrates New York’s strength versus other key regions. (See Appendix B for a more detailed list)

EXHIBIT SIXTEEN

GRADUATE SCIENCE STUDENTS IN ALL INSTITUTIONS, BY REGION 2004

Research Triangle MSA	7,032
Philadelphia MSA	5,389
New York City	18,446
Chicago MSA	9,883
Boston MSA	11,739
Bay Area (San Francisco) MSA	11,239
All institutions	352,630

Note: NYC compared to other metro regions—not cities.

New York City’s universities also are among the most prestigious in the country, including:

- The City University of New York (22 campuses)
- Columbia University
- Fordham University
- Long Island University
- Mt. Sinai School of Medicine
- The New School for Social Research
- New York Institute of Technology
- New York Medical College
- New York University
- Pace University
- Polytechnic University
- Rockefeller University
- The State University of New York’s Health Science Center in Brooklyn
- Wagner College
- Yeshiva University

These institutions and their students offer a tremendous resource to New York area technology enterprises—a talent pipeline that is waiting to be tapped.

13. National Science Foundation, Division of Science Resource Statistics, Science and Engineering Profiles by state, 2003-04.

II. WHAT NEW YORK TECHNOLOGY FIRMS NEED TO GROW

After analyzing the preceding data, we conducted primary research with a cross-section of technology firm executives to identify the challenges of operating a business in New York City. This research was conducted in three phases:

- We conducted a telephone survey among 152 executives at small to mid-size firms (annual sales revenues \leq \$1 million) during February and March, 2006. Participants were involved with new technology R&D. Two-thirds (66%) of the respondents were from software/IT firms. More than three-quarters had operations in Manhattan.
- To gain deeper insight into the issues, we conducted in-depth qualitative telephone interviews with 10 small company executives from the original survey response group. These interviews were conducted during June and July of 2006.
- We interviewed 30 technology managers and directors at larger companies (annual revenues \geq \$100 million) with R&D operations in New York City, by telephone during September and November, 2006. They represented business services, manufacturing and media companies, and were equally divided between software and Internet R&D.

Summary of Survey Findings

- Reducing the overall cost of doing business was the area in which executives at small to mid-size technology firms said they would find assistance most beneficial (68% rated assistance in this area extremely or very helpful). Assistance in other business areas rated as highly helpful included access to skilled employees (63%), access to capital (56%) and identifying/forming strategic partnerships (54%).
- While small firm executives may employ a variety of strategies to finance their businesses, including the use of personal assets/collateral, relatively few (32%) have received any funding or grants. This includes 10% who have received funding or grants from the city, state or federal governments. One possible reason for the low incidence of government grants or funding is the lack of familiarity with these resources; just 15% to 25% of small firm executives were especially familiar with specific types of assistance.
- Since employees at small firms often have to wear many hats, small firm executives strive to hire individuals who combine general business and communication skills with required technical skills. In contrast, just 20% of the R&D managers at larger firms, where job functions may be more narrowly defined, expressed difficulty finding people with needed skill sets.
- Among small firms, joint R&D is fairly common. Sixty-two percent of small firm executives said they conducted joint R&D with customers, 46% with other companies in their industry and 42% with suppliers. However, only 8% to 18% of these executives said they pursue these relationships extensively, and only 25% are conducting any kind of joint R&D with colleges and universities. In contrast, 70% of R&D managers who were surveyed at large companies said they are performing joint R&D with customers and 77% with suppliers, and this was often described as “extensive.” The likelihood of larger firms collaborating with other companies in their industry or with colleges and universities was about the same as with the smaller firms (50% and 23%, respectively).

- Half of the R&D executives at large companies said they sometimes or often contract with small technology firms and that the small firm's technology capabilities are a more important selection criteria than cost, industry knowledge, financial viability or scalability. However, those who rarely or never contract with small firms expressed little likelihood of doing so in the future.
- Proximity to customers and markets was cited most often as one of the top reasons for locating in New York City—by 62% of small company executives and by 67% of large company executives. For small firms, proximity to an owner's residence was the only other factor cited by more than half of executives (59%). In contrast, R&D managers at large companies were likely to mention multiple reasons, such as access to skilled labor (53%), proximity to client firms (43%) proximity to company management (40%) and having always been located here (40%).
- Both small and large firms note that being located in New York City carries certain challenges, particularly prohibitive business costs and infrastructure frustrations. As a result, 36% of executives at small companies said they had considered relocating in the past two years. Similarly, 17% of the large company R&D executives said they had relocated parts of their R&D operations over the past two years, and 23% expressed the likelihood of doing so over the next two years.

Small Technology Firms Looking to Build Organizational Capabilities

For many principals and executives at smaller firms engaged in technology development, dealing with day-to-day company operations is a significant and time-consuming challenge. Selling and servicing customers, “doing the work,” and executing administrative tasks leave little or no time to look at big picture business growth strategy in a planned or systematic way. To survive, these executives feel forced to remain reactive rather than become proactive. Strategic planning, partnership formation, and researching new products become lower priorities. For many, efforts in these areas occur on an ad hoc basis only.

“We've thought about doing a lot of those things and it's just a question of do we have the resources or the immediate need; I think that really what determines an awful lot of what gets done in the course of any day is what seems to have the highest sense of urgency.” (Small company)

When asked which areas of business assistance they would find most helpful, it is not surprising that small firm executives were most likely to cite “reducing the overall costs of doing business” (68% rated it extremely or very helpful). However, other items that were high on their list of priorities speak to the desire to grow their business by getting out from under the day-to-day grind. These included access to skilled employees (63%), access to capital (56%) and identifying/forming strategic partnerships (54%).

- In general, small companies with annual sales revenue of \$1 million or more, along with IT firms, were relatively more likely to require help accessing skilled employee or capital and in forming strategic partnerships. Smaller firms, on the other hand, were more interested in a broader range of business assistance.

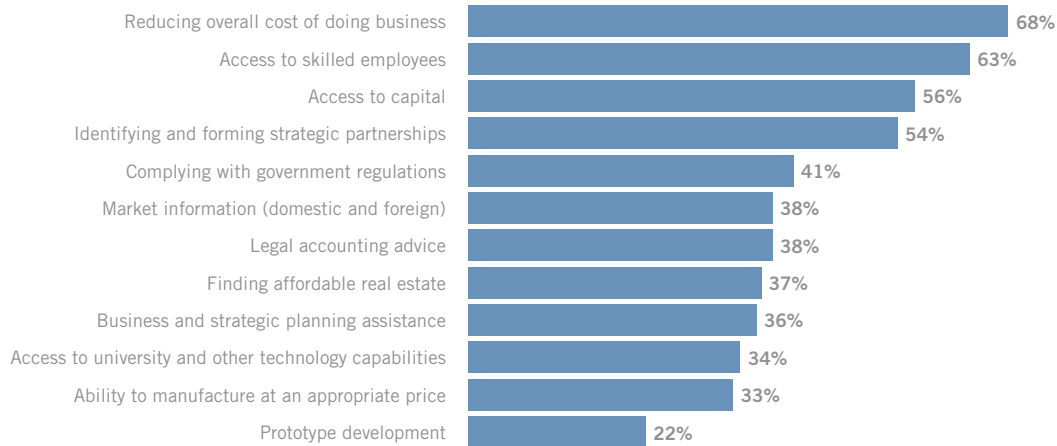
- Obtaining assistance in business and strategic planning does not appear to be a significant priority to most small technology companies, with 36% indicating it would be extremely or very helpful. Some executives interviewed indicated that they believe they know how to prepare a business plan but have been unable to get to it yet. Others either did not recognize the importance of having a business plan or lacked confidence in their abilities to create one.

“I know how to write a business plan, but right now marketing is the challenge.”(Small company)

- Legal or accounting advice was cited as highly helpful by 38% of small company executives. Among those who expressed an interest in this type of assistance, advice on tax credits was rated as very or extremely helpful (43%). Legal or accounting service seen as useful included licensing agreements (34%), business structure (31%) and intellectual property issues (30%). One-quarter mentioned patent filing as an area where they would like support. (See Exhibit 17).

EXHIBIT SEVENTEEN

SMALL TECHNOLOGY COMPANIES: BUSINESS AREAS WHERE ASSISTANCE WOULD BE EXTREMELY/VERY HELPFUL



Seeking Talent

After reducing operating costs, small firm executives cited access to skilled employees as the single greatest area in which they would appreciate assistance. From the in-depth interviews, it appears that finding the right technology skills is not as challenging as finding individuals who possess both general business/communications skills alongside required technology skills. Only by hiring multi-skilled individuals can these executives free themselves from some of the day-to-day operational responsibilities and focus on long-term growth strategies. This means having access to employees who can sell and service clients, work independently and understand the business context, as opposed to those who are mere technologists.

“The operating officer is going to need to have different skill sets, where he manages contracts with OEM manufacturers, and corporate partners, and meshes the efforts of those outside organizations with our internal efforts.” (Small company)

“Techies are a dime a dozen.” (Small company)

“One of the most important things to our company is relationships—the relationships we have with our clients. Being that we’re a small company, I like to have that type of a feeling, where I can see my employees and get a feel for who they are beyond just somebody working on a project.” (Small company)

- Hiring skilled employees is not cited as problematic for the New York City technology operations of larger companies. Only 20% of executives from large companies rated access to skilled employees as highly difficult.

The Quest for Capital

Small company executives said they had known of or employed a wide range of strategies to secure access to working capital. These include financing provided by investors, banks, customers and suppliers and government. Some invest their own personal wealth in the business. For example, one consultant said he took out a home equity loan to help finance his company.

- Executives who would like to receive assistance securing capital cite a variety of barriers as extremely or very significant. These include a required business track record (35%), development of a sound business plan (35%), personal guarantees (35%), collateral requirements (32%), access to angel investors (28%), access to venture capital firms (26%) and the hurdle of required documentation (19%).

Roughly one-third of small company executives (32%) said they had received grants and/or financing, including 10% who had received government grants. (See Exhibit 18) Most small firm executives were not highly familiar with the types of government financial assistance that might be available. Asked about specific types of assistance with which they were highly familiar, just 25% mentioned employee training programs, 20% working capital financing, 19% assistance solving technology problems, 17% capital equipment financing, 17% research grants or tax credits, 16% market development and 15% real estate assistance.

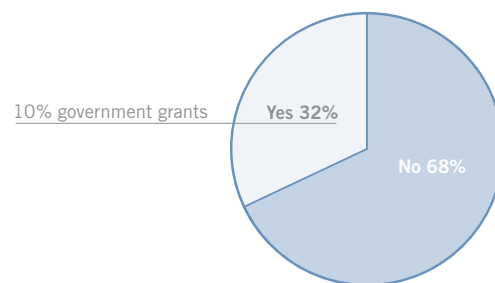
- In-depth interviews with some of these executives suggested an eagerness to apply for government grants or financing but they were not sure how to go about it.

“Sure, who wouldn’t be interested? I haven’t sought those before; I’m not really knowledgeable about them.” (Small company)

“I thought about grants but I didn’t really know how to go about it.” (Small company)

EXHIBIT EIGHTEEN

SMALL COMPANIES: WHETHER COMPANY EVER RECEIVED FUNDING OR GRANTS



Opportunities to Leverage Strategic Partnerships

Executives at small technology companies in New York City cited assistance with strategic partnerships as one of their most pressing needs, with 54% describing such help as extremely or very helpful. Although most of these companies engaged in joint R&D with other entities, they were not making extensive use of these potential partnerships and were more likely to collaborate on an ad hoc basis than as part of a formal strategic initiative. Further, establishing relationships with local colleges and universities was a low priority with these firms—only 34% said that assistance in forming such partnerships would be extremely or very helpful.

“We do that on an ad hoc basis depending on the needs of the particular client or project.” (Small company)

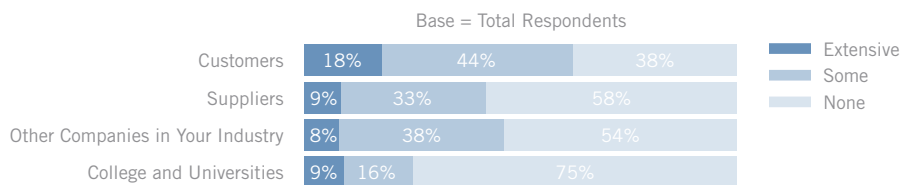
“We do a lot of jobs with others and have to work with them to develop ad hoc solutions. We haven’t done anything with the colleges though that might be an area we might like to pursue.” (Small company)

- Almost two-thirds (62%) of small company executives conducted joint R&D with customers, 42% mentioned such activities with suppliers and 46% with other companies in their industry. In contrast, just 25% of these executives claimed they had conducted any joint R&D with colleges or universities (most often with institutions within the five boroughs). Although these activities took place, only 8% to 18% of small company executives said they conducted extensive joint R&D with research institutions.

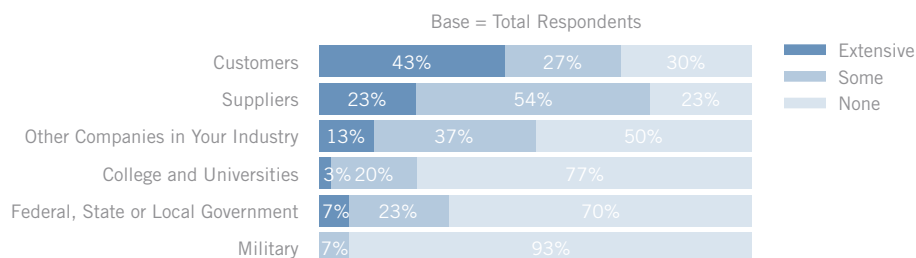
- Certain types of smaller companies were more likely to engage in joint R&D activities. These included companies with under \$1 million in revenues, non-IT companies and companies devoting a larger proportion of their total budget to R&D.
- Large companies were generally more likely than smaller firms to perform joint R&D with certain types of entities. For example, roughly three-quarters of large company managers said they conducted joint R&D with customers and suppliers, often extensively. However, these same managers cited the frequency of R&D efforts with other companies in their industry and/or colleges and universities as comparable with those of other small companies.
- Larger companies are a primary market for small and mid-size technology companies, and this can form a basis for strategic partnerships between the two. Half of the larger company executives surveyed indicated that they often or sometimes contract with small technology firms. On the other hand, those that do not currently see small firms as a resource expressed low interest in doing so in the future. Among the large company managers who partner with small firms, technology capabilities outweighed all other considerations in deciding firm selection. Almost all (94%) of the large company managers named technology capabilities as a highly important factor, while 69% cited cost, 69% mentioned industry knowledge, 56% cited financial viability and 56% indicated a firm's ability to scale to meet their needs. In contrast, just 6% of the large company managers said that proximity to their offices was highly important as a selection criterion. This underscores the opportunity for small New York City technology companies to serve major customers outside the city, and may be one of the reasons that 59% of the revenues of the small companies in the survey came from customers outside the five boroughs. (See Exhibit 19)

EXHIBIT NINETEEN

SMALL COMPANIES: AMOUNT OF R&D CONDUCTED JOINTLY WITH OTHERS



LARGE COMPANIES: AMOUNT OF R&D CONDUCTED JOINTLY WITH OTHERS



Beneficial Synergies Derived from a New York City Location

For both large and small companies, geographic proximity does appear to play a significant role in choosing to locate their businesses in New York City. Some of this is due to metropolitan residents preferring to have their businesses here. However, there is significant evidence that “wanting to be where the action is” represents an important reason for setting up shop in the five boroughs.

- Proximity to markets and clients is an important reason that both large and small companies are located in New York City—cited by 62% of small company executives and by 67% of large company executives as one of their top three reasons.
- Small company executives cited proximity to the owner’s residence (59%) as one of the top three reasons their firm was located in New York City. Similarly, 40% of large company managers mentioned proximity to the residence of company senior management as an important reason for their R&D operations to be located in New York City. Among the large company managers, 40% also cited the fact that their operation has always been located here as one of the top three reasons they were in the five boroughs.
- For small companies, there were a variety of location considerations, each one cited by no more than 20% of executives. With larger companies, there was greater consensus. The importance of New York City as a business hub was underscored by high percentages of large company managers who cited location issues as important: access to skilled labor (53%), proximity to firms in their industry (43%) and proximity to business services and suppliers (30%). (See Exhibits 20 and 21)

EXHIBIT TWENTY

SMALL COMPANIES: MOST IMPORTANT REASONS COMPANY IS LOCATED IN NEW YORK CITY (ITEMS RANKED AMONG TOP THREE)

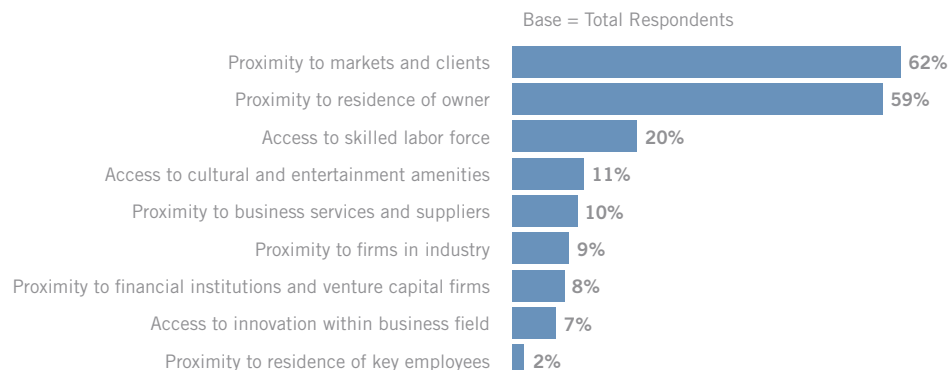
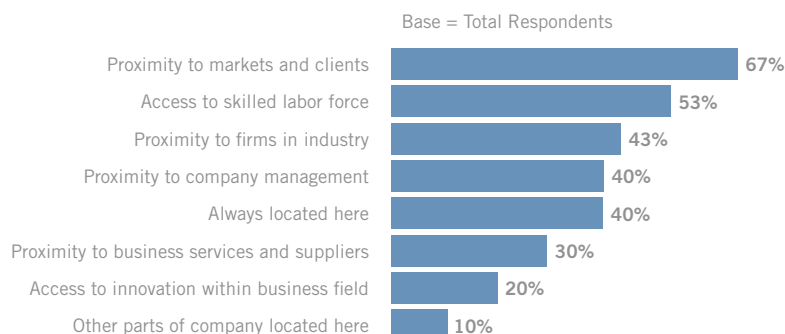


EXHIBIT TWENTY-ONE

LARGE COMPANIES: MOST IMPORTANT REASONS TECHNOLOGY OPERATION IS LOCATED IN NEW YORK CITY
(ITEMS RANKED AMONG TOP THREE)

Overcoming the Challenges of a New York City Location

Despite the appeal of being located in a world-class business hub, both small and large companies face similar challenges with being located in New York City. Many question whether the cost of remaining in New York City is justified by the benefits they receive. Consequently, relocation is never far from their minds.

- In open-ended responses, small company executives and large company managers focused on two themes: the high cost of doing business, especially real estate/rents and taxes and infrastructure issues, and electricity and communications issues.

“We considered relocating because of the high cost of doing business, especially the rents, which are too high.” (Small company)

“Our city taxes are too high.” (Small company)

“Real estate, cost of operations [are challenges]” (Large firm)

“The availability of capacity from Verizon. To get them to give us more megahertz of bandwidth so we can do more things.” (Large company)

“Power. A lot of buildings are older structures like condos and coops, and the power structures are antiquated; they can’t handle the amps. We have major power surges because of it. A lot of companies are building state-of-the-art buildings in other areas because of that.” (Large company)

- Among small company executives, 36% have considered relocating during the past two years, including 15% who admitted serious consideration. Among the larger firms, 17% actually relocated some of their R&D operations outside the five boroughs, and 23% said they were likely to do so over the next two years.
- Even though the vast majority (92%) of small technology companies were headquartered in New York City, many already had a foothold in other locations; these executives reported that, on average, 25% of their operations took place outside the five boroughs.

APPENDIX A: METHODOLOGIES

Methodology for Mt. Auburn Economic Analysis of Technology Sector

Developing a New Paradigm for Assessing the Technology Sector

A review of prior studies and government economic data indicated that a new paradigm was needed for thinking about the New York City's technology economy. The new model included an examination of *all* of the city's technology assets (enterprises, workforce and infrastructure); employees of technology businesses as well as sole proprietorships, and assets "embedded" in businesses in other industry sectors such as medical and financial service.

To identify industry SIC codes, the study also employed a broad definition of "high technology", which included the following:

- *High-technology industries* have a share of workers in research and development and technology occupations, which is at least twice the national average.
- *technology employers* are industries in which employment in scientific and technical occupations exceeds three times the national averages
- *technology generators* are industries that exceed the national average for both research and development expenditures per worker *and* the percentage of research and development scientists and engineers in their workforce

Conducting the NY Technology Industry Census: Data Sources and Methodology

To analyze New York City's high-technology industries, data was collected for each of the 32 industries in New York's five counties and then aggregated across counties and across industries to provide citywide data by individual industry, sector and the total for all high-technology industries. Two primary data sources were combined to provide a complete picture of high technology:

- the ES-202 data series compiled as part of the unemployment system documents employment within established enterprises; and
- non-employer statistics compiled by the census bureau from IRS records that details self-employment.

With the growing role of contractors and individual entrepreneurs, particularly in the information and service industries, it is critical to count self-employment in profiling New York City's high-technology economy.

To provide a basis for understanding the relative size and composition of New York City's high-technology industry, the same data was collected for the New York Metropolitan Statistical Area (MSA) and nine other MSAs that are either recognized as high-technology centers or are among the nation's three largest metropolitan areas. This combination of the largest metro areas and recognized high-tech metro areas was chosen to test New York City's relative size and rank among ten of the nations largest agglomerations of high-technology employment. Since New York City is so much larger than other US cities, it is more appropriate to compare its high-technology employment to metropolitan areas rather than to individual cities.

Data availability posed some methodological challenges for the analysis. First, the most recent year for which non-employer statistics and annual ES-2002 data was for 2004. Consequently, the most complete data set and much of the analysis is for 2004 and thus may not reflect new trends or changes in the past two years. Second, employment and wage figures for several industries at the MSA level were suppressed and the industries with suppressed data varied across metropolitan areas¹⁴. County Business Patterns data was substituted for missing ES-202 data for most information and service industries or when ES-202 was available for 2002 and 2004 the mid-point was used to estimate 2003 employment. However, missing data was not obtained for the oil extraction industry and some small manufacturing industries. With modest employment in these industries, they were not material to determining the magnitude of the metropolitan area's high-tech employment. Moreover, New York City high-technology manufacturing employment is very small and thus it was most important to have complete comparative data for industries in the information and service sectors. Since there are no alternative data sources to address suppressed data for the Census non-employer statistics, these figures under-estimate the level of self-employment, particularly for the high-technology manufacturing industries in which unreleased data was common.

Given these data limitations, it is important to read the figures as estimates of the overall and relative size of high-technology industry employment in New York City and the comparison areas, not as exact figures for the actual employment.

Methodology for Bayer Consulting Executive Surveys and Interviews

Technology Interview Guide - Small Firms

The goal of the Technology Census is to gain a better understanding of the needs of New York City technology firms, like yours, so that ITAC can provide services to help them grow here.

The discussion will be held in confidence and any information that we use will not be attributed to you. Your responses will be strictly anonymous.

The interview is being recorded to ensure accuracy.

- Please tell us about your company:
 - What products or services do you provide?
 - What are your primary markets/customers? Where are they located?
 - What role does technology development play in your company:
 - Embedded in your products and services?
 - Enables you to operate more efficiently and productively?
 - When was your company founded?
 - How many employees do you have?
 - What types of assistance would be most helpful to the growth of your company?
 - Are there any other types of assistance that would be especially helpful?
- Access to Skilled Employees
 - How easy is it for your company to find the skilled employees it needs?

14. Complete ES-202 data for all high technology industries in New York City was obtained.

- What types of skills or experience do have the greatest difficulty finding?
- How are you addressing this issue? Have you worked with any government or nonprofit organizations?

- Access to Capital
 - Has your company been able to secure the financing it needs or has this been an problem?
 - What types of financing have you sought?
 - What have been the obstacles?
 - Have you sought city, state or federal grants, such as SBIR?

- R&D
 - How does your company handled its R&D activities?
 - Does your company need any additional R&D capabilities?
 - Have you explored forming R&D partnerships with universities?
 - Has your company explored forming strategic partnerships with other groups, e.g., customers, suppliers, other firms in your industry?
 - Would any additional assistance in this area be helpful?

- Business and Strategic Planning
 - Does your company have a business plan? If so, how was that created?
 - Would your company benefit from assistance with business planning?
 - Are you familiar with ITAC, the Industrial Technology Assistance Corporation?
 - ITAC's mission is to help businesses grow in New York City. How could ITAC be most relevant to your company?

Thank you for taking the time to participate.

Technology Survey - Small Companies

ASK TO SPEAK WITH PERSON LISTED IN SAMPLE. IF THIS PERSON IS NOT AVAILABLE or IF NO NAME PROVIDED, ASK TO SPEAK WITH A SENIOR EXECUTIVE WITH OVERALL KNOWLEDGE OF THE BUSINESS

Introduction

Hello. My name is _____ from Innovative Concepts, an independent marketing research firm. We are conducting a short survey on behalf of ITAC (pronounced eye-tack). ITAC is a nonprofit organization funded by New York State and New York City to assist technology firms to grow in New York City. The goal of our survey is to gain a better understanding of the needs of firms, like yours, so that ITAC can provide services to help technology firms grow here. Our survey will only take a few minutes and your answers will be held in strictest confidence.

1. First, I'm going to read a list of areas that might be important to a company like yours and I'd like you to tell me how helpful you think assistance in each area would be to the growth of your company? Do you think assistance in (AREA) would be(READ SCALE)?

Scale: Not at All Helpful, Not Too Helpful, Somewhat Helpful, Very Helpful, Extremely Helpful

PROGRAMMER NOTE: REPEAT FOR ALL ATTRIBUTES. ROTATE STARTING POINT.

 - a. Access to capital
 - b. Access to skilled employees

- c. Legal or accounting advice
- d. Business and strategic planning assistance
- e. Access to university and other technology capabilities (for example, technology review, problem solving, enhancement)
- f. Market information (both domestic and foreign)
- g. Identifying and forming strategic partnerships
- h. Prototype development
- i. Ability to manufacture at an appropriate price
- j. Finding affordable real estate
- k. Reducing overall costs of doing business
- l. Complying with government regulations

2. Are there any other types of assistance that would be particular helpful to your company's future growth?

Open end

PROGRAMMER NOTE: Executives who rated assistance with "access to capital" in Q1 as somewhat, very or extremely helpful will be asked Q3

3. How significant have each of the following barriers been to the ability of your company to secure capital?

Has (ITEM) been....(READ SCALE) as a barrier to secure capital?

Scale: Not at All Significant, Not Too Significant, Somewhat Significant, Very Significant, Extremely Significant

PROGRAMMER NOTE: Repeat for all attributes. Rotate starting point.

- a. Lack of access to venture capital firms
- b. Lack of access to angel investors
- c. Required documentation
- d. Required business track record
- e. Developing a sound business plan
- f. Meeting collateral requirements
- g. Requirements to provide personal guarantees

PROGRAMMER NOTE: EXECUTIVES WHO RATED ASSISTANCE WITH "SECURING LEGAL ADVICE" IN Q1 AS SOMEWHAT, VERY or EXTREMELY HELPFUL WILL BE ASKED Q4.

4. How helpful do you think assistance with securing legal or accounting advice on the following issues would be to the growth of your company? Would legal or accounting advice on (ITEM) be....(READ SCALE) to the growth of your company?

Scale: Not at All Helpful, Not Too Helpful, Somewhat Helpful, Very Helpful, Extremely Helpful

PROGRAMMER NOTE: Repeat for all attributes Rotate starting point.

- a. Patents
- b. Other intellectual property issues
- c. Licensing agreements
- d. Business structure
- e. Tax credits

5. Now I'm going to ask you a few questions about New York City as a business location.
- Which one of the following is the most important reasons that your company is located in New York City? (READ LIST. CHECK ONLY ONE ANSWER.)
 - And which of these is your second most important reason? (READ LIST. CHECK ONLY ONE ANSWER.)
 - And which of these is your third most important reason? (READ LIST. CHECK ONLY ONE ANSWER.)
- PROGRAMMER NOTE: REPEAT LIST FOR SECOND (MINUS ITEM MENTIONED FIRST) AND THIRD (MINUS ITEMS MENTIONED FIRST AND SECOND) ROTATE LIST FOR EACH NEW RESPONDENT; THEN KEEP LIST IN SAME ORDER FOR SECOND MOST IMPORTANT REASON AND THIRD MOST IMPORTANT REASON*
- Proximity to residence of owner
 - Proximity to residence of key employees (other than owner)
 - Proximity to markets and clients
 - Proximity to business services and suppliers
 - Proximity to firms in industry
 - Proximity to financial institutions and venture capital firms
 - Access to skilled labor force
 - Access to innovation within business field
 - Access to cultural and entertainment amenities
6. Are there any other important reasons that your company is located in New York City?
Open end
7. Over the last 2 years, has your company considered relocating outside the 5 boroughs of New York City?
Scale: Yes, No
PROGRAMMER NOTE: EXECUTIVES WHO RESPOND 'YES' TO Q7 WILL BE ASKED Q8.
8. How seriously has your company considered locating outside the 5 boroughs of New York City? (READ LIST)
- Not Too Seriously
 - Somewhat Seriously
 - Extremely Seriously
- PROGRAMMER NOTE: EXECUTIVES WHO SAID IN Q8 THAT THEIR COMPANY HAD CONSIDERED RELOCATING SOMEWHAT OR EXTREMELY SERIOUSLY WILL BE ASKED Q9*
9. Why has your company considering moving outside the 5 boroughs of New York City?
Open end
10. How familiar is your company with Federal, New York City and New York State programs to assist businesses in the following areas? Using a five point scale, where "1" means not at all familiar and "5" means very familiar, how would you rate your company's familiarity with Federal, New York City and New York State programs to assist businesses with (ITEM)?
PROGRAMMER NOTE: REPEAT FOR ALL ATTRIBUTES. ROTATE STARTING POINT.
- Employee training
 - Working capital financing

- c. Capital equipment financing
- d. Research grants/tax credits
- e. Assistance in solving technology problems
- f. Market development (for example, exporting and government contracting)
- g. Real estate assistance (including relocation assistance)

11. My next few questions ask about your company's R&D efforts. How much R&D does your company conduct jointly with each of the following groups? Thinking about (ITEM), does your company conduct... (READ SCALE) with (ITEM)?

Scale: No joint R&D, Some joint R&D, Extensive joint R&D

PROGRAMMER NOTE: REPEAT FOR ALL ATTRIBUTES. ROTATE STARTING POINT.

- a. Your customers
- b. Your suppliers
- c. Other companies in your industry
- d. Colleges and universities

12. Are there any other groups that your company conducts joint R&D with?

Open end

PROGRAMMER NOTE: Q13 WILL BE ASKED OF EXECUTIVES WHO SAID IN Q12 THAT THEIR COMPANY CONDUCTS R&D WITH COLLEGES AND UNIVERSITIES

13. Where are the colleges and universities located that your company jointly conducts R&D with? (READ LIST. CHECK ALL THAT APPLY.)

- a. In the 5 boroughs of New York City
- b. In New York State outside the 5 boroughs of New York City
- c. In another state
- d. In another country

14. Finally, I have just a few questions to help classify your responses. As a reminder, all answers are held in the strictest confidence. Which of the following best describes your company's primary activity? (READ LIST. CHECK ONE ANSWER)

- a. Computer Software (including media and entertainment software)
- b. Computer Hardware
- c. Telecommunications and Internet (i.e., equipment and services, excluding software)
- d. Biotechnology (i.e., research and development of materials used in biological research)
- e. Pharmaceuticals (i.e., drug research and manufacturing)
- f. Medical (i.e., medical equipment manufacturing, services, consulting and diagnostic services)
- g. Environmental
- h. Energy
- i. Factory Automation
- j. Chemicals
- k. Photonics
- l. Defense
- m. Subassemblies and Components
- n. Test and Measurement

- o. Manufacturing Equipment
- p. Transportation
- q. Advanced Materials
- r. Other—Manufacturing (Please specify) _____
- s. Other—Non-manufacturing (Please specify) _____

15. What are your company's unique technology-based products or services?

Open end

16. Which of the following ranges includes the annual sales revenue of your company? (READ LIST. CHECK ONE ANSWER)

- a. Less than \$250,000
- b. \$250,000 to less than \$500,000
- c. \$500,000 to less than \$1 million
- d. \$1 million to less than \$5 million
- e. \$5 million to less than \$25 million
- f. \$25 million to less than \$100 million
- g. \$100 million or more

17. Approximately what percentage of your company's annual budget is devoted to R&D for new technologies or for new technology-based products or services?

_____ %

18. Does your company have patents either assigned to it or pending? Yes/No

- a. [IF YES] Approximately how many patents does your company have either assigned to it or pending? _____

19. Has your company ever received any of the following? (READ LIST. CHECK ALL THAT APPLY)

- a. Venture capital funding
- b. Angel investor funding
- c. Federal or State research and development grants or financial assistance

PROGRAMMER NOTE: Q20 WILL BE ASKED OF EXECUTIVES WHO SAID IN Q98 THAT THEIR COMPANY HAD RECEIVED FEDERAL OR STATE TECHNOLOGY GRANTS.

20. Which of the following Federal or State research and development awards has your company received?

(READ LIST. CHECK ALL THAT APPLY)

- a. National Institutes of Health (NIH)
- b. National Science Foundation (NSF)
- c. Small Business Innovation Research (SBIR)
- d. Small Business Technology Transfer (STTR)
- e. Other federal R&D award (Please specify) _____
- f. New York State R&D award

21. In which boroughs does your company have operations? (READ LIST. CHECK ALL THAT APPLY)
- Manhattan
 - Bronx
 - Brooklyn
 - Queens
 - Staten Island
22. Does your company have locations outside the 5 boroughs of New York City?
Scale: Yes/No
 [IF YES]
- What other locations does your company have?
Open-end
 - Where is the headquarters of your company located?
 - Within the five boroughs of New York City (SPECIFY BOROUGH)
 - Outside the five boroughs of New York City (SPECIFY)
 - Approximately what percentage of your company's operations take place in the following locations?
 (READ LIST. ANSWERS MUST ADD TO 100%)
PROGRAMMER NOTE: PROVIDE THE FOLLOWING CHOICES FOR 22C - WITHIN THE 5 BOROUGHS OF NEW YORK CITY, ELSEWHERE IN NEW YORK STATE, ELSEWHERE IN THE U.S., OUTSIDE THE U.S.. INTERVIEWER READS LIST AND TYPES IN A PERCENT FOR EACH. ANSWERS MUST ADD TO 100%
23. How many full-time employees does your company have in the 5 boroughs of New York City?
 Number of full-time employees _____
24. How many part-time employees does your company have in the 5 boroughs of New York City?
 Number of part-time employees _____
25. In which year was your company formed?
 Year Company Formed _____ (TYPE IN ALL 4 DIGITS)
26. Approximately what percentage of your company's annual sales revenues come from customers in the following locations? (ANSWERS MUST ADD TO 100%)
Programmer note: Answers must add to 100%
- 5 boroughs of New York City _____%
 - New York metropolitan area (outside the 5 boroughs of New York City) _____%
 - Elsewhere in the U.S. _____%
 - Outside the U.S. _____%
27. Does your company have business customers? Yes/No
 [IF YES] In which of the following industries does your company have customers? (READ LIST. ALL THAT APPLY.)
- Financial services
 - Healthcare
 - Information technology

- d. Telecommunications
- e. Media/entertainment
- f. Manufacturing
- g. Business and professional services (e.g., consulting, accounting, advertising)
- h. Other industries (Please specify) _____

28. To better understand what types of assistance could help New York City technology firms grow, ITAC will be conducting a select number of 30-minute telephone interviews of senior technology executives. Would you be willing to participate in one of these interviews?

- a. Yes
- b. No
- c. Not sure

THANK RESPONDENT AND TERMINATE

Thank you for taking time to participate in the New York City Technology Census being conducted by ITAC. ITAC is a nonprofit organization funded by New York State and New York City to assist technology firms to grow in New York City.

Technology Survey - Large Companies

Respondents will be instructed to answer the survey questions about their division or subsidiary.

1. Which of the following types of research activities does your company conduct in the five boroughs of New York City? Please select all that apply.
 - d. Software development (i.e., beyond simply purchasing vendor applications)
 - e. Materials research
 - f. Pharmaceutical research
 - g. Biotechnology
 - h. Financial products
 - i. Other (Please specify)
 - j. None

IF AN EXECUTIVE RESPONDS "NONE", THANK AND TERMINATE

2. What are the most important challenges your company faces in conducting research activities in New York City?
Open end
3. To what extent does your company conduct R&D jointly with the following groups?
Scale: Not at All, Some joint R&D, Extensive joint R&D
 - a. Customers
 - b. Suppliers
 - c. Other companies in your industry
 - d. Colleges and universities
 - e. Government (Federal, state or local)

4. Are there any other groups that your company conducts joint R&D with?

Open end

IF AN EXECUTIVE SAYS IN Q4 THEY CONDUCT R&D WITH COLLEGES, THEY WILL BE ASKED Q6

5. Where are the colleges and universities located that your company jointly conducts R&D with?

(Please choose all that apply.)

- a. In the 5 boroughs of New York City
- b. In New York State outside the 5 boroughs of New York City
- c. In another state
- d. In another country

6. What are the 3 most important reasons that your company has R&D operations located in New York City?

- a. Proximity to markets and clients
- b. Proximity to business services and suppliers
- c. Proximity to firms in industry
- d. Access to skilled labor force
- e. Access to innovation within business field
- f. Proximity to company management
- g. Have always been located here

7. Are there any important reasons that your company has R&D operations located in New York City?

Open end

8. Over the last 2 years, has your company moved R&D or research operations outside the 5 boroughs of New York City?

Scale: Yes, have relocated operations elsewhere; No, but considered it seriously; No, and didn't considered it seriously; Don't know

9. Looking ahead over the next 2 years, how likely do you think it is that your company will move some or all of its research activities outside the 5 boroughs of New York City?

Scale: Not at all likely, Not too likely, Somewhat likely, Very likely, Extremely likely, Don't know

EXECUTIVES WHO ANSWER SOMEWHAT/VERY/EXTREMELY LIKELY TO Q10 WILL BE ASKED Q11

10. Why do you think your company may move some or all of its research activities outside the 5 boroughs of New York City?

Open end

11. How easy or difficult is it for your company to hire people with the technology skills that it needs for its research?

Scale: Extremely easy, Somewhat easy, Neither easy nor difficult, Somewhat difficult, extremely difficult

EXECUTIVES WHO ANSWER SOMEWHAT/EXTREMELY DIFFICULT WILL BE ASKED Q13

12. What are the types of technology skills or experience that your company has had the most difficult in finding?
Open end
13. To what extent does your New York City research operation contract with small technology companies (i.e., those with less than 100 employees) to conduct research for it?
Scale: Never, Rarely, Sometimes, Often
EXECUTIVES WHO ANSWER NEVER/RARELY IN Q14 WILL BE ASKED Q15
14. Over the next 2 years, how likely is it that your New York City research operation will contract with small technology companies (i.e., those with less than 100 employees) to conduct research for it?
Scale: Not at all likely, Somewhat likely, Very likely
15. Does your company contract with small technology companies located in New York City to conduct research for it?
Scale: Yes, No, Don't know
EXECUTIVES WHO ANSWER SOMETIMES/OFTEN IN Q14 WILL BE ASKED Q17
16. How important are the following factors when your company selects a small technology company to conduct research for it?
Scale: Not at all important, Not too important, Somewhat important, Very important, Extremely important, Don't know
- a. Cost
 - b. Technical capabilities
 - c. Knowledge of our industry
 - d. Financial viability
 - e. Close proximity to our offices
 - f. Ability to scale to meet our needs
17. Are there any other important factors that your company considers when selecting a small technology firm to conduct research for it?
Open end

Demographics

18. Which of the following best describes your company's primary activity?
- a. Computer Software (including media and entertainment software)
 - b. Computer Hardware
 - c. Telecommunications and Internet (i.e., equipment and services, excluding software)
 - d. Biotechnology (i.e., research and development of materials used in biological research)
 - e. Pharmaceuticals (i.e., drug research and manufacturing)
 - f. Medical (i.e., medical equipment manufacturing, services, consulting and diagnostic services)

- g. Environmental
- h. Energy
- i. Factory Automation
- j. Chemicals
- k. Photonics
- l. Defense
- m. Subassemblies and Components
- n. Test and Measurement
- o. Manufacturing Equipment
- p. Transportation
- q. Advanced Materials
- r. Other—Manufacturing (Please specify)_____
- s. Other—Non-manufacturing (Please specify)_____

19. Approximately how many employees are there in your company's research operations in the 5 boroughs of New York City? If you are not sure of the number, please provide your best estimate. _____
20. Approximately what percentage of your company's total research activities are conducted in the 5 boroughs of New York City? If you are not sure of the number, please provide your best estimate. _____
21. To better understand the issues that face companies conducting research in New York City, ITAC will be conducting a select number of 30-minute telephone interviews of senior technology executives. Would you be willing to participate in one of these interviews?
- a. Yes
 - b. No
 - c. Not sure

Thank you for your participation.

Survey of Representative Companies to Identify Challenges and Needs

A sample of executives from the database created from the census was conducted in three phases and included both telephone surveys and in-depth interviews. Small, mid-sized and large companies in the information technology industry or technology/R&D business units in manufacturing, business services, media and other services companies participated. The surveys took place between February and November, 2006.

Three Phases of Research Survey

- A telephone survey among 152 executives at small to mid-sized firms was conducted during February–March, 2006. These companies were identified from a list compiled by ITAC from various sources; all participants were screened for involvement with researching or developing new technology.
- During June and July, 2006, qualitative in-depth interviews were conducted by telephone with 10 of the respondents to the original survey of small company executives in order to gain deeper insight into the issues.

- A telephone survey among 30 technology managers and directors larger companies (i.e., those with \$100 million or more in annual revenues) that have research and development operations in New York City was conducted during September–November, 2006.

Respondent Profiles

Small to mid-sized firms who participated in the survey included the following:

- Two-thirds (66%) were IT firms (mainly software) and the remainder covered a broad range of other manufacturing and service activities.
- Almost half (46%) had annual sales revenues less than \$1 million.
- Two out of three (65%) spent at least 10% of their annual budget on R&D. The average proportion of annual budget devoted to R&D was 22%.
- One-third (32%) had patents, either assigned or pending.
- More than three-fourths (78%) had operations in Manhattan.
- Fewer than half (41%) had more than 10 full-time employees. Most (80%) also had part-time employees, but generally one or two part-time workers.
- Almost all (92%) had business customers, covering a broad range of industry types.

Large companies who participated in the survey had the following characteristics:

- 26 of the 30 respondents were involved in R&D for IT activities. Software and Internet technology were represented in roughly similar proportions.
- Business services (30%), manufacturing (23%) and media (17%) were the most common types of businesses surveyed.

These managers reported an average of 45 employees involved in R&D activities at their company or division within New York City and that on average 69% of the R&D activity for their operation took place in the five boroughs

APPENDIX B

Graduate Science Students by Institution, Region and State

Graduate science students in all institutions, by region, state, institution and citizenship and by race/ethnicity of U.S. citizens and permanent residents: 2004

Research Triangle	Duke U.	1,425
Research Triangle	NC Central U.	343
Research Triangle	NC State U.	2,401
Research Triangle	U. NC Chapel Hill	2,118
Research Triangle	U. NC Charlotte	745
		7,032
Philadelphia	Bryn Mawr C.	84
Philadelphia	Drexel U.	1,356
Philadelphia	Philadelphia C. of Osteopathic Medicine	363
Philadelphia	Swarthmore C.	0
Philadelphia	Temple U.	1,080
Philadelphia	Thomas Jefferson U.	228
Philadelphia	U. PA	1,720
Philadelphia	U. of the Sciences Philadelphia	124
Philadelphia	Villanova U.	434
		5389
NEW YORK CITY	Columbia U.	2,449
NEW YORK CITY	CUNY Baruch C.	437
NEW YORK CITY	CUNY Brooklyn C.	646
NEW YORK CITY	CUNY City C.	580
NEW YORK CITY	CUNY C. Staten Island	64
NEW YORK CITY	CUNY Graduate Ctr.	1,786
NEW YORK CITY	CUNY Herbert H. Lehman C.	69
NEW YORK CITY	CUNY Hunter C.	512
NEW YORK CITY	CUNY John Jay C. of Criminal Justice	1,541
NEW YORK CITY	CUNY Queens C.	199
NEW YORK CITY	Fordham U.	411
NEW YORK CITY	Long Island U. all campuses	1,121
NEW YORK CITY	Mt. Sinai School of Medicine	204
NEW YORK CITY	New School, The	1,247
NEW YORK CITY	NY Institute of Technology all campuses	302
NEW YORK CITY	NY Medical C.	204
NEW YORK CITY	NY U.	2,979
NEW YORK CITY	Pace U. all campuses	786
NEW YORK CITY	Polytechnic U.	295
NEW YORK CITY	Rockefeller U.	151
NEW YORK CITY	St. John's U. (Jamaica, NY)	539

NEW YORK CITY	SUNY Health Science Ctr. Brooklyn	42
NEW YORK CITY	Teachers C. Columbia U.	1,251
NEW YORK CITY	Wagner C.	9
NEW YORK CITY	Yeshiva U.	622
		18,446
Chicago	Chicago State U.	207
Chicago	DePaul U.	2,940
Chicago	IL Institute of Technology	810
Chicago	Loyola U. Chicago	472
Chicago	Midwestern U. (Chicago, IL)	30
Chicago	Northeastern IL U.	368
Chicago	Northwestern U.	1,110
Chicago	Roosevelt U.	626
Chicago	Rosalind Franklin U. of Medicine and Science	200
Chicago	Rush U.	79
Chicago	U. Chicago	1,295
Chicago	U. IL Chicago	1,746
		9,883
Boston	Boston C.	466
Boston	Boston U.	2,523
Boston	Brandeis U.	354
Boston	Harvard U.	3,551
Boston	MA C. of Pharmacy and Health Sciences	28
Boston	MA Institute of Technology	3,138
Boston	Northeastern U.	710
Boston	Tufts U.	969
		11,739
Bay Area	CA Institute of Integral Studies	542
Bay Area	Chapman U.	331
Bay Area	Golden Gate U.	560
Bay Area	John F. Kennedy U.	675
Bay Area	San Francisco State U.	1,230
Bay Area	San Jose State U.	915
Bay Area	Santa Clara U.	395
Bay Area	Sonoma State U.	68
Bay Area	Stanford U.	2,344
Bay Area	U. CA, Berkeley	3,492
Bay Area	U. CA, San Francisco	461
Bay Area	U. San Francisco	226
		11,239
	All institutions	352,630

APPENDIX C

Academic Research and Development Centers, New York City

NEW YORK ACADEMIC RESEARCH AND DEVELOPMENT CENTERS: BIOTECH

Rockefeller University (*Second in biological R&D spending*)

Anderson Center for Cancer Research
 Pels Family Center for Biochemistry and Structural Biology
 Center for Studies in Physics and Biology
 Christopher H. Browne Center for Immunology and Immune Diseases
 Fisher Center for Alzheimer's Disease Research
 F.M. Kirby Center for Sensory Neuroscience
 Shelby White and Leon Levy Center for Mind, Brain and Behavior
 Starr Center for Human Genetics

Columbia

Audubon Business and Technology Center
 Center for Advanced Technology in Information Management
 Center for Molecular Cardiology
 Center for Radiological Research
 Columbia Genome Center
 Columbia Integrated Imaging Center
 Herbert Irving Comprehensive Cancer Center
 Institute for Cancer Genetics
 Institute for Human Nutrition
 Naomi Berrie Diabetes Center
 Taub Institute for Research on Alzheimer's Disease and the Aging Brain

Memorial Sloan-Kettering Cancer Center

Sloan Kettering Institute (life science research)

Weill Medical College of Cornell University

Center for Vascular Biology,
 The Institute for Computational Biomedicine
 The Ansary Center for Stem Cell Therapeutics
 Biotechnology Resource Center

Mount Sinai School of Medicine

Computational Neurobiology and Imaging Center

Yeshiva University/Albert Einstein College of Medicine

Albert Einstein Biodefense Proteomics Research Center
 Albert Einstein Cancer Center
 Chanin Institute for Cancer Research

Albert Einstein Center for Synchrotron Biosciences
 Bronx Comprehensive Sickle Cell Center
 Cardiovascular Research Center
 Center For AIDS Research (CFAR)
 Center for Reproductive Biology
 Children's Evaluation and Rehabilitation Center (CERC)
 Comprehensive Bone Center
 Diabetes Research and Training Center (DRTC)
 General Clinical Research Center (GCRC)
 Human Genetics Program
 Institute for Aging Research
 Institute for Brain Disorders and Neural Regeneration
 Institute for Communicative Disorders
 Institute for Community and Collaborative Health
 The Bronx Center to Reduce and Eliminate Ethnic and Racial Health Disparities
 (Bronx CREED)
 Hispanic Center of Excellence
 Institute for Smooth Muscle Biology
 Marion Bessin Liver Research Center
 Michael F. Price Center for Genetic and Translational Medicine in the Harold and
 Muriel Block Research Pavilion
 Neuropsychopharmacology Center
 Resnick Gerontology Center
 Rose F. Kennedy Center for Research in Mental Retardation and Human Development
 Seaver Foundation Center for Bioinformatics
 Women's Health Initiative (WHI)

State University of New York Health Science Center at Brooklyn (Downstate)

Advanced Biotechnology Incubator
 Brooklyn Center For Health Disparities
 Center for Cardiovascular & Muscle Research
 Cancer Research Focus Group
 Center for Treatment and Study of Endometriosis

NYU

NYU Bioinformatics Group at Courant Institute of Mathematical Sciences
 Center for Neural Science
 Aging and Dementia Research Center
 Alzheimer's Disease Center
 Brain Research Laboratories
 Brain Tumor Research Center
 NYU Cancer Institute (NYUCI)
 Center for AIDS Research (CFAR)

Center for Brain Health
 Center for Immigrant Health
 Center for Retinal Degeneration
 Center for the Study of Asian American Health
 Child Study Center
 Comprehensive Epilepsy Center
 Department of Environmental Medicine
 Division of Alcoholism and Drug Abuse
 Dysautonomia Treatment and Evaluation Center
 NYU-NIEHS Environmental Health Sciences Center of Excellence
 General Clinical Research Center
 Heart Rhythm Center
 Institute for Urban and Global Health
 Mental Health and Addictive Disorders Research Program
 Mental Health Clinical Research Center
 Musculoskeletal Research Center
 Nathan Kline Institute
 Occupational and Industrial Orthopedic Center
 Rehabilitation Engineering Research Center
 The Silberstein Institute (Institute for Aging and Dementia)
 Sleep Disorders Center
 Skirball Institute of Bimolecular Medicine
 Smilow Research Center
 Spinal Cord Injury Center
 NYU Voice Center

New York Structural Biology Center (501c3 collaborative)

Includes Einstein, Columbia, Sloan Kettering, Mont Sinai, NYU, Rockefeller, Cornell and Wadsworth Center (Albany)

**NEW YORK ACADEMIC RESEARCH AND DEVELOPMENT CENTERS: NANOTECHNOLOGY
Columbia**

Center for Electron Transport in Molecular Nanostructure
 Center for Nanostructure Material
 Environmental Molecular Sciences Institute

**NEW YORK ACADEMIC RESEARCH AND DEVELOPMENT CENTERS:
INFORMATION TECHNOLOGY: SOFTWARE, COMPUTER SCIENCE, NEW MEDIA
Columbia**

ADVENT Project
 Center for Advanced Technology in Information Management

Center for Applied Probability
 Columbia Institute for Tele-Information
 Center for Research on Information Access
 Center for Resilient Networks
 Columbia Center for New Media Teaching and Learning
 COMET research Group
 Digital Government Research Center
 Digital Media Center
 Distributed Computing and Communications Lab
 Institute for Learning technologies
 Center for Advanced Information Management (CAT)

NYU

NYU Center for Advanced Technology in Multimedia: NYSTAR funded (no longer funded –
 now Media Research Lab
 The Courant Institute of Mathematical Sciences

CUNY

Center for Information Networking and Telecommunications
 Institute for Software Design and Development

Polytechnic University

Center for Advanced Technology in Telecommunication (CAT)
 Institute for Mathematics and Advanced Supercomputing
 Center of Excellence in Wireless Internet and Information Technology
 (New York Institute of Technology and Polytechnic Institute)

Pace University Ivan G. Seidenberg School of CSIS

Advancement of Formal Methods Education
 Center for Advanced Media
 Information Assurance Center
 Pervasive Computing Lab
 Robotics Lab

New School University

Parsons Institute for Information Mapping

NEW YORK ACADEMIC RESEARCH AND DEVELOPMENT CENTERS: OTHER

CUNY

New York State Center for Advanced Technology in Photonics

CUNY

Center for Optical Sensing and Imaging

CUNY

Center for Nanoscale Photonic Emitter and Sensors

CUNY

Center for Engineered Polymeric Materials

NYU

Courant Institute of Mathematical Sciences

US Department of Homeland Security, Science and Technology Directorate

Federal Environment Measurements Laboratory

Polytechnic University

Polymer Research Institute and NSF Center for Biocatalysis and Bioprocessing
of Macromolecules

The opinions, findings, conclusions and recommendations expressed in this report are those of the author(s) and do not necessarily reflect the views of NIST, NYSTAR, the State of New York, the Advisory Council or any other entities that provide support to ITAC.