



## BUILDING NEW YORK CITY'S INNOVATION ECONOMY

Academic research institutions have sparked significant economic growth in cities from Boston to San Diego; but while New York is practically unrivaled in the depth of its scientific research, the city's universities and research centers have not yet emerged as powerful engines of local economic development

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# BUILDING NEW YORK CITY'S INNOVATION ECONOMY

ACADEMIC RESEARCH INSTITUTIONS HAVE LONG BEEN IMPORTANT economic anchors for New York City. They provide thousands of jobs and serve as a magnet for talented students and faculty, who inject hundreds of millions of dollars into the local economy through federal research grants. Yet, even though New York's concentration of top-flight scientific institutions—from Columbia University and New York University to Memorial Sloan-Kettering Cancer Center and Rockefeller University—is among the world's most impressive, this part of the city's economy has never served as a major source of growth.

In the wake of an economic downturn that has delivered a powerful blow to the city's traditional economic drivers—finance in particular—this will have to change. With analysts predicting that the financial sector will never return to its 2007 job levels, New York's universities and nonprofit research institutions could provide a crucial economic spark in the near term and become a reliable job generator in the long run. These institutions represent a promising opportunity for New York in part because they are immobile assets—even in today's global economy, they're not going anywhere—and because scientific and technological breakthroughs are likely to fuel much of the nation's future economic growth. Many of these breakthroughs will emanate from university research.

It is unrealistic, however, to expect the city to reap big rewards from this activity under status quo conditions. Even with all its economic creativity and dynamism, and despite its practically unrivaled depth and quality of academic research infrastructure, New York has never come close to harnessing the full potential of those institutions to build a meaningful innovation economy. For a variety of reasons, the city's universities and nonprofit research centers have not emerged as powerful incubators of innovation and economic development to the extent that similar institutions have in several other regions.

To be sure, New York will never create a high-tech economy on par with Silicon Valley, where technology sectors are as firmly rooted as the finance and media industries are here. Nor does it need to do so. But the city could do much more to capitalize on its prowess in scientific research and technological innovation. And the moment is perfect for such an effort—it has never been more important to diversify the local economy and create a powerful new engine for job creation.

In previous years, the Center for an Urban Future has published reports about the growth potential of the city's biotech and video game sectors. This study, however, goes beyond any one technology industry, and looks at the role that universities and nonprofit research institutions play in New York City's economy and their potential to be a catalyst for future growth. It documents both the breadth of scientific assets in the five boroughs and the challenges to converting these resources into economic activity. This report mainly assesses what the city's scientific institutions have done to support and promote the commercialization of research in a way that has local economic benefits, but it also explores the level to which New York City and state economic development officials have attempted to cultivate the growth of emerging technology industries. We also provide a comparative analysis of the city's leading scientific institutions with those of national leaders such as Stanford University, the Massachusetts Institute of Technology (MIT) and the University of Florida.

Funded by the Alfred P. Sloan Foundation and based on more than three years of research, this work is built upon extensive data analysis, a thorough literature review and interviews with more than 100 local and national experts—including academic leaders, science faculty, economic development professionals, investors, technology transfer specialists, government officials and entrepreneurs in fields from biotechnology to information technology. Our 48 page study is accompanied by New York City's first-ever Innovation Index, a compendium of data that demonstrates where New York stands compared to other cities and regions on a broad range of indicators measuring both existing science and technology assets and the city's level of success at commercializing these assets. (While this report includes several charts taken from our Innovation Index, the full index—with more than 45 charts—is available at [http://www.nycfuture.org/images\\_pdfs/pdfs/InnovationIndex.pdf](http://www.nycfuture.org/images_pdfs/pdfs/InnovationIndex.pdf))

It's not just the economic downturn that has prompted so many cities and states to look to universities and nonprofit research institutions to help spur local economic growth. Academic research institutions are firmly rooted assets that have the potential to be critical catalysts for invention, entrepreneurship and jobs—key attributes at a time when local economies have stalled and globalization has enabled many large employers to more easily move jobs to cheaper

locales. These institutions are natural incubators of innovation, fueled by scientists conducting cutting edge research in fields from digital media and environmental technologies to software development and bioscience. In many regions, this scientific activity has spawned a steady stream of new business ventures, including many of the nation's fastest growing firms. Google, Cisco and Sun Microsystems—among many others—grew out of research conducted at Stanford University. Further, a critical mass of research institutions provides a foundation for the rise of self-sustaining clusters of companies in high-growth fields such as biotech and cleantech.

"Increasing entrepreneurship and the commercialization of research have created new roles for universities as engines of economic development," concludes a 2006 study by the Milken Institute. "Universities around the world have expanded their mission beyond that of basic research and teaching to become places where knowledge fuels patent development, business collaborations and incubators for startups."<sup>1</sup> Another recent report by CEOs for Cities and the Initiative for a Competitive Inner City puts it even more bluntly: "In many respects, the bell towers of academic institutions have replaced smokestacks as the drivers of the American urban economy."<sup>2</sup>

This dynamic has been playing out in a number of regions across the United States, most famously in Boston, San Diego, the San Francisco Bay area and the "Research Triangle" of Raleigh, Durham and Chapel Hill in North Carolina. Academic research institutions in each of these areas have served as laboratories for new businesses in emerging technology sectors—including biotechnology, nanotechnology, digital media, software development, computer and communications hardware, cleantech and telecommunications. Some of these firms have achieved explosive growth, collectively creating thousands of jobs and billions of dollars in economic activity.

New York City appears to be similarly well positioned to capture a significant amount of economic activity from scientific discovery occurring inside the halls of its universities and research institutions. The city is a global leader in science and technology research, with nine major academic research institutions, 26 additional research institutions and medical centers and 175 hospitals, research centers and laboratories.<sup>3</sup> These institutions consistently attract many of the world's brightest students and faculty; the rich

talent pool includes 19 Nobel Prize winners in the sciences and 39 Howard Hughes Medical Investigators (HHMI)—more than twice as many as San Diego and behind only the much larger San Francisco Bay Area (with 49 HHMI investigators) and Greater Boston (60) regions.<sup>4</sup>

The life sciences are an area of particular local strength. New York's universities and nonprofit research centers pull down nearly \$1.3 billion a year in federal research grants from the National Institutes of Health (NIH), more than any other American city except Boston.<sup>5</sup> Eight institutions based in

panies," observes one biotech entrepreneur who started a company at Columbia but later moved it to California. The numbers bear out this observation:

- New York City is home to just six companies on the Deloitte 2008 Technology Fast 500 list, an annual ranking of 500 fast-growing technology, media, telecommunications and life sciences companies in North America. The city fared much worse than regions such as the San Francisco Bay area (88 firms on the list), Los Angeles (50 firms), Washington, DC (47), and Boston (41) that are

New York City has only scratched the surface when it comes to tapping the economic potential of its scientific research institutions. Elsewhere, universities and research centers have helped spark the emergence and growth of technology sectors by producing a steady flow of new start-ups that locate and expand nearby.

the five boroughs are among the top 100 recipients of NIH grants; six rank among the top 50 in biotech patents.<sup>6</sup> Other pockets of excellence include environmental science, computer science, digital media, mathematics, quantitative finance and chemistry, among other disciplines. Overall, the metro area's colleges and universities—anchored by those in the five boroughs—spend more on scientific research and development than those in any other region.

Despite all of this, New York City has only scratched the surface when it comes to tapping the economic potential of its scientific research institutions. Elsewhere, universities and research centers have helped spark the emergence and growth of technology sectors by producing a steady flow of new start-ups that locate and expand nearby. That high rate of new business formation helped those regions establish a critical mass of tech-related businesses, which in turn attracted entrepreneurially-minded faculty and students to local institutions and prompted venture capital firms that specialize in technology enterprises to open offices there. This pattern has never taken hold in New York, however, and largely as a result, the city has never managed to develop a decent-sized innovation economy.

"New York has good institutions with quality research, but it somehow doesn't translate into compa-

known as tech hotbeds. The rest of the New York City metro region had 17 firms on the list, bringing the area's total to 23.<sup>7</sup>

- New York City's research strength is in life sciences, yet in the fourth quarter of 2008 and the first quarter of 2009, the city was home to just one biotech company receiving venture capital. In contrast, the rest of the New York City metro region had 13 biotech firms receiving VC funds in these quarters, while Silicon Valley had 41, the Boston area had 33 and San Diego had 17. Nor was this a one-time aberration: in the first two quarters of 2008, VC companies invested in two biotech firms in the city, compared to nine in the rest of the metro area, 47 in Silicon Valley and 38 in the Boston area.<sup>8</sup>
- The New York City metro area was ninth in a ranking of North America's top high-tech centers, according to a report released this June by the Milken Institute.

New York is not totally devoid of technology companies. For instance, it is one of a handful of cities to develop a modest cluster of bioscience companies. But even in this field, New York has considerably fewer firms in this sector than Boston/Cambridge, the San Francisco Bay area and San Diego, and most of



the city's biotech companies have only their finance or headquarters operations here—not their research labs.<sup>9</sup> New York also has a formidable digital media sector and a respectable number of software companies, but hardly any of the firms in these sectors emerged out of research at the city's scientific research institutions. While the MIT Media Lab has spun out 69 media technology companies, no New York City institution has produced anything close to that output in the media field.<sup>10</sup>

Many believe the city also has considerable potential in the cleantech sector. A recent report by the New York City Investment Fund noted that New York has more Leadership in Energy and Environmental Design (LEED)-certified professionals than any other American city, and is ranked among the top five U.S. cities in the number of environmental consultants working on issues such as sustainable design, energy management and environmental engineering.<sup>11</sup> Additionally, Columbia, City College and Polytechnic Institute of NYU all have research centers focused on environmental technologies.<sup>12</sup> Yet the city has only a handful of cleantech firms, none of which have attracted any of the recent high-profile venture investments made in the sector.<sup>13</sup>

There are a host of reasons why New York's science and technology assets haven't translated into more economic activity. The exorbitant expense of renting space and doing business in the five boroughs has long been a crucial deterrent to technology entrepreneurs and their investors, while the high cost of living here has made it difficult to attract and keep scientists. Companies in the biotech sector, in particular, have been constrained by a dearth of commercial lab space across the city for both start-ups and mid-sized firms. But while we fully recognize the need of tech firms in New York for more affordable space, it is not the only area of concern, and the widespread and long-standing focus on the space question has obscured other critical problem areas that the city must address if it is to take full advantage of its science and tech assets. Another consideration is that the widespread emphasis on space lets the city's universities and nonprofit institutions, which themselves have been a big part of the problem, off the hook.

This report addresses those other problem areas. First, the city lacks a major engineering presence—a crucial shortcoming, since it is the mix of engineering and science that often provides a critical spark for

commercializing technologies. New York City colleges and universities together spend about \$90 million on engineering research and development, compared to \$337 million for institutions in the Boston region and \$299 million in the San Francisco Bay area.<sup>14</sup> Incredibly, only one institution in the five boroughs is among the top 100 U.S. universities measured by research and development (R&D) expenditures in engineering—Columbia (ranked 50th).<sup>15</sup> New York's academic leaders simply have not invested heavily in engineering programs.

Second, the leaders of New York City's major universities and medical institutions have done little to foster a culture of entrepreneurship among scientists, faculty and technology transfer officers and have had limited collaborations with industry. Several of the city's institutions have under-invested in technology transfer, the process by which academic institutions commercialize their researchers' inventions. Perhaps more importantly, many institutional leaders have signaled to their tech transfer staff—as well as their scientists—that they are most interested in commercializing research to generate royalties, rather than as a step toward the creation of start-up companies.

"Too many New York institutions think of spin-off as the last available option," says David Hochman, a New York City-based consultant who has conducted extensive research about technology-based economic development.

Limited support among institutional leaders for entrepreneurship is apparent in other crucial ways. For example, New York research institutions offer comparatively fewer opportunities for their scientists to access entrepreneurship training and advice; there are only limited examples of collaboration and cross-pollination between science departments and business schools here. Some New York institutions have a reputation for driving a hard bargain with their scientists during the licensing process, an approach that sometimes deters faculty and post-doctoral researchers from going the entrepreneurial route. And city institutions have not been as accommodating to faculty who wish to take a temporary leave of absence to pursue a business opportunity associated with their research discovery—in stark contrast to Stanford, MIT and other institutions that often go to great lengths to encourage their scientists to start businesses.

New York City universities and nonprofit research institutions are at the top of their class in one

measure of technology transfer: earning royalties on their scientific discoveries, usually through the process of licensing a patented technology to a pharmaceutical corporation or other existing technology company. In 2007, NYU and Columbia maintained their accustomed place atop the list of research institutions in America for licensing income, earning \$791 million and \$135 million, respectively.<sup>16</sup> No other university earned more than \$100 million, including innovation leaders like MIT (\$61 million), Stanford (\$50 million) and the University of California system (\$97 million).<sup>17</sup>

rial Sloan-Kettering Cancer Center—all among the nation’s leaders in attracting NIH research grants—produced a combined total of three startups in 2007.<sup>20</sup> Rockefeller University, another nationally renowned research center, has produced just 14 startups in the last 15 years.<sup>21</sup>

Third, the city lacks a deeply ingrained high-tech “ecosystem” that allows for frequent, casual interactions between the web of people who form the core of any dynamic tech sector: scientists, engineers, entrepreneurs, VC and angel investors, tech transfer officers and patent lawyers. This culture of deal-making, idea-

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There is certainly nothing wrong with institutions generating royalties. In many cases, licensing a technology to an existing company with deep pockets is the easiest way to ensure that scientific discoveries are developed into drugs or products that will reach the marketplace. Yet, according to numerous entrepreneurs, investors and high-tech experts interviewed for this report, many of the city’s leading universities and nonprofit research institutions go too far: they have traditionally focused on a small number of discoveries that offer the most potential to yield blockbuster licensing deals, at the expense of other discoveries that might have less immediate market appeal but which could be developed commercially by a start-up company.

Indeed, many if not most of New York’s academic research institutions still have much room to improve when it comes to turning scientific breakthroughs into start-up enterprises. Overall, the city’s leading universities and nonprofit research institutions generated 21 startups in 2007, compared to 59 for institutions in Boston.<sup>18</sup> Not every New York institution fell short on this front: Columbia produced 12 start-ups, more than all but four universities in the nation, while NYU had six startups, their highest total ever.<sup>19</sup> But Mount Sinai School of Medicine, the Albert Einstein College of Medicine at Yeshiva University and Memo-

sharing and collaborations—not only among scientists, but between inventors and investors—is present in every one of the nation’s top high-tech regions, constantly reinforcing an ethic of innovation and entrepreneurship. In several other cities, local government officials have taken action to help create innovation intermediaries whose mission is to foster collaboration among such individuals; New York has not.

Fourth, the scope of tech-based business creation in New York City remains limited by the comparatively small number of seasoned technology entrepreneurs who understand how to bring promising technologies to market. The presence of experienced entrepreneurs is critical because they can be recruited to take the helm of new ventures that may boast outstanding scientific talent but lack management experience. Such individuals also usually play a key role in mentoring new entrepreneurs and forming angel investment networks. To a large extent, this process needs to occur organically after enough local entrepreneurs have cashed out of successful ventures. Yet, institutions like Stanford, University of California Berkeley and University of California San Francisco have created entrepreneurship-in-residence programs to harness the expertise of successful tech entrepreneurs. For the most part, New York’s leading institutions have not followed suit.

Fifth, many tech entrepreneurs here often face greater difficulty than their peers in other regions in accessing seed and early-stage venture capital financing, in large part because of the city's surprisingly small number of VC firms and angel investors that specialize in high-tech enterprises. For instance, only two of the 55 most active venture capital firms in the country in 2007—those that closed 20 or more deals—were based in New York City, compared to 27 in Silicon Valley and 11 in the Boston area.<sup>22</sup>

Sixth, city and state economic development agencies generally have been less assertive in supporting the growth of various tech sectors than their counterparts elsewhere. While the Bloomberg administration has made significant strides, the city's economic development officials historically have focused on shoring up traditional industries and retaining large employers instead of cultivating emerging sectors or helping small firms grow. Meanwhile, officials in Albany have steered the lion's share of its money for technology development into every part of the state but New York City.

In the months and years ahead, the city will find it increasingly important to maximize the economic potential of its scientific research institutions. The challenge for New York is not to replace traditional economic drivers like Wall Street. Rather, it is to finally make science and technology one important component in the city's long-term economic development strategy. This will help create jobs at a time when other key industries are struggling, add balance to the economy and strengthen the city's research community in the intensifying competition for top scientists and research dollars.

New York cannot afford to stand still. Dozens of cities and states are now making science and technology a central part of their economic development strategies: forty regions across the nation are targeting biotech alone, while metropolitan areas in Europe and at least ten Asian countries are investing heavily in developing their innovation economies to compete on a global scale.<sup>23</sup> If New York does not follow suit, it will run the risk of falling even further behind.

The good news is that steady progress is being made on almost every front.

From his earliest days in City Hall, Mayor Michael Bloomberg has made the growth of the city's biotech industry a significant economic development priority. Already, his administration's decision to create a bioscience desk at the city's Economic Development

Corporation (EDC) and aggressive lobbying for the development of East River Science Park, a major new bioscience research facility, have gone a long way towards improving industry perceptions of New York. The administration has also helped finance a new biotech research park in Sunset Park aimed at companies that have grown too big for an incubator, meaning that two major commercial lab facilities will come on line in the near future—directly addressing one of the biggest obstacles to the growth of the sector. In the past year, his administration has also started to take steps to nurture other emerging technology sectors, through support for a digital media incubator at Polytechnic Institute of NYU in downtown Brooklyn and two other incubators for new ventures in lower Manhattan, and the creation of NYC Seed, a new entity that is providing capital to some early-stage technology firms in the city. City economic development officials finally seem to be embracing technology sectors and developing a strategy to grow this part of the economy.

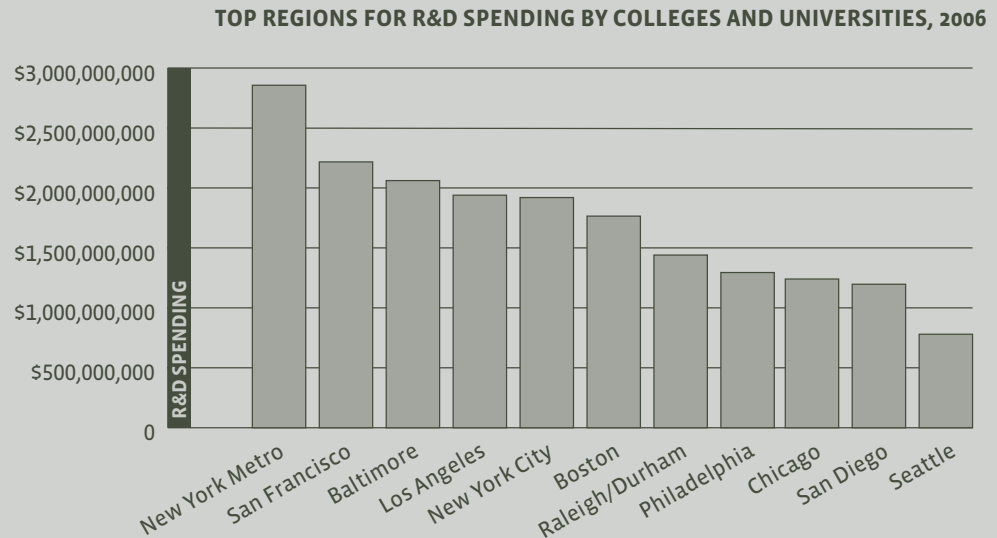
In the private sector, the city's most influential business organization—the Partnership for New York City—has made the creation of a larger bioscience cluster one of its top priorities, invested millions of dollars in projects like the East River Science Park and NYC Seed, and pushed City Hall to embrace a technology strategy. At the same time, a close-knit technology community has begun to emerge in the city, thanks in part to regular networking get-togethers of groups like NY Tech Meetup and nextNY.

Many of the city's research institutions are also on the right path. NYU and Brooklyn's Polytechnic University recently agreed to a merger that could lead to a stronger engineering presence in the five boroughs and new collaborations between engineers and scientists; Columbia is significantly expanding its campus to include new research centers and labs; and SUNY Downstate Medical Center in Brooklyn is planning to double the size of its biotech incubator. In recent years, several of the city's institutions have brought in new, entrepreneurial-minded presidents and tech transfer managers—from Polytechnic President Jerry Hultin to Alan Paau, who took over the tech transfer office at Cornell in 2007 after doing the same type of work in tech hotbed San Diego.

Perhaps most noteworthy, the city's tech transfer offices are asserting themselves to a degree not evident before. Columbia, in particular, has organized numerous forums and workshops in recent months



Source: National Science Foundation/ Division of Science Resources Statistics, Survey of Research and Development Expenditures at Universities and Colleges, FY 2006.



in which they have brought in VC leaders, angel investors, local tech entrepreneurs and patent lawyers to meet with and provide advice to their faculty and students. Other institutions are creating more of these opportunities as well; for instance, Weill Cornell Medical College recently held a "Startup Boot Camp." In addition, the tech transfer offices of seven of the city's leading institutions came together to produce a brochure that promotes New York City's collective science and tech assets.

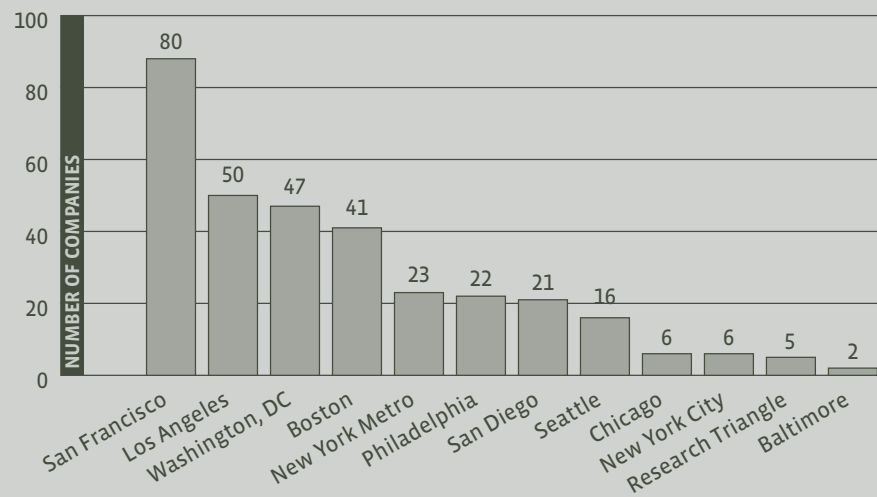
"I really think that these [institutions] are turning it around," says Lesa Mitchell, vice president of advancing innovation at the Ewing Marion Kauffman Foundation, one of the nation's leading authorities on

entrepreneurship. "I'm seeing huge progress at Columbia and we're starting to see some of it at NYU. The old model of tech transfer is going away."

As this report details, there is still a long way to go. And it's far from apparent that the initial strides made by the city's research institutions and economic development officials will be sustained. But with hundreds of thousands of square feet of new commercial lab space now under development in the five boroughs and key players in government, the business community and academia moving in the right direction, the stars may be moving into alignment for New York City to take full advantage of its scientific assets and build a more formidable cluster of technology companies.

Source: Deloitte Technology Fast 500, November 2008.  
The Deloitte Technology Fast 500 recognizes North America's fast-growing technology, media, telecommunications and life sciences companies in terms of percentage revenue growth over five years.

**REGIONS WITH THE MOST COMPANIES ON THE 2008 DELOITTE TECHNOLOGY FAST 500 LIST**



# Key Findings

## **New York City is practically unrivaled in the breadth of its scientific assets.**

- ▶ The New York City metro area leads all other regions in overall research and development spending by colleges and universities, with \$2.9 billion in total R&D expenditures in 2006. The San Francisco Bay area was second, with \$2.2 billion. (The New York City metro area ranks second among all regions in R&D expenditures by hospitals and nonprofit research centers, well behind Boston.)
- ▶ Seven colleges and universities in the five boroughs rank among the nation's top 200 in money spent on R&D, while 11 of the city's hospitals and research centers are in the top 200 for R&D spending by nonprofit institutions.
- ▶ New York ranks second nationally among all cities, behind Boston, in the total amount of federal grants from the National Institutes of Health (NIH). Sixty-eight percent of NIH funds that came into New York State in 2008 went to institutions in the city.
- ▶ City research institutions employ 19 Nobel Prize winners in the sciences and 39 Howard Hughes Medical Investigators, more than any other U.S. region except Boston and the San Francisco Bay area.

## **New York stands out in the life sciences, but has a number of other scientific strengths.**

- ▶ Eight institutions in the city were among the top 100 recipients of NIH grants in 2008, a sign of New York's pre-eminence in biomedicine.
- ▶ Six institutions in the five boroughs ranked among the top 100 universities in the U.S. for R&D spending in life sciences in 2006—in fact, all were in the top 60. In addition, five were among the top 100 in computer sciences and three were on the list in mathematical sciences, physical sciences, psychology and social sciences.
- ▶ Columbia is among the top 10 universities in R&D expenditures in the environmental sciences. NYU is number 13 in R&D spending in mathematics and number 6 in psychology.
- ▶ City institutions also boast strong programs in neuroscience, biomaterials, bioinformatics, systems biology, nanotechnology, quantitative finance and digital media.

## **Despite their unquestionable strengths, the city's universities and nonprofit research centers have not sparked the creation of a large technology sector the way similar institutions have elsewhere.**

- ▶ New York City is home to just six companies on the Deloitte 2008 Technology Fast 500 list, an annual ranking of the 500 fast-growing technology, media, telecommunications and life sciences companies in North America. The city's total was miniscule compared to other regions, such as the San Francisco Bay area (which had 88 firms on the list), Los Angeles (50 firms), Washington, DC (47) and Boston (41).
- ▶ New York City's research institutions are particularly strong

in the life sciences; however, in the fourth quarter of 2008 and the first quarter of 2009, the city was home to just one biotech company receiving venture capital. In contrast, the rest of the New York City metro region had 13 biotech firms receiving VC funds in these quarters, while Silicon Valley had 41, the Boston area had 33 and San Diego had 17.

- ▶ The city has a respectable biotech cluster that has grown in recent years, but there are still far fewer biotech firms here than in regions such as Boston, the San Francisco Bay area and San Diego. Many of the city's biotech firms have only their finance functions here and conduct their R&D here elsewhere.
- ▶ New York has a formidable digital media sector, but hardly any of the firms in these sectors emerged out of research at the city's scientific research institutions.

## **New York City academic research institutions are among the world's leaders in generating royalties from their discoveries.**

- ▶ Columbia and NYU have long been at or near the top of the rankings of all U.S. universities in the amount of licensing revenue earned. In 2007, the most recent year for which data is available, NYU was number one among all U.S. universities, with \$791 million in royalties, while Columbia was number two, with \$135 million. No other university topped \$100 million.
- ▶ Mount Sinai School of Medicine was 14th among all U.S. universities in licensing revenue earned in 2007, with \$27 million. Memorial Sloan-Kettering Cancer Center did not report data on its licensing revenue for 2007, but in 2006 it earned \$43 million—third among all hospitals and research institutions and ninth among all institutions.

## **The city's research institutions have historically lagged behind their counterparts in other regions when it comes to converting their research into start-up companies, though there has been steady improvement in the last couple of years.**

- ▶ In 2007, the city's major academic research institutions spawned 21 start-ups; compared to 59 for Boston—including 24 by MIT.
- ▶ Some institutions in the city have made major strides in this area in recent years: Columbia produced 12 startups in 2007, up from 8 in 2002, while NYU's 6 start-ups in 2007 was their largest annual output ever and up significantly from 1 in 2002.
- ▶ Most of the city's other top-flight research institutions weren't as prolific in seeding start-ups: Mount Sinai School of Medicine (with one start-up), the Albert Einstein College of Medicine at Yeshiva University (two) and Memorial Sloan-Kettering Cancer Center (zero) generated only three startups between them in 2007.

## **Many of the companies that do emerge out of scientific research at New York's research institutions end up establishing their operations elsewhere.**

- ▶ Out of 84 companies spun off from Columbia between 1983 and the middle of 2008, 60 are still in business but only seven of them maintain significant operations in the city.

- Just one of the 14 start-ups produced by Rockefeller University over the last 15 years remains in the city.

**The city lacks a major engineering presence, a key problem since it is the mix of engineering and science that often provides a critical spark for commercializing technologies.**

- In 2007, only one New York City institution was among the top 100 U.S. universities for R&D expenditures in engineering—Columbia (50th out of 100). City College was 121st and Polytechnic University was 152nd.
- New York City colleges and universities spend less than one third as much on engineering R&D as their counterparts in Boston and the San Francisco Bay area. In 2006, the amount for universities in the five boroughs was \$90 million, compared to \$299 million in the Boston region and \$327 million in the Bay area.

**The leaders of the city's top research institutions have not done enough to promote and support entrepreneurship among their faculty and students**

- Too few mechanisms exist on New York campuses that assist scientists to cross-pollinate with engineers, investors and experienced tech entrepreneurs. There are also insufficient linkages between city science departments and businesses schools.
- Some of New York City's technology transfer offices have a reputation for driving a hard bargain with their scientists during the licensing process.
- Many of New York's tech transfer offices have tenuous ties to the investment community.
- Several of the tech transfer offices at local institutions have been underfunded or excessively bureaucratic. While Columbia is an exception—it has one of the largest tech transfer offices in the country, with 19 full time equivalent staff—NYU had just four staff devoted to licensing and tech transfer in 2007, tying it for 64th place among U.S. universities. Rockefeller University and Albert Einstein College of Medicine each had five tech transfer staff.
- Until 2006, the CUNY system effectively had no tech transfer office.

**New York is missing both a vibrant high-tech "ecosystem" and a large pool of seasoned tech entrepreneurs**

- The city lacks a deeply ingrained high-tech "ecosystem" that allows for frequent interactions between scientists, engineers, entrepreneurs, investors and tech transfer officers. This culture of deal-making, idea-sharing and collaborations is present in most of the nation's other top high-tech regions.
- New York lacks experienced tech entrepreneurs, a problem because start-ups that have a solid scientific or technological foundation but lack management experience often turn to seasoned entrepreneurs to guide them through the early stages of development and growth.

**New York City scientific institutions enter into comparatively fewer partnerships with industry than their counterparts.**

- New York City ranks well behind every other major technol-

ogy region in the amount of industry-financed R&D going to its colleges and universities, a deficiency in large part due to its limited engineering presence. In 2006, industry-financed R&D in the city totaled \$39.7 million; a fraction of the total for Raleigh Durham (with \$182.3 million), Boston (\$118.4 million) and San Francisco (\$96.1 million).

- In 2007, no university in the city was among the nation's top 50 in industry-financed R&D. Columbia was 56th, Mount Sinai School of Medicine was 59th and NYU, 79th.
- Only 25 percent of industry funding for academic R&D in New York State went to institutions in the city, compared to 68 percent for upstate institutions and eight percent for centers in the rest of the downstate region.

**Tech entrepreneurs in New York find comparatively few options for early stage financing.**

- Of the top 55 most active venture capital firms in the country in 2007, only two were based in New York City. Silicon Valley was home to 27 and Boston to 11.
- A comparatively small share of the VC money that does get invested here goes into high-tech and biotech businesses. In the first two quarters of 2008, only two percent of all VC deals in the city went to firms in the biotech sector—compared to 33 percent of all VC deals in San Diego, 30 percent in the Boston region and 16 percent in the Philadelphia area.
- A disproportionately large share of VC deals in the five boroughs are with companies in the finance, media and entertainment sectors.

**New York City captures a miniscule share of SBIR and STTR awards, two federal grant programs that support technology innovation and entrepreneurship.**

- In 2006, New York City received just 43 of the 249 Small Business Innovation Research (SBIR) awards handed out statewide (17 percent). The city accounted for less than a quarter of the total for the New York metro region (182 awards), which was itself a fraction of the number going to the Washington, D.C. metro area (307 awards), the San Francisco Bay area (340), the Boston area (380) and the Los Angeles area (449).
- New York City fared no better with the Small Business Technology Transfer (STTR) program. The city received only seven of the 37 STTR awards dispersed statewide in 2006 (19 percent). The total for the metro region was slightly higher (24 awards). In contrast, both the Boston and Los Angeles areas received 54 STTR awards, the D.C. metro area 53, the Bay area 35 and San Diego 27.

**New York City research institutions receive a disproportionately small share of state funding for R&D**

- New York City institutions receive 68 percent of the federal funds from NIH that come into the state, and 50 percent of all federal R&D funding for colleges and universities in the state. However, only 16 percent of state and local spending on R&D in New York goes to institutions in the five boroughs, compared with 82 percent for institutions located upstate and two percent for centers in the rest of the downstate area.

# A Laboratory for Innovation

New York City is a powerhouse of cutting edge scientific talent and research, two of the main ingredients needed to develop a high-tech business sector

IF, AS ECONOMIC DEVELOPMENT EXPERTS BELIEVE, scientific research is one of the most potent catalysts of ideas, innovation and entrepreneurship, New York City should be sitting pretty. Only a few cities in the world rival New York for the sheer concentration of its scientific genius and the quantity and quality of its research institutions.

Mainly due to the strength of institutions in the five boroughs, the New York City metro area leads all other regions—by far—in overall research and development spending by colleges and universities.<sup>24</sup> In fact, seven colleges and universities in the city rank among the nation's top 200 in money spent on R&D, while 11 of the city's hospitals and nonprofit research centers are in the top 200 for federal spending on R&D to nonprofit institutions.<sup>25</sup>

While the breadth of the city's scientific assets is surely impressive, so is the pre-eminence of scientific talent. Institutions based in the five boroughs employ 19 Nobel Prize winners in the sciences and 39 Howard Hughes Medical Investigators, recipients of a highly competitive and prestigious award in the field of biomedical research that rewards cutting edge research.<sup>26</sup> There are only about 300 HHMI Investigators nationwide; only Greater Boston (with 60 HHMI Investigators) and the San Francisco Bay area have more.<sup>27</sup> The New York metro area is also fourth among U.S. regions in the number of faculty who are members of the highly prestigious National Academy of Sciences.<sup>28</sup>

The city's strengths run the gamut across the sciences. Six institutions in the five boroughs rank among the top 100 universities for R&D spending in life sciences; five crack the list in computer sciences and three each in mathematical sciences, physical sciences, psychology and social sciences.<sup>29</sup> While only one city institution is among the top 100 in R&D expenditures for environmental sciences, that institution, Columbia, is among the top 10.<sup>30</sup>

Biomedicine is undoubtedly the bedrock of advanced science in New York. In fact, if you stand on Roosevelt Island and look across the East River, you

will see one of the most extraordinary collections of biomedical research centers in the world: Memorial Sloan-Kettering Cancer Center, Weill Medical College of Cornell University, Rockefeller University, the Hospital for Special Surgery, and, turning to the south, NYU Medical Center. Between them, they receive more than \$500 million a year in federal research funding. And that's not even counting Mount Sinai College of Medicine and Columbia University, located elsewhere in Manhattan, or the Alfred Einstein College of Medicine of Yeshiva University in the Bronx and SUNY Downstate Medical Center in Brooklyn.

New York City consistently ranks second among all cities in research funding from the National Institutes of Health (NIH), with roughly \$1.3 billion annually flowing to local institutions. That's considerably more than the entire San Francisco Bay area (from Berkeley to Palo Alto) and nearly double the amount going to the San Diego area. An astounding eight New York City institutions were among the top 100 recipients of NIH grants in 2008: Columbia University Health Sciences (16th place), Mount Sinai School of Medicine (29th), Yeshiva (43rd), NYU School of Medicine (47th), Sloan Kettering (53rd), Weill Medical College of Cornell University (54th), Rockefeller University (78th) and New York State Psychiatric Institute (93rd).<sup>31</sup>

The city's strength in the life sciences has made it a global leader in biomedical innovation. Six of its institutions are among the top 50 worldwide in biotech patents, according to a 2006 ranking by the Milken Institute—Cornell, 5th; Columbia, 6th; Rockefeller University, 16th; NYU, 35th; Mount Sinai School of Medicine, 44th; and Yeshiva University, 46th.<sup>32</sup> All together, institutions in the area created 6,800 biotech-related patents in the last decade, more than any other metro area in the country and almost double second-place San Francisco (3,991).<sup>33</sup>

Columbia alone manages more than 600 patents and 180 revenue-generating license agreements.<sup>34</sup> Discoveries made at the school's labs have generated

more than \$1.75 billion in gross revenue and an average of 175 inventions per year in the life sciences. More than 30 pharmaceutical products based on Columbia technology are on the market today. The school's "Axel patents," named for Nobel Prize-winning research led by Dr. Richard Axel, covered several technologies by which cells are made to produce particular proteins, a crucial tool in the creation of pharmaceuticals.

Several local institutions have been at the forefront of breakthrough biomedical discoveries which were either licensed to major pharmaceutical companies or successful start-up biotech firms. Examples include:

- NYU's Jan T. Vilcek discovered a monoclonal antibody which led to the development of Remicade, a blockbuster drug used in the treatment of rheumatoid arthritis, Crohn's disease, psoriatic arthritis and other inflammatory diseases.
- Vern Schramm, Einstein's chairman of biochemistry, developed novel compounds for treating autoimmune diseases and several types of cancer. These compounds were ultimately licensed to a pharmaceutical company for \$25 million, with future payments of up to \$530 million plus royalties based on product sales. In 2005, this transaction was the fifth largest biotech-pharma deal in the world.
- Paul Greengard, one of Rockefeller University's seven Nobel Prize winners, is co-founder of Intra-Cellular Therapies, a biopharmaceutical company developing novel drugs for the treatment of central nervous system diseases, including Parkinson's Disease, schizophrenia and Alzheimer's. The company, headquartered at the Audubon Business and Technology Center in Harlem, is currently testing

drugs in early to mid-stage clinical trials.

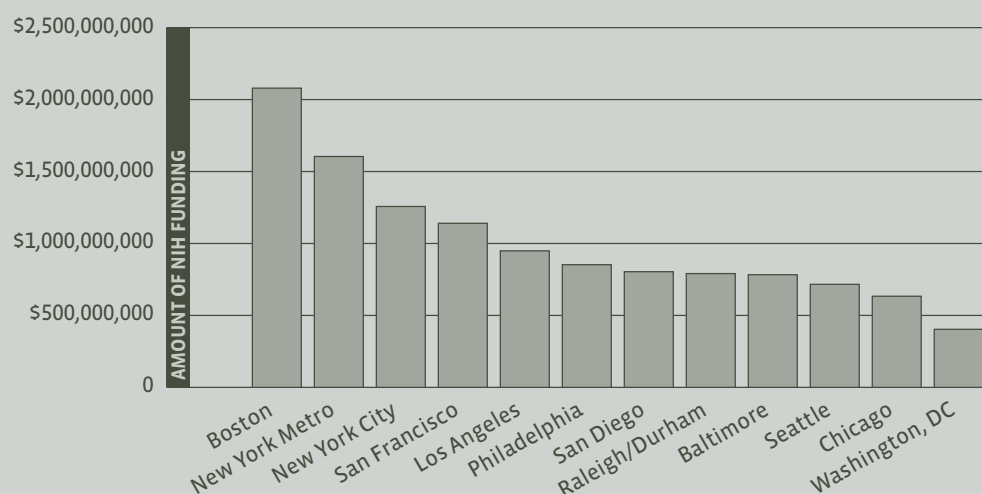
- Paul Marks, president emeritus of Memorial Sloan-Kettering Cancer Center, and Columbia professor Ron Breslow co-founded Aton Pharma, which develops novel treatments for cancer and other diseases. The company, based in Tarrytown, N.Y., was founded in 2001 and acquired by Merck in 2004.
- Columbia professor Wayne Hendrickson leads an NIH Protein Structure Initiative—one of only ten nationwide—that produced the research that led to the formation of Structural GenomiX, now SGX Pharmaceuticals, one of the fastest growing biotech companies in the country.

High achievement in the sciences is not limited to these schools or the realm of drug formation. City institutions are doing cutting edge work in neuroscience, biomaterials, bioinformatics and systems biology. Further, the city is developing strengths in nanoscience, quantitative finance and new media technology.

"Just as New York City is a melting pot for people, it has become a melting pot for science and technology," says René Bastón, chief business officer for the New York Academy of Sciences. "While it hasn't reached its full potential in some categories, the city has strength in a broad diversity of areas beyond biomedicine."

Columbia's neuroscience program consistently ranks in the top five nationally, according to both *U.S. News & World Report* and the Association of American Medical Colleges.<sup>35</sup> In the past three years, the program has received separate donations of \$200 million and \$7.5 million to establish major new institutes for the study of the brain and human behavior. Other in-

TOP REGIONS FOR NIH FUNDING, 2008



Source:  
National Institutes  
of Health



stitutions in the city—including Rockefeller University, NYU, Albert Einstein and Mount Sinai—are also strong in neuroscience. New York has “the strongest set of neuroscientists in the world,” says Ellis Rubinstein, president of the New York Academy of Sciences. “There’s no question about that.”

Columbia also excels at bioinformatics. In 2005, the National Institutes of Health gave the university an \$18.5 million grant to establish a National Center for Biomedical Computing, one of seven in the country. The center established Columbia as a major player in both bioinformatics and computational biology, fields designed to leverage the vast core data generated in part by the Human Genome Project.

NYU’s Courant Institute of Mathematical Sciences is doing cutting edge work in machine learning, image capture, computer vision, mobile robotics, financial prediction and natural language processing. Its machine learning program is headed up by Mehryar Mohri and Yann LeCun, former department heads at Bell Labs who are considered two of the top scientists in the field. The program maintains strong ties to Yahoo! and Google, from which their students benefit through internships and collaborative research projects. One scientist with the program, Jeff Han, developed a multi-touch computer screen that was the sleeper hit of the 2006 Technology, Entertainment & Design Conference in Silicon Valley. The technology is now the basis for Perceptive Pixel, Han’s fast-growing start-up company, and was used for the

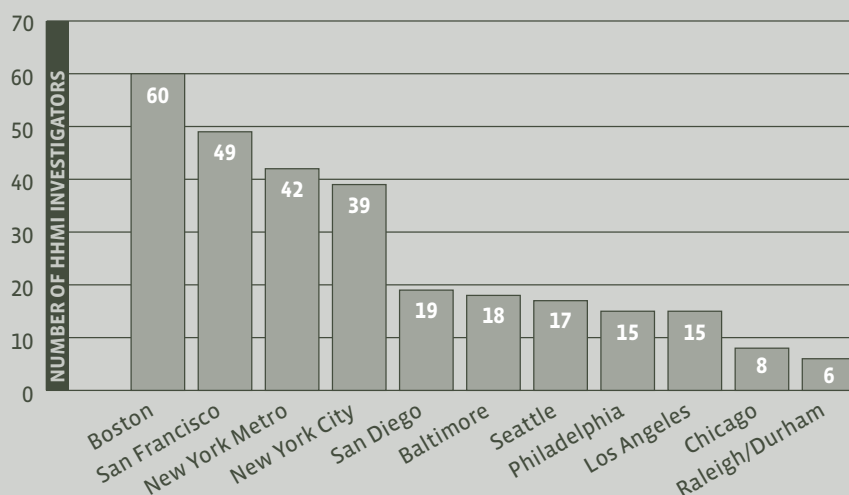
“Magic Wall” on CNN’s 2008 Election Center coverage. Last year, Han was named by *Time* magazine as one of the “100 Most Influential People in the World.”<sup>36</sup>

Both Columbia and Cornell have highly respected programs in nanoscience, one of the most promising scientific disciplines. Cornell’s nanoscience initiative, in which the university recently invested more than \$100 million, is based largely in Ithaca but carries on a fruitful collaboration with Weill Cornell Medical Center on the Upper East Side.

Polytechnic Institute of NYU has especially strong potential in biomaterials, based on historic strengths in materials and biological sciences. Scientists there are devising materials that can deliver drugs to targeted sites in the body or turn “bioplastic” packages into fuel.<sup>37</sup> And the school’s Wireless Internet Center for Advanced Technology is prototyping a new generation of wireless EKGs and operating machines. The school receives National Science Foundation funding for both areas of research, which aim “to translate scientific breakthroughs into engineering realizations and new technologies and ultimately into economic value,” according to associate provost Kurt Becker.

The Center for Neurobotics and Neuroengineering at SUNY Downstate Medical Center has the largest concentration of scientists in the United States studying memory disorders. Its research on the role of long-term potentiation in new memory recording by the brain was recognized by *Science* magazine as one of the top 10 scientific breakthroughs of 2006.

REGIONS WITH THE MOST HOWARD HUGHES MEDICAL INVESTIGATORS, FEBRUARY 2009



Source:  
Howard Hughes Medical  
Institute website,  
February 2009

# Invention Without Entrepreneurship

In a handful of other regions, academic research institutions have been catalysts for the creation of a large and sustainable high-tech cluster; but New York City's prestigious institutions haven't provided the same spark

THE EXTRAORDINARY LEVEL OF RESEARCH conducted inside the halls of New York City's universities and medical centers has produced some of the world's most rewarding scientific breakthroughs and scores of patented technologies. It has led to the development of drugs and commercial products that have improved the lives of countless people, and resulted in hundreds of millions of dollars in royalties that have enriched the institutions. What all of this remarkable scientific activity has not done is spark the creation of a meaningful technology sector in the five boroughs.

Regions with large and self-sustaining technology clusters are not created by luring the best high-tech companies from elsewhere, but by generating a consistent pipeline of homegrown technology businesses. Academic research institutions are by no means the only source for these new ventures, but they can provide a critical foundation, as cutting edge scientific research leads to a steady number of tech start-ups, often including enterprises with the greatest potential for growth. Perhaps the best example is MIT in Boston: according to a 2009 study, an estimated 6,900 companies founded by MIT graduates are currently located in Massachusetts; those firms employ just under one million people worldwide and account for 26 percent of the sales of all companies in the state.<sup>38</sup>

Unfortunately, in New York, too many of the city's leading academic research institutions have lagged behind their counterparts elsewhere in spawning start-up technology ventures from scientific breakthroughs achieved in their facilities. At the same time, the city's institutions have historically done little to ensure that the companies that do emerge from scientists' research form and grow within the five boroughs.

In 2007, the most recent year for which data is available, 21 start-ups emerged out of research at the city's major universities and nonprofit research centers.<sup>39</sup> While this is actually quite an improvement over previous years, it pales in comparison to the 59 new ventures produced by similar institutions in Boston.<sup>40</sup> More than half of New York City's total emerged

from one institution, Columbia, which launched 12 start-ups that year—up from 8 in 2002.<sup>41</sup> Most of the city's other top-flight research institutions weren't nearly as productive. Mount Sinai School of Medicine (with 1 start-up), the Albert Einstein College of Medicine at Yeshiva University (two) and Memorial Sloan-Kettering Cancer Center (zero) generated only three startups between them.<sup>42</sup> (Columbia's Orin Herskowitz argues that his institution, as well as other in the city, compare more favorably with other national universities in the rate of start-up formation when taking into account the relatively lower amounts of overall research expenditures made by New York institutions. For instance, Columbia and NYU spent \$620 million and \$298 million, respectively, on research in 2007, compared to \$1.2 billion for MIT and \$700 million for Stanford.)

The comparatively small amount of business formation from research is not a recent phenomenon. Rockefeller University has generated just 14 startups in the last 15 years.<sup>43</sup> For five of the eight years between 1998 and 2005, Mount Sinai School of Medicine produced no start-ups. In the other three years, it produced a total of five.<sup>44</sup> The Albert Einstein College of Medicine produced just five start-ups from 2004 to 2006.<sup>45</sup> NYU averaged just one start-up per year between 1998 and 2002 before gradually upping its total to three in 2005, five in 2006 and six in 2007.<sup>46</sup>

"New York City has great research, great inventions, but most of the academic institutions have absolutely no concept on what it takes to move things down the commercialization path," says one tech transfer official in New York.

That sentiment was echoed by numerous other experts interviewed for this report. "New York City has brilliant academic research and unbelievable scientific qualifications, but we're missing the middle piece of development of intellectual property and commercialization that other places have," says Jim Singer, a partner with consulting firm A.T. Kearney who helped lead a 2007 study his firm conducted for

the state's Empire State Development Corporation (ESDC) about New York's innovation economy.

While the low rate of new business ventures emerging from the labs of New York's academic research institutions has clearly hindered the development of a local technology sector, another problem is that the city's universities simply have not churned out enough entrepreneurial-minded graduates. Many of the experts interviewed for this report suggest that the universities do little to instill an entrepreneurial culture among their students and faculty. In fact, although New York is beginning to develop a foundation of technology-related companies, hardly any of these firms emerged out of research at the city's universities and nonprofit research institutions.

"The majority of people that I know building interesting tech companies in New York did not come out of New York schools," says Charlie O'Donnell, co-founder and CEO of online employment startup Path 101 and the creator of nextNY, a networking community of almost 1,000 young digital media and technology professionals in the five boroughs. "From a technology perspective, there are not nearly enough kids coming out of college and building something out of their dorm room considering the number of students here in New York."

A 2008 report by the Ewing Marion Kauffman Foundation confirms that New York universities have not played a major role in seeding high-tech firms. According to the report, no New York City university ranked among the top ten institutions in the nation at which more than 600 key U.S.-born tech founders received their terminal (highest) degree.<sup>47</sup> "After the top universities, each school on the list had one or two founders," says Vivek Wadhwa, the primary author of the study. "The fact that New York didn't figure anywhere on the list is the only significant fact."

A final problem is that too many of the technology start-ups that are hatched by local scientists inside the halls of city research institutions end up being established elsewhere—from Boston and San Diego to Northern New Jersey. Out of 84 companies spun off from Columbia between 1983, when it produced its first start-up company, and the middle of 2008, 60 are still in business but only seven of them maintain significant operations in the city.<sup>48</sup> Even worse, just one of the 14 start-ups produced

by Rockefeller University over the last 15 years remains in the city.<sup>49</sup>

The shame of this is that New York City frequently misses out on the tremendous economic benefits of technology start-ups that were created here. One missed opportunity is the jobs: while many tech startups never succeed, some end up achieving phenomenal growth and creating dozens or hundreds of jobs, with revenue benefits accruing to the city through taxes. Another is the chance to establish a critical mass of technology companies as well as a community of seasoned entrepreneurs, both of which are fundamental to the formation of an entrepreneurial ecosystem.

Reasons for the city's longtime failure to retain companies spun out of local research institutions include everything from the high cost of living and pricy real estate to a dearth of commercial lab space. Many previous studies have pointed out that space issues were at the heart of the problem, including a 1999 report by the Center for an Urban Future and a 2001 study by the New York City Investment Fund, which concluded: "Lack of affordable commercial lab space is the primary reason why New York City has failed to develop a biotechnology industry cluster. New York City-based companies have had to look outside the city and state for space to accommodate growth, primarily moving their research and manufacturing facilities to Massachusetts and New Jersey ... The lack of space is consistently cited as a reason for their departure."<sup>50</sup>

To a considerable extent, these factors are beyond the control of the city's academic research institutions. But the leaders of those institutions deserve a share in the blame as well. They have not exerted much effort into helping the companies they spin off get established nearby.

Technology transfer officials in New York attest that, while they would be thrilled if more scientists opted to spin off technologies into nearby businesses, local economic development is not their responsibility or mission—regardless of the consequences for the local economy to which the institutions are inextricably tied. In addition, they maintain that they have no say in where firms set up shop, especially given external factors such as the limited amount of commercial lab space and the high cost of doing business here.

**TOP U.S. UNIVERSITIES AND NONPROFIT RESEARCH INSTITUTIONS FOR SEEDING START-UPS, 2007**

INSTITUTIONS	START-UPS CREATED
U. of California System	38
MIT	24
U. of Utah	18
Columbia	12
California Institute of Technology	11
U. of Washington	11
Northwestern	10
U. of Colorado	10
U. of Kentucky	10

**OTHER NYC INSTITUTIONS**

NYU	6
Albert Einstein College of Medicine	2
Mount Sinai School of Medicine	1
Sloan Kettering Institute for Cancer Research	0

*Source: Association of University Technology Managers, U.S. Licensing Activity Survey: FY 2007.*

“We’re tired of being blamed for not doing tech transfer in New York,” says Kathleen Denis, associate vice president of technology transfer at Rockefeller University. “We do a lot of tech transfer; it just goes elsewhere.”

“We have no influence on start-up location,” adds Orin Herskowitz, executive director at Columbia Science & Technology Ventures, the university’s tech transfer unit. “Perhaps that’s the right thing to do. Our mission, per the Bayh-Dole act, is to get technology out of the university for maximum social and economic benefit. I would love if the best business decision was to stay in New York but the decision about where to locate is ultimately between the company and its investors, not Columbia.”

Viewed through a lens of narrow self-interest, New York City’s universities and research institutions need not care much if the scientific breakthroughs that occur in their labs end up as the basis of new companies that contribute to the local economy. After all, their primary purpose is to educate students and contribute to the total sum of knowledge in their

fields. To put it mildly, that is a noble and indispensable vocation, and there is no question that the city’s universities and research centers perform that function—often to the highest standards.

Yet, the passive attitude that has prevailed at city institutions regarding start-up formation and location seems to overlook the reality that the city’s academic research institutions have much to gain from a clustering of start-ups coming out of their campuses. The experience of Silicon Valley, Boston and other leading regions shows that new companies that remain near the research institutions that spawned them support those institutions in myriad ways, from partnering in further research projects with faculty and students to cultivating ensuing generations of tech-savvy investors who might serve as the basis for a new generation of companies, a process that tends toward repetition. Not incidentally, some of those same tech entrepreneurs will become major university donors. Once this exchange between academia and industry is established, universities and research centers often find it easier to attract top scientists and the federal research grants that often come with them.

And, despite officials’ claims to the contrary, they do have some potential leverage in determining where companies go, through the amount and type of assistance they provide. Indeed, several successful technology start-ups that emerged from research at city institutions told us stories about being dropped by the institution once their licensing deal was complete.

New York City wouldn’t be as reliant on the actions of private institutions if it were home to a public land-grant college or university. Unlike private institutions, local economic development is embedded in the mission of land-grant schools. But the city has no comprehensive branch of the State University of New York (SUNY) system and most of the land-grant ethos in the state is found at Ithaca-based Cornell, New York’s “contract” school of agriculture.

Without a large land-grant institution, New York City needs the private institutions to assume a leadership position. Considering all the assistance universities and research institutions solicit from New York City—preferential tax and zoning treatment above all—it is not unreasonable for city officials to expect them to do more to support the economy.

# Engine Failure

**The city boasts some of the world's best scientific research programs, but it has a glaring weakness when it comes to engineering—a major problem since engineers are instrumental to tech entrepreneurship**

WHILE NEW YORK CITY HAS THE SCIENTIFIC excellence that can provide the foundation for technology-related innovation, the city lacks the engineering prowess that is often critical to converting breakthroughs from the lab into real world applications and sustaining a vibrant cluster of high-tech and biotech firms.

Compared to technology hubs like Boston, San Francisco and the Research Triangle in North Carolina, New York City has a small overall engineering presence and lacks a first-rate engineering school that exhibits across-the-board excellence and depth across the full spectrum of disciplines and applications. In fact, out of \$7 billion spent annually in the United States on engineering research, all New York City institutions combined spend only \$90 million—a fraction of that spent by single universities such as Georgia Tech (\$310 million), MIT (\$216 million) or the University of California, Berkeley (\$153 million).<sup>51</sup>

Just one New York City university ranked among the nation's top 100 institutions in R&D spending for engineering in 2007 (Columbia, in 50th place) while only two other institutions in the city conducted more than \$1 million a year in engineering research.<sup>52</sup> Columbia's Fu Foundation School of Engineering & Applied Science is the city's leader, by far, spending \$41.1 million on engineering research in fiscal year 2007.<sup>53</sup> The City College of New York's Grove School of Engineering conducted \$14.2 million in engineering research that year, while Brooklyn-based Polytechnic University did \$7.6 million.<sup>54</sup> NYU essentially went without an engineering program from 1973, when it sold its University Heights campus, until 2008, when it completed a merger with Polytechnic.<sup>55</sup>

Columbia's engineering school was a respectable 21st in *U.S. News & World Report's* 2008 ranking of the nation's top graduate engineering programs.<sup>56</sup> But with 883 degrees awarded in 2006, Columbia is small compared to competitors like Stanford (1,643), MIT (1,373) and Georgia Tech (1,132). Columbia also spends a paltry six percent of its university-wide R&D budget on engineering, a much smaller percentage than other leading universities, including many

that are similarly strong in biomedical research.<sup>57</sup>

A number of technology experts contacted for this report indicated that the city's weakness in engineering is one of the major reasons why its universities do not churn out more start-up firms, and helps explain why New York has long struggled to harness its scientific strengths for local economic development. "Engineers typically devote their intellectual lives to pursuing real-world applications to research, while many basic science researchers are inspired purely by the quest for understanding," notes David Hochman, a former entrepreneur who has written extensively about technology-based economic development in New York and many other regions. "Though both are important, the mixture of engineering and science can provide an important spark for invention, commercial applications and the economic growth opportunities that result."<sup>58</sup>

Overall, universities in the five boroughs spent about \$90 million on engineering R&D in 2006, less than most other leading regions—including Chicago (which spent \$97 million), San Diego (\$97 million), Raleigh-Durham (\$131 million), Philadelphia (\$175 million), Los Angeles (\$182 million), San Francisco (\$299 million), Boston (\$337 million) and Baltimore (\$489 million).<sup>59</sup>

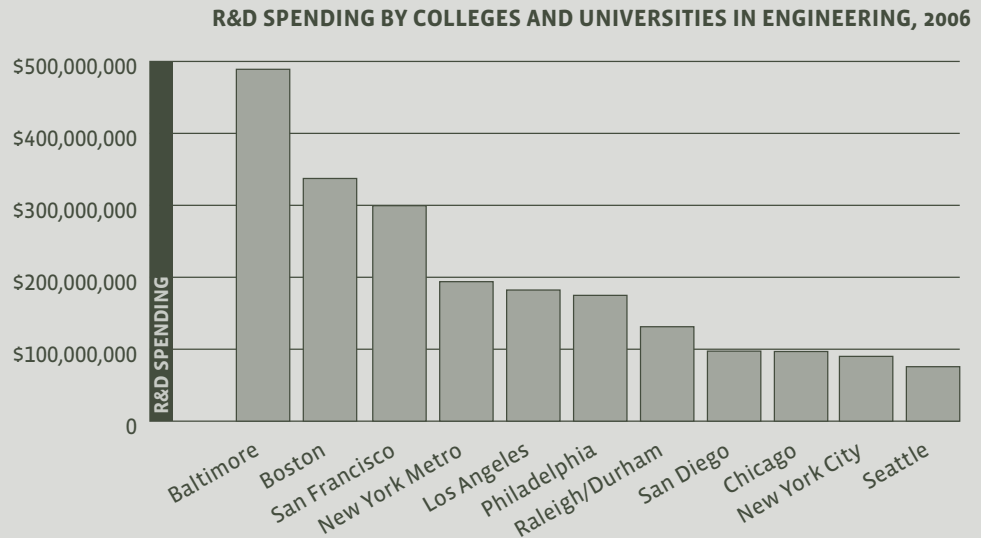
New York's shortcoming in engineering has also made it difficult for technology-related firms in the five boroughs to attract the technical talent they need. Indeed, when a recent survey asked New York IT executives what form of assistance they most needed to grow their companies, a resounding 63 percent of them answered "finding skilled workers."<sup>60</sup>

At least until the recent Wall Street meltdown, part of the problem was that small and mid-sized technology firms in New York faced enormous competition for skilled tech workers from investment banks, media titans and tech behemoth Google—all of which would pay significantly higher salaries than start-up technology companies. But many tech experts believe the city's universities aren't graduating enough engineers or attracting the type of creative engineering students that often gravitate towards tech start-ups.

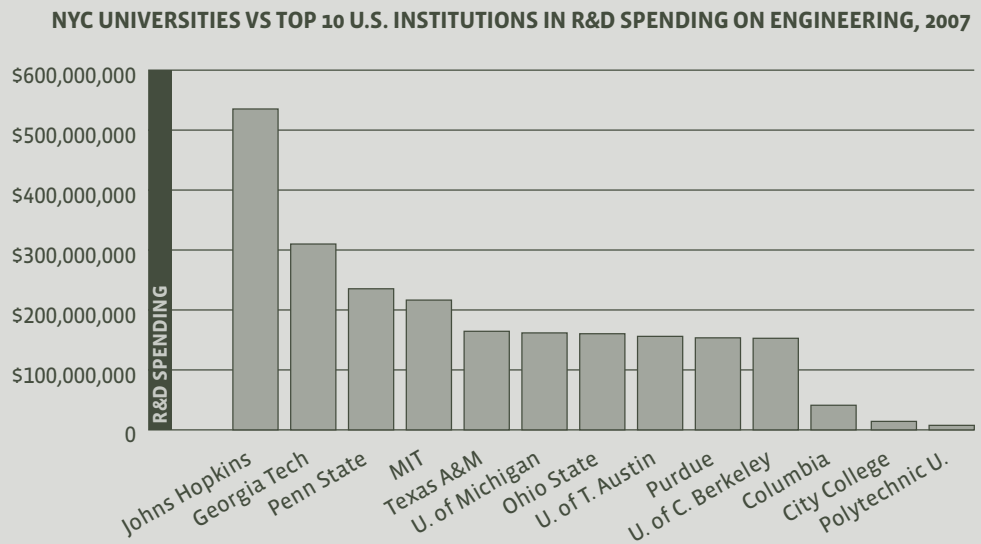


Source: National Science Foundation, FY 2006.

Note: Our figure for NYC (\$90 million) includes \$31 million in spending by Cornell, which is 40 percent of the school's engineering R&D expenditures. We used the same 40-60 allocation for Cornell in all R&D calculations for this report, at the suggestion of school officials, since Cornell's medical school is in the city. This provides a decent estimate for some research areas, but not engineering; most of its engineering R&D occurs in Ithaca.



Source: National Science Foundation/Division of Science Resources Statistics, Survey of Research and Development Expenditures at Universities and Colleges, FY 2007.



"The city doesn't breed IT people," said Joseph Zagrobelny, CEO of tech start-up ModSpec, in an interview before the Wall Street meltdown. "What's hot here at the universities is finance and fashion. But go to Silicon Valley and Boston and look at all the schools there that build first-rate IT people."

George Bugliarello, chancellor emeritus of Polytechnic Institute of NYU and a member of the governing board of the National Research Council, agrees that the city lacks a singular institution of higher learning where engineering research and entrepreneurship merge to create an atmosphere conducive to new business formation. "New York City doesn't have an MIT," he says, "and that's a very strange thing, because it should."

Despite the longstanding need for a top-tier en-

gineering program among New York's academic institutions, university leaders here have resisted calls to invest the resources necessary to hire additional faculty and expand their research capacity. Fortunately, things are finally looking up. In 2008, NYU and Polytechnic University finalized a merger between the two institutions, clearing the way for regular collaborations between NYU's highly regarded science departments and Poly's engineers. The hope is that NYU will invest new resources to expand Poly's engineering program; doing so would increase the supply of engineering graduates in New York and could up the ante for Columbia to take similar steps. Additionally, the cross-pollination between NYU and Poly could help the new institution become a vibrant center of technological innovation.<sup>61</sup>

# Giving Scientists the Business

New York's academic research institutions haven't done nearly enough to promote and support entrepreneurship among their students and faculty

THE ABSENCE OF A TOP-TIER ENGINEERING program in the five boroughs is only one obstacle to the creation of a dynamic innovation economy in New York. Another fundamental problem is that the leaders of the city's universities and nonprofit research institutions have not shown sufficient support for entrepreneurship among their faculty, post-doctoral researchers or students.

For the most part, entrepreneurship doesn't come naturally to basic science researchers. Trained to define and answer questions that push outward the boundaries of knowledge and understanding, most do not immediately grasp potential commercial applications for their work and are often clueless about the particulars of launching a technology business—from applying for patents and writing a business plan to securing capital and finding real estate. Although growing numbers of scientists now aspire to commercialize their discoveries, many need lots of help doing so. That's where the academic research institutions can be invaluable.

Much like the academics that populate them, most universities and medical centers aren't entrepreneurial by nature either. But several institutions in the U.S. have gone to great lengths to promote and support entrepreneurship among their students and faculty. To this end, they have established technology transfer offices and supported them with ample resources, a clear mandate to execute a high volume of licenses, and a devotion to championing students and faculty who wish to commercialize their research breakthroughs through the entrepreneurial path. Perhaps even more importantly, the most successful institutions have also set up procedures that are designed to facilitate—not thwart—entrepreneurship. The most successful of these institutions have created programs that facilitate routine exchanges between scientists, engineers, MBA students, investors, and seasoned entrepreneurs, as well as a support structure whereby a would-be entrepreneur easily can get advice on various aspects of starting and running a business.

Unfortunately, most of New York City's academic institutions lag behind in these areas. Linkages between science departments and business schools are meager on New York campuses, and there are few mechanisms that assist scientists to cross-pollinate with engineers, investors and experienced tech entrepreneurs. Institutions in the city have a reputation for taking a hard negotiating stance with faculty and students in hammering out licensing agreements, in sharp contrast to institutions like Stanford and MIT that emphasize volume over battling for the last dollar of profit. And whereas Stanford, MIT and a handful of other schools often encourage their faculty to take a sabbatical to pursue promising entrepreneurial options, New York's institutions historically have frowned upon this type of flexibility for researchers and instructors. At the same time, there is a lingering perception that some of them lack the know-how or the networking connections to put their scientists in touch with the right venture capital firm, angel investor or management team.

The task of ensuring that academic breakthroughs are converted into real-world applications typically falls to technology transfer offices at universities and nonprofit research institutions. These offices do everything from obtaining patents and identifying corporations that might be interested in developing an invention to drawing up intellectual property agreements and helping scientists considering forming a start-up company to connect with investors. Recent studies have found that institutions producing high rates of start-up ventures generally boast tech transfer offices that enjoy strong support from above. "In most examples [of success], the university president showed leadership and commitment to technology transfer, and it was actively embraced by deans and department chairs," concludes a 2007 report by tech consulting firm Innovation Associates. "These academic leaders set the tone and instituted incentives to create an academic culture that rewarded technology transfer and entrepreneurship."<sup>62</sup>

## LESSONS FROM MIT AND FLORIDA

MIT's emergence as a national and global leader in technology-driven entrepreneurship came only after years of its leaders emphasizing this mindset at every turn, according to MIT Entrepreneurship Center chairman and longtime professor Ed Roberts. Few institutional leaders did more to send the message than Roberts, who boils down his philosophy into a handy epigram: "MIT has attitudes; the attitudes foster programs; the programs produce results." In other words, universities can establish an entrepreneurial ethos by making it an important part of their educational and scientific mission, not a side activity pursued by the business school.

A veteran educator and innovator who has spent 48 years at MIT, Roberts offers three simple rules for driving innovation at a research institution. First, he says, staff should be available to help any faculty member or student with questions about developing their intellectual property, whether or not their ideas look like they might profit the institution. Second, where appropriate, they should encourage faculty and students to consider not only licensing their technology but starting their own company. Finally, the leadership of the institutions should fill the institution with examples of faculty and students who were not penalized academically for pursuing commercial interests but, to the contrary, were celebrated for risks undertaken and rewards gained.

A turning point in MIT's cultural transformation toward entrepreneurship came in 1991, when the school hired several of Stanford's tech transfer officers and assigned them the task of replicating their former school's success in Cambridge. One of those officers was Lita Nelsen who now heads tech transfer at MIT. Among Nelsen's key early moves was, in Roberts' words, to "throw out all the lawyers" and replace them with "staff who are expert in commercial management" and whose mandate was to move away from the previous practice of seeking maximum profit for the university when pursuing licensing deals. Nelsen, in turn, credits Roberts with helping to launch the school's innovative Venture Mentoring Service, a program begun by a pair of MIT alumni that connects more than 100 business mentors with students and faculty at the school. She characterizes her tech transfer strategy as "role models and mentors"—an emphasis that allows her to pursue another of her priorities: "Impact, not income."

The proven success of such strategies could allow New York's universities to improve their own entrepreneurial culture within a span of years, not the decades it took MIT. The University of Florida, for example, has in under a decade transformed itself from a non-entity in technology transfer to a national powerhouse. In 2006, the Milken Institute ranked Florida fifth on its "University Technology Transfer and Commercialization Index," based on performance in the categories of patents issued, licenses executed, licensing income and start-ups.<sup>66</sup> That year, the university earned nearly \$43 million in licensing income, up from \$10 million in 2000, and its technology served as the basis for 10 new companies, bringing its total over the previous five years to 46 start-ups.<sup>67</sup>

The change began when the school hired David Day as director of its tech transfer office, allowed him to triple the unit's staff to 19 and encouraged him to use his private sector experience to make deals and get technology out the door. "They told me to use my business experience to knock down the walls and make it happen," he says. "I enjoy putting these start-ups together." A *Newsweek* profile of Day reported that before 2000, Florida had been "sitting back, waiting for corporate giants to materialize and write megachecks for the rights to its patents. But the bigs almost never appeared because the investments and corresponding returns were too small for multi-billion dollar outfits. So the university chose instead to go after small businesses that don't require blockbusters to thrive."<sup>68</sup> ♦

Universities in New York have not always offered this support. Our research finds that several of the tech transfer offices at local institutions have been underfunded or excessively bureaucratic. While Columbia is clearly an exception—it has one of the largest tech transfer offices in the country, with 19 full time equivalent staff—NYU had just four staff devoted to licensing and tech transfer in 2007, tying it for 64th place among U.S. universities. Rockefeller University and Albert Einstein College of Medicine each

had five tech transfer staff.<sup>69</sup>

It isn't only the city's private institutions that have missed opportunities to commercialize academic discoveries. The City University of New York (CUNY), which is home to the New York Structural Biology Center, a state-designated Center for Advanced Technology (CAT) in Photonics Applications, and more than 1,000 research labs, did not even have a centralized technology transfer office until late 2006. In a 2007 interview, Jake Maslow, CUNY's director of technol-

## HOW TECHNOLOGY TRANSFER WORKS

Technology transfer simply means converting patented knowledge into a useful product, or part of a useful product. In most cases, an existing company licenses the knowledge from both the researcher who produced it and the university or research institution in whose lab the work was done. Sometimes the researcher will choose to transfer the technology from lab to marketplace himself by starting a company. In either case, the guiding principle is that the private sphere depends on institutions funded by public money (for instance, grants from the National Institutes for Health or the National Science Foundation) to produce new knowledge. Institutions then rely on companies to turn that knowledge into beneficial products and procedures—an action that also generates revenue for the university or research institution.

Many universities have set up offices of technology transfer (OTT) to direct that process, which begins with a researcher's breakthrough. The scientist documents the discovery by filing an invention disclosure form with the OTT. If the office thinks the invention has commercial potential, it may acquire a patent for it. The patented piece of "intellectual property" (IP) can now be developed in one of two ways: either the IP can serve as the basis for a start-up company run by the researcher or business executives brought in to do the job, or an existing company can license the IP and turn it into a product like a drug or wireless protocol. In both cases, the researcher and her university or research institution receive a cut of the profits if the product is successful.

An example of a researcher-led start-up would be Fonar Corporation, founded in the 1970s by SUNY Downstate professor Dr. Raymond V. Damadian, who essentially invented the MRI machine and then left the school to commercialize his idea. A prominent product that emerged from a licensed technology is Gatorade, the electrolyte-replacing drink developed in the 1960s by Dr. J. Robert Cade at the University of Florida. Gatorade, which is now owned by PepsiCo, has brought the university more than \$150 million in royalties since 1973.<sup>69</sup>

The path to commercial success is narrowed by attrition at every stage: Not every invention disclosure leads to a patent, not every patent leads to a license and not every license pays out royalties. For every Gatorade there are dozens of products and companies that fail, producing a loss of investment for their research institution. Yet technology transfer, while imperfect, helps spur research and development and gives life to innovations that might otherwise remain cloistered in the halls of academe. ♦

ogy commercialization, a position the university created in 2006, could not give the number of start-ups spawned by the CUNY system in recent years. CUNY also routinely failed to file patent applications for technologies discovered at its campuses. Alan Doctor, deputy director for business development at CUNY's CAT in Photonics Applications, one of 15 CATs statewide, says that a patent costs about \$20,000 and takes time to pursue, resources the school has long dished out sparingly.

Gillian Small, vice chancellor for research at CUNY, counters that the system has recognized the problem and begun to change its culture. In fact, CUNY Chancellor Matthew Goldstein designated 2005 to 2015 as the "decade of science" and committed new funds for scientific research. "We are making huge investments across the board and the commitment is coming directly from the chancellor and board of trustees," says Small.

The bigger problem for tech transfer offices in New York is that most have been insufficiently com-

mitted to licensing new technologies to start-ups. "I don't think it's the fault of these offices," says David Hochman, a local expert in technology-based economic development. "[The problem] is what they are being asked to do, charged to do and expected to do by the institution's leaders. The institutions have not decided they want to be more aggressive."

To be sure, many of the city's tech transfer offices have made meaningful progress in the past few years. These offices are generally bigger and more active than they were five or 10 years ago. They have also begun to embrace collaboration and to see themselves as parts of a collective—an important step for famously independent and often-fractionious academic institutions. Last year, the tech transfer offices from the seven largest biomedical institutions in the five boroughs—Columbia, Cornell, Einstein, Mount Sinai, NYU, Sloan-Kettering and Rockefeller—came together to publish an informational brochure that touts the city's collective biomedical strengths. Members of the

group, collectively known as the New York Academic Consortium, also travelled to San Diego last summer to promote their efforts at the annual convention of the Biotechnology Industry Organization (BIO).

"This represents a lot of hard work and flexibility [by the tech transfer officers] to work outside the traditional parochial boundaries to try to make the city itself competitive," says Bill Fair, the founder and managing general partner of Ajax Ventures, a company that provides advisory services in the biotech field, and former head of the bioscience desk at the

courses in entrepreneurship, taught multiple times throughout the year; in all, more than a quarter of the university's 5,500 undergraduate and graduate students receive lessons in becoming entrepreneurs each year. That is but one example of the interdisciplinary culture at the school, whose faculty and alumni have launched more than 5,000 companies. In addition, the MIT Sloan School of Management, with its 750 students, provides ideas and services to the university's research departments, and the MIT Enterprise Forum is justly famous for sponsoring and

### Cornell has worked to raise the profile of tech transfer at the school by holding events like a day-long "Startup Boot Camp."

city's Economic Development Corporation. Fair believes the tech transfer offices have come a long way in improving their operations in the past few years. "I think you're starting to see in most institutions an important change happening," he says. "It's a completely different world than five years ago."

"There's leadership to try to move the group in a more entrepreneurial way," adds Maria Gotsch, president and CEO of the New York City Investment Fund, speaking of the city's tech transfer offices.

Most of the experts in technology-based economic development interviewed for this report believe that the city's tech transfer offices still have much room for improvement when it comes to supporting technology start-ups and creating a supportive environment for entrepreneurship. But the needed changes go beyond simply making tech transfer offices more effective. "You can have a fine tech transfer office, which Columbia now seems to have," says Walter Plosila, a past chairman of the National Science Foundation's Industrial Innovation Committee who served as vice president of the technology partnership practice at Battelle Memorial Institute, a renowned tech consulting firm, until his recent retirement. "But if you don't have the tech commercialization support and services that go along with it, then you can't create the local entrepreneurial culture that turns that research into local value-added enterprises."

MIT is perhaps the best example of an institution that supports its technologists in learning how to start and run a business. It offers 30 separate

conducting countless entrepreneurial workshops, meet-ups and mentoring programs on campus and through its chapters around the U.S., including one in New York City. (See "Lessons From MIT, page 19)

Several other universities across the nation stand out for providing their scientists ample opportunities to learn entrepreneurship, with offerings that range from networking with MBAs to workshops on everything from writing business plans to wooing potential investors with effective "elevator pitches." Bryan Soper, who earned a graduate degree from Cornell and worked at a lab at Sloan-Kettering before moving to the West Coast to pursue post-doctoral research at the University of California, San Francisco (UCSF), points out that it's difficult not to come away with information about starting a business at California schools. "There's a seminar series on going from scientist to CEO. There's a staff member assigned to promoting bio-entrepreneurship," he says. "There's a class on 'From Idea to IP [Intellectual Property],' which has a lot of VC involvement."

Soper says it was just the opposite in New York. "That's not part of the curriculum of any New York institution. You really have to seek it out in New York, beyond the standard curriculum."

"There's also this whole silo mentality," adds Charlie O'Donnell, the founder of nextNY and one of the most networked technology entrepreneurs in New York. "Are there computer science programs at the universities? Yes. Are there entrepreneurship classes at the business schools? Yes. But no one's putting the two together."



Most New York universities have some ties between their research and business sides, and some have stepped up these programs in recent years. For instance, Columbia's tech transfer officials report that the university increasingly is looking to train its science students and faculty to think and act entrepreneurially. It now offers a fellowship program in which Ph.D. and business school students evaluate the commercial potential of patents and other intel-

lectual property and help scientific researchers write business plans and marketing analyses. Additionally, the school's Center for Technology, Innovation and Community Engagement coordinates entrepreneurial education and experiential learning opportunities for engineers and other Columbia students.

## "The institutions have not decided they want to be more aggressive."

Columbia has also made strides in bringing potential investors together with its scientists. The school runs a business plan competition that has intensified as its prestige and payout—the prize for first place is now \$50,000—has risen. Arnold Leitner, who holds degrees in physics and business from Columbia, won the competition in 2006 for his idea to add solar thermal generators to the open space around power plants. He used the prize to help start Skyfuel, a company that is developing the technology to do this and which now has more than 20 employees. While Leitner and the company's headquarters are located in Albuquerque, the firm also retains a small presence in New York.

NYU recently began an internship program in which students create a business plan that includes a market analysis for a piece of university research that holds potential to be commercialized. The school plans to expand the program, which in 2008 served a mere 12 students. NYU is also beginning to provide business training to Ph.D. students in the sciences, and its Berkley Center for Entrepreneurial Studies at the Stern School of Business hosts presentations from the technology transfer office about current patents. Business students are then invited to form teams to come up with commercialization strategies and submit them to the school's annual business plan competition.

Allan Paau, the vice provost for technology trans-

fer and economic development at Cornell, has worked to raise the profile of tech transfer at the school by holding events like "IP & Pizza," at which scientists at its New York City medical school are given seminars in subjects like the proper technique for keeping patent-worthy lab notes, as well as a day-long "Start-up Boot Camp" in November 2008 that allowed researched affiliated with Weill Cornell Medical College to pick the brains of venture capitalists, intellectual

property lawyers and university entrepreneurs who have experience founding and running start-ups.<sup>64</sup> "We are trying to do this on both campuses [Ithaca and New York City] because both have lacked an entrepreneurial climate in the past," Paau said.<sup>65</sup> While a good start, these programs are only a small part of the cultural shift required to compete with schools that reliably turn their intellectual property into economic activity. "It's hard not to run into the entrepreneurial spirit at MIT," says John Pyrovolakis, a Web entrepreneur who has a B.S. from NYU and a Ph.D. from MIT, which uniquely positions him to comment on the entrepreneurial climate at the two schools. "Very few places compare to it. At NYU, when I was there, there was nothing going on."

Pyrovolakis says that he loved NYU as an undergrad, but it was his experience with a business plan competition he entered at MIT that turned him into an entrepreneur. He ended up starting a software company that produced online college applications. His company was profiled on the cover of *The New York Times* Circuits section; 18 months later he sold it to the Thomson Corporation, now known as Thomson Reuters, one of the world's largest information companies. Pyrovolakis stresses that at the start he knew nothing about business. It was MIT's "entrepreneurial spirit" and easy access to the school's business expertise, along with hard work, that propelled him to success.

"At MIT, it's really cool to start a company," he says. "There's high prestige around that. There are also a lot of people around who have successfully started a company. You can always meet with someone who's two steps ahead of you, people familiar with the experience you are in, no matter where you are in the process."

# Wanted: Experienced Entrepreneurs

New York isn't just missing an entrepreneurial climate at its universities and nonprofit research institutions; it's lacking seasoned technology entrepreneurs, period

"TO BUILD LOCAL INDUSTRIES, YOU NEED entrepreneurs with experience," says Lesa Mitchell, vice president of advancing innovation at the Ewing Marion Kauffman Foundation. "If I have a great technology sitting at my door in Kansas City, I guarantee you I can link it with a VC. But if I don't have a local management team that can bring it to market, I can't do it."

A critical mass of experienced entrepreneurs is important for any region hoping to develop a large and sustainable tech cluster. Start-ups that have a solid scientific or technological foundation but lack the management experience to put together a business plan, round up financing, find space, hire employees and run the firm's day-to-day operations often turn to experienced entrepreneurs to guide them through the crucial early stages of development and growth. And many of these successful technology CEOs end up investing some of their personal wealth into other local start-up ventures, often through angel groups.

Most of the nation's leading high-tech hubs boast a large number of executives who have gone through the trials and tribulations of running a start-up technology company and learned—often through initial failure—what it takes to succeed. Indeed, in these re-

gions, it's not unusual to find dozens of individuals who've been at the helm of multiple start-ups, known as serial entrepreneurs.

But New York hasn't yet developed a sizable pool of experienced technology entrepreneurs. This is partly a result of the comparatively small numbers of technology firms that have emerged out of the city's research institutions and remained here. It's also due to the fact that the tech sector here is relatively young. After all, it wasn't until the emergence of Silicon Alley in the mid-1990s that New York even got on the map as a technology hub. In comparison, Northern California has produced several generations of tech businesses, going back at least to when Stanford graduates Bill Hewlett and Dave Packard incorporated Hewlett-Packard in 1947.

"The main differential between New York and Silicon Valley is that in Silicon Valley they've been doing it a while and have a supply of seasoned CEO types who know how to do budgets, keep staff low and move the product into a market position quickly," says Bruce Niswander, director of the Office of Innovation Development at Polytechnic Institute of NYU. "You have professors here with the smarts and energy, but they're not always the entrepreneurial business types."

## A PROVEN CONCEPT

With increasing evidence that a good technology transfer office alone does not ensure that a meaningful number of breakthroughs in the lab get commercialized into start-up ventures, some universities and research centers around the country have opted to provide further assistance through a new type of organization called the proof-of-concept center.

These centers came about as many angel investors and venture capital funds began to shift their focus to larger and later-stage investments, leaving a funding gap for researchers seeking seed-stage investment to prove the viability of promising technology. Rather than watch such work with commercial potential go begging, the institutions created the proof-of-concept centers to provide seed funding for novel, early stage research that conventional investors have overlooked—with the funding typically coming from a wealthy alumnus. Importantly, though, the centers do more than simply provide gap funding; they also connect the faculty and students working on the promising technologies with business advisors, experienced tech entrepreneurs, angel investors and other support services. By providing scientists support through a team of advisors as well as seed funding, the proof-of-concept center allows them to advance their

**“With proof-of-concept centers, I absolutely believe that if, in fact, you’re at a large enough university and if you have enough philanthropic dollars and the right expertise, this model will work to accelerate commercialization.”**

technology to the point at which it becomes clear whether or not they have a viable business.

Unlike traditional business incubators, the proof-of-concept center has no central research space. Instead, researchers work in their own labs with assistance from an administrative team and advisors who act as “hubs” in local venture capital, technology and industry networks. “The proof of concept center facilitates and fosters the exchange of ideas between the university innovators and industry via various mentors associated with the center,” according to a January 2008 report by the Ewing Marion Kauffman Foundation.

Leading examples of the proof-of-concept approach are the Deshpande Center at MIT and the von Liebig Center at the UC San Diego Jacobs School of Engineering. Deshpande began in 2002 with a \$17.5 million grant from an alumnus. It extends seed funds to about 16 projects per year, in amounts ranging from \$50,000 to \$250,000, and has volunteer advisors to help grantees. The von Liebig Center started in 2001 with a \$10 million grant from an alumnus. It provides seed funding to about 11 projects per year in amounts of \$15,000 to \$75,000 and has paid advisors who help their grantees navigate all the particulars of readying a technology for commercialization. Both have useful web sites and are well known on their campuses as the place to go to accelerate the transfer of technology coming out of university labs.

“With proof-of-concept centers, I absolutely believe that if, in fact, you’re at a large enough university and if you have enough philanthropic dollars and the right expertise, this model will work to accelerate commercialization,” says Lesa Mitchell, vice president for advancing innovation at the Kauffman Foundation.

“It’s culture-changing within the institution. It gives faculty the legitimacy to be pursuing commercialization,” adds Abigail Barrow, director of the Massachusetts Technology Transfer Center, a program created by the state of Massachusetts to work with 30 university tech transfer offices statewide to help launch start-ups. “When the money is out there, it makes investigators think, ‘Is there something in this lab that qualifies for proof-of-concept money?’ A lot of the graduate students think that way.”

Some New York research institutions have established variations of this model. NYU has an internal seed fund, called the Applied Research Support Fund (ARSF), which is designed to encourage the development of technologies which have the near-term potential for licensing and commercialization. Cornell recently established a dedicated wet-lab space at its main campus in Ithaca for life science spinout companies to conduct proof-of-concept work, which is available to scientists at its New York City-based Weill Medical College.<sup>70</sup> In Manhattan, the Weill Cornell Clinical and Translational Science Center, which was established in 2007, provides dedicated lab space for clinical and translational research and attempts to foster collaboration between researchers at Cornell and other Weill-affiliated institutions in the five boroughs to increase the chances of commercial success by tapping into a diverse array of knowledge and expertise.<sup>71</sup>

Additionally, Columbia has a “Validation Fund” that Orin Herskowitz, executive director at Columbia Science & Technology Ventures (STV), the university’s tech transfer unit, believes is comparable to the better-known Deshpande and von Liebig Centers. Herskowitz says the fund has been “formalized for five years” and is administered by STV using funds from the university’s operating budget. It makes “anywhere from 10 to 30 investments” a year, disbursing a total of \$410,000 in 2007 and as much as \$750,000 last year. As for the mentoring and connecting part, Herskowitz says STV does that as a matter of course.

But while critically important, some say that New York institutions lag behind exemplars like MIT and UCSD when it comes to proof-of-concept centers. Consultant David Hochman says that the programs don’t include enough linkages to experts outside the university. “The virtue of programs like Deshpande is that they reach out beyond the university community. They connect to outside entrepreneurs and make that part of the business development process,” says Hochman. “I don’t think they’ve achieved that yet at Columbia. They do it with internal resources, not with all the resources that New York City as a community can bring to bear.” ♦

# A Royal Problem

The city's research institutions have long excelled at earning royalties from licensing their technological breakthroughs but lagged when it comes to generating new companies

ACADEMIC RESEARCH INSTITUTIONS IN NEW YORK long have had a reputation for pushing researchers to license their technologies to existing companies, thus generating substantial royalties for the institution, rather than attempting to directly commercialize new patents through new business ventures. Their policies and processes often signaled to scientists and technology transfer officials a disinterest in newly created start-ups. Although start-ups do emerge from city institutions, several individuals interviewed for this report say that it rarely happens without the faculty inventor strenuously pushing that option.

"Some of the New York institutions have not emphasized spinning off companies locally," says Walter Plosila, former vice president of the Battelle Technology Partnership Practice.

Scientists at Columbia, NYU, Sloan-Kettering and other New York institutions have patented their discoveries and licensed the resulting technologies to pharmaceutical companies, biotech firms and other businesses. But too many promising inventions end up languishing in labs because city institutions offer little or no support for taking them to market. Some experts say that this is because several of the city's tech transfer offices have been overly focused on a handful of technologies with the strongest potential to be scooped up by existing pharmaceutical companies, IT firms or financial corporations—at the expense of other discoveries that could be commercialized through forming start-ups.

A number of the city's institutions have achieved extraordinary success in earning royalties from scientific research. For years, Columbia and NYU have ranked at or near the very top of all U.S. universities in licensing revenue. In 2007, the most recent year for which data is available, NYU earned \$791 million and Columbia \$135 million. No other university topped \$100 million in royalties that year, and only 10 of 157 American universities that reported their data earned over \$50 million.

Nor is this practice limited to just NYU and Columbia. Mount Sinai School of Medicine was also among the nation's leaders, posting licensing revenues

of \$27 million in 2007, more than all but 13 universities. Memorial Sloan-Kettering Cancer Center did not publish data on their licensing revenues for 2007, but in 2006 it earned \$43 million—third among the 25 U.S. hospital and nonprofit research institutions reporting this information and ninth among all institutions (including universities).

This isn't a new trend. A 2006 study by the Milken Institute ranked NYU first among the top 25 North American institutions in licensing income, but fifth from the bottom (21st) in spinning out new firms. In 2002, Columbia received more in licensing revenue (\$156 million) than the total brought in by Stanford, the California Institute of Technology, the University of Southern California and the University of California system combined (\$145 million).

## TOP 15 U.S. UNIVERSITIES FOR LICENSING INCOME, 2007

INSTITUTION	LICENSING INCOME
NYU	\$ 791,200,000
Columbia	\$ 135,600,000
U. of California system	\$ 97,600,000
Northwestern	\$ 85,300,000
Wake Forest	\$ 71,200,000
U. of Minnesota	\$ 63,300,000
U. of Washington	\$ 63,300,000
MIT	\$ 61,600,000
U. of Rochester	\$ 53,300,000
Stanford	\$ 50,400,000
U. of Florida	\$ 48,000,000
U. of Wisconsin Madison	\$ 46,700,000
U. of Massachusetts	\$ 40,700,000
Mount Sinai School of Medicine	\$ 23,600,000
U. of Colorado	\$ 22,700,000

Source: Association of University Technology Managers, U.S. Licensing Activity Survey: FY 2007.

## ENTREPRENEUR ENVY

New York City's universities and nonprofit research institutions attract many of the best and brightest scientists from around the world. But as the race to lure top scientific talent becomes increasingly competitive, New York's institutions might lose out if they don't do more to promote and encourage entrepreneurship among their faculty and post-doctoral students.

Jeffrey Brancato, associate vice president for economic development at the University of Massachusetts and former director for economic initiatives at Columbia's tech transfer office, points out that up-and-coming faculty in the sciences increasingly want to work at a university that will help them commercialize their work either by assisting them in striking out on their own or collaborating with an industry partner.

"The old mentality of going into an ivory tower and never coming out has changed quite a bit in the life sciences over the last 20 years," Brancato says. "The ideal used to be to work in a lab, write papers, get published in the best journals, teach grad students and win the Nobel Prize. That has been replaced by the academic scientist who is very deeply engaged in turning research into therapeutics, diagnostics, products and processes that improve the quality of health. That means having collaborative relationships with industry scientists, possibly starting up a company or even a new industry."

Good old-fashioned envy also figures into this cultural shift. Bill Fair, former managing director of health care and biosciences at the city's Economic Development Corporation, calls this "the Professor Fluffy effect." Professor Fluffy is a fictional character he uses to explain how Cambridge, England formed a biotech cluster in the late 1990s. "It started in the car park of the Chemistry Building," he explains. "The first guy in the department who started a chemistry company did well. Then he bought a red Italian sports car. The other professors saw it in the car park and said, 'How did Professor Fluffy get a Testarossa?' When they found out, they started their own companies."

American versions of Professor Fluffy and his brethren are becoming more numerous: Tech transfer is up around the United States. A recent study sponsored by the National Science Foundation found the number of licenses and options entered into by universities nationwide nearly doubled to 4,200, from about 2,200 ten years earlier. And a report by Innovation Associates found that gross license income from universities in 2005 totaled \$1.6 billion. The increase is changing expectations among what Fair calls "Gen X researchers," who are more likely than their predecessors to judge a potential academic employer on their prowess at commercializing intellectual property.

"Schools need to say to themselves: 'If we're going to retain our position, we can't be agnostic about where our researchers go to start their companies,'" Fair says. "Because where the company goes and grows, so goes the researcher. And if Columbia University's ability to attract the next hot researcher declines, the grant money erodes, and then we have a problem." ♦

The institutions' longtime success in earning royalties suggests that their scientists are generating breakthroughs with clear commercial appeal. But many observers wonder why so few of the institutions' research discoveries have been licensed to start-up ventures. "There's a huge difference between selling technologies and supporting new technology ventures," says John Pyrovolakis, Web entrepreneur based in New York.

Some say that NYU and Columbia, among others, got so used to earning large royalties from a small number of blockbuster patents that they came to view their tech transfer office as a cash cow. Instead of trying to get large numbers of innovations into the marketplace, university leaders essentially directed tech transfer officials to focus on technologies that have the greatest potential to lead to blockbuster deals and continued high earnings. "If money

is the only metric, the rest of the mission will suffer," says consultant David Hochman.

New York tech transfer officials point out that things are changing; even though NYU and Columbia remain the nation's leaders in licensing revenue, both universities have been churning out more start-ups in recent years. But at least one local tech transfer official says that there is still work to be done. At an April 2009 forum, Cornell's Alan Paau said that the city's tech transfer offices "tend to be very deal-specific ... and try to do the big deal."<sup>72</sup> He suggested that there needs to be "little bit of an attitude adjustment," noting that there was a different approach in biotech boomtown San Diego, where he previously headed up the tech transfer operations at the University of California, San Diego. "My California colleagues tended to be more portfolio-focused. A positive result of this approach is that you start to develop an ecosystem or culture."<sup>73</sup>



# Let's Make a Deal

New York's research institutions have a reputation for driving a hard bargain when negotiating licensing agreements, which some experts say has led to a smaller volume of deals and fewer start-ups

NATIONWIDE, THE INSTITUTIONS WITH THE BEST track records for birthing start-up ventures tend to be those that aren't overly focused on driving the hardest bargain with a scientist or industry partner when hammering out a license agreement. In some instances, these institutions agree to take less money to keep up their volume of licenses signed. Unfortunately, New York institutions haven't always followed this path.

The experiences of two scientists who signed licensing agreements with their universities to develop and commercialize their biotechnology invention—one at Columbia and one at Stanford—show how these two approaches lead to very different consequences.

Leon Chen, a Ph.D. student at Stanford, joined with his professor in 2002 to found Kai Pharmaceuticals, a company developing peptide-based drugs to treat cardiovascular disease, pain and inflammation. Chen and his professor, Dr. Daria Mochly-Rosen, struck a single deal with Stanford for the rights to more than ten patents, and then went looking for established companies to license the technology. When they didn't find any, they instead decided to form their own company. In short order, Stanford renegotiated their deal and granted Mochly-Rosen a one-year sabbatical to help get the company off the ground. Within a year, the partners had landed a venture capital investment of \$17 million, which they used to begin their "proof-of-concept" lab work.

Chen, who entered the negotiations as a graduate student with no business experience, says he realized quickly that the school's main concerns were getting technology out to the public while giving the company its best chance to succeed. "In Kai's deal with Stanford, there was more of a collaborative spirit of working together than 'Who can make the most money out of this thing?'" he says. Now an investment analyst at Venrock Associates, one of Silicon Valley's leading venture capital firms, Chen characterizes Stanford's perspective as "If it's successful, we're all going to make money."

The experience of the Columbia researcher was altogether different. This scientist, who asked that we not give his name or a more detailed description of his work

because he still has business dealings with the school, was a post-doctoral researcher in Columbia's chemistry department who developed a novel technology in the life sciences. "I had the good fortune to license my own technology. But it was difficult to do that," he says. "Columbia was not set up the way I imagine MIT and Stanford are. They [the tech transfer office] didn't say, 'Oh, I get it. I'm going to help you do it.'"

The researcher eventually was able to negotiate a license with Columbia's tech transfer office and launched his own company. But the experience wore him down. "They were kind of pugnacious. They have this national reputation for being combative about intellectual property. Getting the technology out of the university was hard," he recalled.

After spending a few years conducting further research at Columbia's biotech incubator in upper Manhattan, the researcher moved his company to California. "I think they could have made that process a lot simpler, a lot less costly for me. Columbia is renowned for its bureaucracy. They move slowly. It is not a nimble organization."

He praises Columbia for providing relatively affordable space and good facilities at its Upper Manhattan biotech incubator—Audubon Biomedical Science and Technology Park—during an important phase of his research. "They helped me a lot," he says. "They put money into my lab because I needed some specialized equipment." Nevertheless, the researcher argues, the staid scientific culture of the university holds back the commercial possibilities of work done there. "They don't seem to be a university that is committed to engendering new technologies. They don't encourage it. At places like Stanford or MIT or Harvard, it's encouraged because what happens with the companies that stay in the area is they form strong links with the university and the university ends up making money with that."

Katharine Ku, director of the Office of Technology Licensing at Stanford University, believes that some New York institutions haven't licensed as many technologies as they could have because their priority has

## THE COLUMBIA CONUNDRUM

During the course of our research over the last three years, we stumbled upon a strange paradox about New York City's most prominent academic research institution. The data shows that Columbia University is far and away the city's leader in everything from overall scientific research expenditures to patents filed and start-ups created. It also appears to have made the most progress of any city institution in setting up a more supportive infrastructure for tech entrepreneurship over that time. Yet, during the dozens of interviews we conducted with local and national tech entrepreneurs and experts in technology based economic development, Columbia came in for the harshest criticism over their commercialization policies.

Columbia's strengths are unmistakable. In 2007, the school ranked 19th among all U.S. universities in total research expenditures, 10th in invention disclosures, seventh in patent applications, 25th in licenses executed, eighth in patents issued and fourth in the number of start-ups produced.<sup>74</sup> In each category, it topped all other institutions in the five boroughs.

Columbia has also made notable strides in recent years. The university had 322 invention disclosures in 2007, up from 207 in 2002—a 56 percent increase. Meanwhile, the number of start-ups it generated jumped by 50 percent, from 8 in 2002 to 12 five years later.

Why, then, did Columbia retain its bad reputation for hard bargaining with its scientists and focusing narrowly on blockbuster deals even after it had begun to change its ways around 2005? Why did more than a dozen tech experts and entrepreneurs across the country, when interviewed for this report, single out Columbia as an aggressive negotiator interested mainly in its revenue streams?

At least part of it probably stems from inevitably and justifiably high expectations for New York's largest and most distinguished research institution. But as scientists with firsthand experience in dealing with the school insisted and as even current administrators admitted, the university's negative reputation was well earned over a period of years.

"I love Columbia, but they've got a greedy streak," says one former Columbia researcher who started a company from a technology he licensed with the school.

*(continued on next page)*

been to strike the most favorable financial terms for the university. While that mission might lead to robust revenue streams on the deals they do complete, it prevents the institutions from reaching agreements on other technologies, some of which end up sitting on the shelf. "A school like Columbia used to pride itself on doing big dollar deals," she says. "They sometimes had up-front license fees of \$300,000. We would easily take a \$10,000 fee."

Stanford's goal is to grant as many licenses as possible because, says Ku, "you don't know which ones will succeed. I give our licensing people lots of authority. I almost never say, 'Why didn't you get more money?' For us, it's not about money."

Orin Herskowitz, executive director at Columbia Science & Technology Ventures, the university's tech transfer unit, strenuously disagrees with Ku's allegation about the \$300,000 licensing fees, arguing that Columbia never would have spawned more than 80 start-ups over the past 25 years—as they, in fact, have done—if the school regularly demanded such high up-front licensing fees. "Our deals are specifically aligned to generate revenues through equity, milestones and

royalties, so that we profit when the company profits," says Herskowitz, adding that Columbia takes a similar approach as Stanford in terms of licensing. "Columbia even put into place a program whereby all inventions that we file provisional patents on get a significant amount of marketing regardless of upside potential. I would posit that all of our patented inventions get, on average, more marketing efforts than virtually any other school in the country."

While numerous technology experts interviewed for this report echoed Ku's sentiments regarding Columbia's reputation for hard negotiations, many of the same officials acknowledge that the university has made significant progress in turning things around in the last few years (See "The Columbia Conundrum, above). "Orin Herskowitz has been a phenomenal addition to Columbia," says the Kauffman Foundation's Lesa Mitchell, speaking of the man who has had a key role in transforming Columbia's tech transfer office since arriving there in 2006. "We're seeing some big changes in [Columbia] trying to focus on volume. But they have a perception problem that they've had for a long time."

Columbia University is far and away the city's leader in everything from overall scientific research expenditures to start-ups created. It also has made the most progress of any city institution in setting up a more supportive infrastructure for tech entrepreneurship in recent years. Yet, during the dozens of interviews we conducted for this study, Columbia came in for the harshest criticism over their commercialization policies.

"Historically, Columbia has let it be known that they're not too concerned about having a local economic impact at all," high-tech expert Walter Plosila noted. "Their emphasis is on doing good research, offering a good education, [and] licensing the research to the best and highest bidder. They're more likely to go with an established firm that's more likely to pay an up-front licensing fee than to spin out a new enterprise that might not make it. If you look around the country at medical centers and university research centers, they're changing their script. They're taking more risks. They're all taking increased equity in start-ups and reducing fees."

A high-ranking Columbia official acknowledged that, until a few years ago, the school's tech transfer office pursued a negotiating strategy that was burdensome to its researchers. While asserting the university has since become much more aggressive in attempting to spin off new ventures, the official conceded that Columbia's previous reputation for hard bargaining with its scientists was deserved.

Columbia also was widely condemned as greedy for using a legal maneuver to extend its "Axel patents," named for Columbia professor Richard Axel, who discovered a process by which cells could be made to mass-produce proteins useful to the production of pharmaceuticals. The university earned a reported \$600 million dollars on the patents, which expired in 2000. But Columbia was not satisfied with that amount. It sought to extend its valuable revenue stream by filing a "submarine patent," which critics and the 11 biotech companies that sued the university claimed amounted to "double-patenting." In 2004, after much courtroom wrangling, the university withdrew its royalty demands.

The university's lingering perception problems are also rooted in its refusal to allow the Association of University Technology Managers (AUTM) to publish its licensing and commercialization data from four years in the middle of this decade. Each year, AUTM collects statistics from technology transfer offices at academic research institutions around the United States and Canada in a range of categories, including research expenditures, invention disclosures, patents, start-up companies, license income and number of full-time tech transfer staff. Hundreds of institutions allow AUTM to publish their data each year. But from 2003 to 2006, Columbia did not.

Columbia had kept the statistics, and provided them to AUTM so the organization could use them to make aggregate calculations, but refused to let the public see them. Why is this important? The answer is simple transparency: the public has a right to know whether its money (in this case, government grants to support research) is being effectively spent. And AUTM provides the best single source for evaluating the strengths and weaknesses of tech transfer operations around the United States.

As one university administrator said, they withheld the data because school officials thought critics were "overly focused" on Columbia's massive income from royalties: \$156 million in 2002 alone, which was far ahead of second-place finisher NYU at \$63 million, and vastly more than every other research institution in the U.S. The officials' concern was justified: the soaring revenues and flat numbers of inventions, patents and licenses that Columbia had reported in 2002 had led some experts to conclude that the school put much more energy into pursuing blockbuster deals than maintaining a growth-oriented pipeline of new technology. Rather than take on these critics, especially at a time when the school was engaged in a politically sensitive campaign to expand its campus into the Manhattanville neighborhood, Columbia withdrew from the discussion. Columbia's decision to hide its 2003-2006 numbers is hard to fathom, especially since the data would have shown improvement in the very aspects of Columbia's tech transfer performance for which the university had drawn such criticism.

In a positive step, Columbia reversed course and reported its 2007 statistics to AUTM, which were published in late 2008. ♦

# A Critical Missing Ingredient

New York has a respectable number of IT and biotech companies, but it still lacks a critical mass of technology-related businesses—a shortcoming that hurts the city's ability to attract and retain tech entrepreneurs

NEW YORK CITY IS HOME TO OVER 100 BIOSCIENCE companies, more than in all but a handful of cities. It also boasts a modest-sized IT sector that has grown significantly in the last few years. However, New York lags well behind regional leaders in both sectors and is still not widely perceived by technology entrepreneurs and investors as one of the nation's principal high-tech or biotech hubs.

More than other sectors, companies in technology-related industries have tended to cluster together in a relatively small number of regions. For the most part, the regions that have succeeded in establishing these tech clusters have done so not by luring companies from other regions but by nurturing home-grown firms, many of which were started by scientists at local universities and medical centers.

Once a critical mass of similar firms is established, the regions often attract venture capital firms, law firms specializing in intellectual property and other essential support services. In turn, tech entrepreneurs from other regions relocate there, typically out of a desire to be “where the action is” or in close proximity to their investors.

“You need a critical mass of people doing similar work around you to get collaborators and just feel like you’re in the right place doing the right thing,” says the founder of a biotech start-up company who conducted his basic research at Columbia University before shifting operations to the San Francisco Bay area. As a scientist formerly based in New York, he is far from alone in moving to a region with a more robust cluster of businesses in his field.

The bioscience industry in Cambridge and along Route 128 outside of Boston is a prime example of a successful tech cluster that sprang from and continues to be fed by research at its world-class medical centers. In Cambridge, where acres of derelict factories once dozed, there are now millions of square feet of lab space, much of which houses companies that convert basic research at local institutions into the next generation of drugs, medical devices and therapeutic methods. (Not surprisingly, about 80 percent of

tech start-ups generated by Boston universities and hospitals remain in the area.<sup>75</sup>) Then there is the famous example of the computer industry in Northern California’s Silicon Valley, which owes its existence to breakthrough technologies engineered at Stanford, UC Berkeley and Cal Tech and the investment networks and other supporting structures that grew up to capitalize on them.

Once such an ecosystem is formed and an industry gathers momentum, the larger and more successful companies often spin off clusters of new companies. For instance, a single company, Hybritech, a medical diagnostic firm founded in 1978 in San Diego, has spawned at least 100 additional bioscience firms in the region.<sup>76</sup> It is the anchor of the nation’s third largest biotech region, behind the Boston area and San Francisco Bay area, and in many ways as productive as Silicon Valley’s software industry.<sup>77</sup> It happened because a pair of researchers at UC-San Diego decided their work with monoclonal antibodies was both medically exciting and commercially viable. That is the power of clustering in a knowledge economy fueled by innovation from universities and research centers.

The number of companies and jobs in the city’s tech sectors are nothing to scoff at. New York has a better-than-average foundation of IT and biotech companies that easily could be built upon. New York is also particularly strong in the digital media sector; a 2002 study found that the metro area is second among all regions in North America in digital media jobs.<sup>78</sup> “New York has become the Internet and new media capital of the country,” asserts David Blumenstein, co-founder of The Hatchery, an organization based in Chelsea that aims to connect entrepreneurs with investors and other useful services.

But New York is certainly not yet on par with Boston, Silicon Valley, San Diego and other leading technology centers. For example, New York City is home to just six companies on the Deloitte 2008 Technology Fast 500 list, an annual ranking of 500 fast-growing technology, media, telecommunications and life sciences companies in North America—a fraction of the

number in top tech regions such as the San Francisco Bay area (88 firms on the list), Los Angeles (50 firms), Washington, DC (47), and Boston (41).<sup>79</sup> The rest of the New York City metro region had 17 firms on the list, bringing the area's total to 23.<sup>80</sup>

New York City has 128 biotech companies—a considerable jump since 2002, when the city had just 27 firms in the industry—but the Boston area has 243, the San Francisco Bay area has 423 and San Diego has about 350.<sup>81</sup> Meanwhile, most of the city's biotech companies only keep their finance or headquarters operations here—not labs for R&D or facilities for manufacturing.<sup>82</sup> Additionally, New York didn't even appear among the 12 leading biotech and life science clusters as compiled by the Milken Institute in 2004.<sup>83</sup>

The city's software sector is also relatively small in scale. The city had 44,700 jobs in the software and information technology sectors in March 2008, a 35 percent jump from March 2003.<sup>84</sup> Yet, Silicon Valley had 4,500 software companies that employed 93,650 people in 2004; in addition to 59,000 jobs in its semiconductor cluster, 54,500 in the computer and communications hardware sector and 23,400 people working in electronics components.<sup>85</sup> (A 2007 report by the Industrial + Technology Assistance Corporation found that the New York City metro area employs roughly 620,000 people in technology jobs, more than any other region, with 226,000 in the five boroughs. While notable, the study points out that most of these jobs are embedded in non-technology industries such as finance, media, higher education and health care.)<sup>86</sup>

The tech sector in New York also tends to be fragmented (at least compared to a place like Silicon Valley, where the VCs all eat at the same diner on Sandhill Road), overwhelmed by larger, more established industries and hobbled by the widespread notion that cutting-edge research and development seldom occurs here.

To be sure, conditions in New York improved considerably since the dot com bubble burst in 2000. Silicon Alley has exhibited signs of creative percolation and productive self-organization. A number of groups now regularly hold networking/product demonstration events meant to foster a sense of community and, perhaps, display the next killer app. One of them, the nearly 10,000 member NY Tech Meetup, has grown over the past five years from monthly audiences in the dozens to the hundreds: Web entrepreneurs now jostle for an invitation to take the stage at the Great Hall at Cooper Union, where the Meetups are held, to show off their ideas. Another, nextNY, promotes itself as “a fun way to connect both socially and professionally with young people who have a stake in future of tech and new media in New York City.”

And co-working spaces—free-to-dirt-cheap work areas shared by bootstrapping entrepreneurs—are popping up around the city, like New Work City in Hudson Square, where designers, programmers and technologists interact and collaborate for \$25 a day or between \$200 and \$550 a month.

These are all good signs, but more progress is still needed for New York to establish a self-sustaining tech cluster.

*Source: Milken Institute, June 2009. Metros were ranked by their performance as “tech poles,” or clusters of high-tech activity. This is based on jobs and wages, as well as the local tech concentration and each metro's relative share of North American activity. A location quotient (LQ) of 1.0 means the local high-tech concentration matches the average for North America; an LQ of 2.0 is twice that of North America.*

#### TOP HIGH-TECH CENTERS IN NORTH AMERICA, RANKED BY MILKEN INSTITUTE, 2007

Metro Area	Metro Area Employment (thousands)	Location Quotient	Share of N. American Wages	Tech Pole Scores
San Jose-Sunnyvale-Santa Clara	244.0	4.6	5.7%	100.0
Seattle-Bellevue-Everett	226.3	2.7	3.2%	46.4
Cambridge-Newton-Framingham	163.6	3.4	2.8%	45.2
Washington-Arlington-Alexandria	275.7	2.0	4.2%	41.8
Los Angeles-Long Beach-Glendale	376.4	1.6	4.2%	40.2
Dallas-Plano-Irving	187.7	1.5	2.4%	21.8
San Diego-Carlsbad-San Marcos	136.4	1.8	2.0%	19.3
Santa Ana-Anaheim-Irvine	147.0	1.7	1.6%	17.7
New York-White Plains-Wayne	262.0	0.9	3.9%	16.8
San Francisco-San Mateo-Redwood City	106.4	1.8	2.0%	16.1



# Nothing Ventured, Nothing Gained

Despite some recent strides, New York City and state economic development officials could be doing far more to support the growth of a meaningful technology sector in the five boroughs

NEW YORK CITY MAY BE THE FINANCIAL CAPITAL of the world, but it has a money problem. Despite the wealth of expertise and energy on Wall Street—despite the wealth of Wall Street, period—New York’s innovation entrepreneurs are often overlooked when it comes to investment capital, the lifeblood of any new technology-related business.

Dozens of entrepreneurs, investors and high-tech experts interviewed for this report affirm that New York City has a shortage of angel networks and VCs that invest in technology start-ups, especially compared to Boston and Silicon Valley. They add that many New York investors look outside the city for deals and, when they do invest locally, they shy away from taking chances on early-stage companies. And New York’s universities have fewer and weaker ties to established investment groups compared to Boston and Silicon Valley, yet another factor in the city’s failure to capitalize on its enormous research assets.

“There’s a shortage of capital here in New York City,” says Daniel J. Schultz, co-founder and managing director of DFJ Gotham Ventures, which focuses on early-stage technology companies in the New York metro area. “You can count the number of venture firms here on one hand. In Silicon Valley and Boston there are dozens and dozens and dozens.”

The numbers back him up. Amazingly, only two of the 55 most active VC firms in the United States in 2007—those that closed 20 or more deals—were based in New York City.<sup>87</sup> In contrast, Silicon Valley was home to 27 and the Boston area to 11. (New York City was home to slightly more of the most active venture firms in 2008—five—but Silicon Valley, with 40, and Boston, with 16, also greatly increased their totals.) The paucity of active VC firms in the five boroughs is cause for concern since venture firms have traditionally preferred to invest in companies in their own backyard, so they can keep an eye on their investments.

But New York’s financing gap is not limited to its relatively small number of active venture firms. Local entrepreneurs say the real challenge is that few of the

VC firms that are here invest in early-stage companies. “There isn’t a lack of capital in New York. There’s a lack of capital useful to someone starting up a company,” says one tech entrepreneur based in the city.

Schultz and others interviewed for this report believe that while VC firms elsewhere are largely focused on high-tech companies, including many early stage firms, investors in New York are more interested in bigger and safer bets. “In the New York City area, the money tends to gravitate toward hedge and buy-out funds,” says Schultz.

Overall, companies in the New York metro attracted just under \$1.9 billion in venture capital investments in 2008.<sup>88</sup> While that isn’t peanuts, New York ranked fourth among all regions in the country in VC investments, well behind Silicon Valley (which attracted \$11.0 billion) and New England (\$3.3 billion); it also trailed LA/Orange County (\$2.0 billion).<sup>89</sup> (The New York metro area did better in the total number of venture deals. The 308 deals closed here in 2008 puts New York third, behind only Silicon Valley, with 1,170, and New England, with 460.<sup>90</sup>)

In addition, a comparatively small share of the VC money that does get invested here goes into high-tech and biotech businesses. For instance, in the first two quarters of 2008, only two percent of all the venture capital deals in the five boroughs went to firms in the biotech sector—compared to 33 percent of all VC deals in San Diego, 30 percent in the Boston region and 16 percent in the Philadelphia area.<sup>91</sup> The share of all VC deals going to software firms was also lower in New York City (19 percent) than other leading tech regions, including Washington, DC (36 percent), Boston (29 percent) and Silicon Valley (25 percent).<sup>92</sup> Perhaps not surprisingly, a disproportionately high number of VC deals in the five boroughs are with companies in the finance, media and entertainment sectors. The share of VC deals going to finance companies in New York (seven percent) was considerably higher than every other leading tech center, including Silicon Valley (two percent), San Diego (one percent) and Boston (zero percent).<sup>93</sup>

In addition to fewer overall investments in technology businesses, New York's meager number of VC firms specializing in tech start-ups deprives the city of a crucial source of expertise and leadership that could be useful in growing a larger cluster. "VC's provide glue for the community in terms of the networks formed among deals they've invested in and support of the local community," Charlie O'Donnell, a New York-based tech entrepreneur, wrote on his blog *This is Going to Be BIG* in August 2008. "Unfortunately, we don't have much of that in New York City. If you're an early stage technology company, you're going to [VC firms] Union Square Ventures, Greycroft, Venrock, DFJGotham, SAVP, RRE, Softbank...and who else? These are good firms, but they don't represent enough of a critical mass—a mafia, if you will—to attract companies and talent here from the outside the way VC firms in the Valley do."<sup>94</sup>

While some entrepreneurs complain that VC firms aren't as invested in the local technology community as they should be, some investors say that they're not getting phone calls and business plans from scientists at local research institutions. David Rose, chairman of the New York Angels, the city's leading early-stage investment group, said that less than half the investments his group made between 2005 and 2007 were with New York companies. And few of the applications his group receives emanate out of university research.

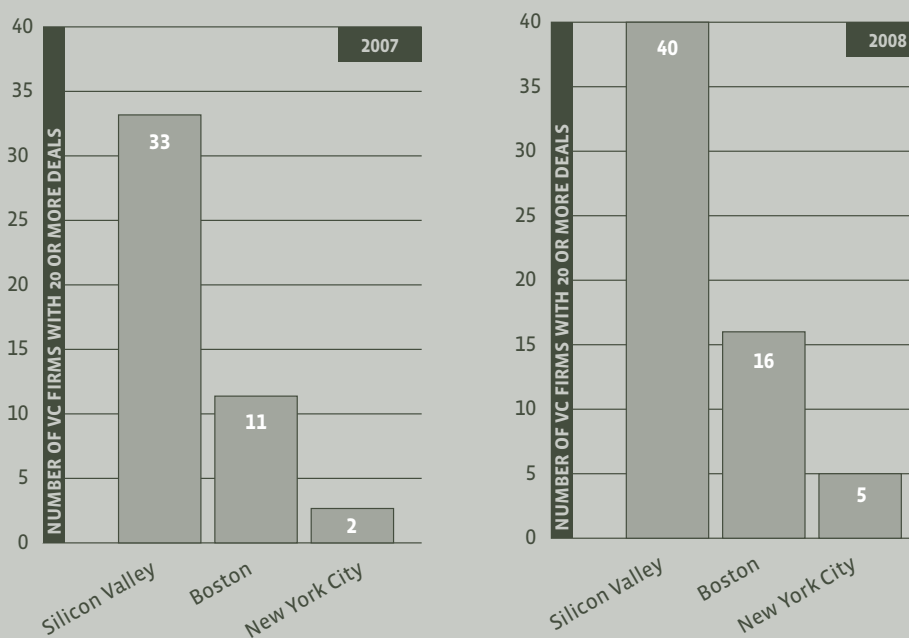
"We know for a fact that there are more deals in New York than we're getting," he said in 2007. "We'd love to get more deal flow and so would the VCs."

The 75 members of New York Angels invested more than \$25 million between 2002 and 2008, making it the most active group of its kind in the region. Yet incredibly, it has had little interaction with the city's tech transfer offices. "What we mostly see is stuff coming out of the business schools," Rose said. "But I know for a fact there is cutting-edge tech here. I've seen the stats: The tech transfer offices are filing tons and tons of patents. We never see any of that. We haven't seen a single deal come out of the universities of New York, out of their labs."

David Lerner, director of the Columbia STV Venture Lab, states that his office has increased networking opportunities between its scientists and local investors, and that entrepreneurs at a majority of the school's ten start-ups per year receive introductions to VCs and angels. In 2008, for instance, Columbia Science and Technology Ventures brought in David Rose to speak to the university's aspiring entrepreneurs about "pitching to angel investors."<sup>95</sup> But Lerner admits that Columbia, and New York as a whole, has room for improvement when it comes to finding funding for its scientific capital. "We don't have the culture of a Silicon Valley," says Lerner. "We are ten, fifteen years behind them ... in terms of venture deals."

Source:  
PricewaterhouseCoopers  
and the National Venture  
Capital Association,  
"MoneyTree Report," 2007  
and 2008.

**MOST ACTIVE VC FIRMS BY LOCATION, 2007 & 2008**



# Leaving Money On the Table

A shockingly small number of New York City-based entrepreneurs have taken advantage of two federally-funded grant programs that provide early stage financing for fledgling technology firms

THE FEDERAL GOVERNMENT HAS A PAIR OF competitive grants that help fledgling businesses commercialize new technology: the Small Business Innovation Research (SBIR) program and Small Business Technology Transfer (STTR) program. Begun in 1982, both

Bay area (322), the Los Angeles area (454) and the Boston area (652).<sup>97</sup>

New York City fared no better with the STTR program. The city received only seven of the 37 STTR awards dispersed statewide in 2006 (19 percent).

In 2006, New York City received just 43 of the 249 SBIR awards handed out statewide (17 percent). Meanwhile, only seven of the 37 STTR awards dispersed statewide (19 percent) came to recipients in the city.

programs are designed to bring an entrepreneurial spirit to research and development by funding start-up companies. The grants can be incredibly useful to entrepreneurs who have not yet secured venture capital funding. Unfortunately, an appallingly low number of businesses in New York City are taking advantage of these programs.

SBIR dispenses grants that enable businesses to explore the commercial potential of an innovative technology, product or service. STTR does the same thing for small companies working in partnership with nonprofit research institutions. Each program has two levels of grants: Phase I, up to \$100,000, and Phase II, up to \$750,000. In the big picture, those are not large sums. But many small businesses have used them to test and develop products before they are able to attract significant private investment. The grants also bring credibility.

The number and amount of SBIR and STTR grants given to companies in a state or region is usually a good indication of the level of innovation occurring within that state. If that is the case, New York City clearly isn't doing something right.

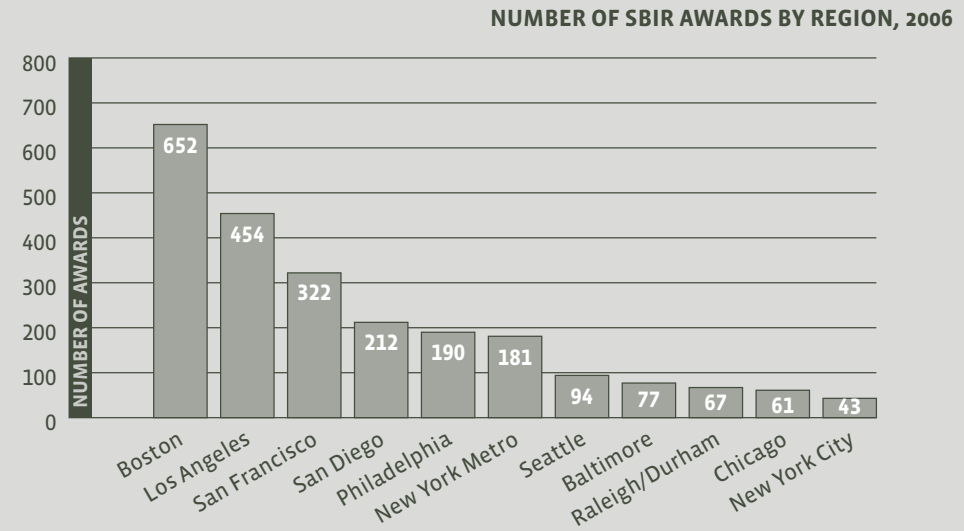
In 2006, New York City received just 43 of the 249 SBIR awards handed out statewide (17 percent).<sup>96</sup> The city accounted for less than a quarter of the total for the metro region (181 awards), which was itself a fraction of the number going to the San Francisco

The total for the metro region was slightly higher (25 awards) thanks to 12 grants awarded in Northern New Jersey and six for Westchester and Long Island. Most other leading tech centers received more STTR awards, including Boston (92), Los Angeles (52), San Francisco (33) and San Diego (27).<sup>98</sup>

The low numbers illustrate the absence of an entrepreneurial culture at the city's leading research universities and medical institutions, which should be working to gain a larger share of the grants. It also suggests that entrepreneurs here either don't know about the programs, get little help negotiating the application process or face bureaucratic hassles when approaching a university. In fact, New York State has a high approval rate for its SBIR and STTR grant applications; the problem is that the number of applications is relatively low.

"I think the numbers would go up if there were more universities proactively looking to partner with small businesses," says Franklin Madison, technology program director at the Industrial + Technology Assistance Corporation, a local nonprofit whose mission includes helping businesses access SBIR and STTR grants. "The biggest hurdle for these businesses is having access to the strategic partners. It'd be helpful if the universities would make themselves more accessible to businesses looking to partner with them on SBIR/STTR grants."

Source: U.S. Small  
Business Administration



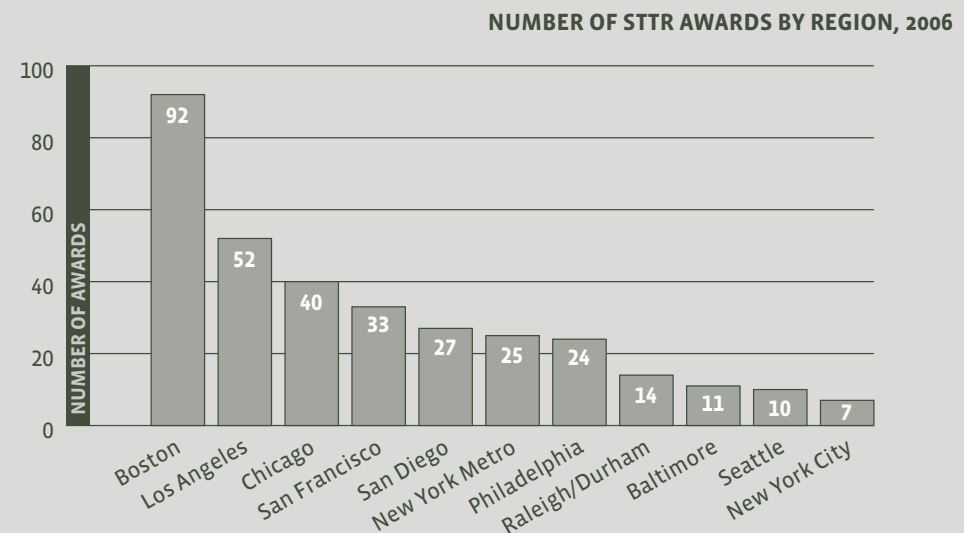
Columbia did conduct an SBIR seminar in partnership with ITAC last year, an important step. But this was a one-time event, whereas institutions in other regions do events like this regularly.

The key need now is for greater receptivity on the part of the city's universities when small businesses approach them about partnering on a project. "First, the universities need to have a list of researchers who would love to do an SBIR/STTR project," says Madison. "Then they need to get the business owners in

a room with them to meet, mingle and discuss how to commercialize their intellectual property. And if something results, they need to act quickly because businesses need to be agile."

The tech transfer offices are the logical place to make that scenario happen. But as noted elsewhere in this report, they would be vastly helped by resources and a mandate from the office of the university president. "The push has to come from the highest level," Madison adds.

Source: U.S. Small  
Business Administration





## BEST PRACTICES

### **CONNECT: SEEDING SAN DIEGO'S HIGH-TECH ECOSYSTEM**

#### **WHAT IT IS:**

An independent organization that over the last 24 years has been instrumental in building a cluster of biotech companies in San Diego. CONNECT is the brainchild of small group of academic scientists and business leaders who believed that the research occurring in the area's first-rate institutions—the UC-San Diego School of Medicine, Jacobs School of Engineering, San Diego Super Computer Center and the Scripps and Salk Institutes—could seed a cluster of high-tech companies that would grow and compensate for the sharp decline in the local defense industry, long a pillar of the San Diego economy.

Before CONNECT was established, the local business community knew that nearby institutions were producing a wealth of scientific innovation but possessed few mechanisms for bringing it out to market. CONNECT began with the task of creating linkages between academia and industry, investment firms and entrepreneurs, as well as specialized providers like patent attorneys, marketers and accountants. Interactions led to business opportunities, which led to further research. Much of San Diego's biotech success has sprung from the constant round of networking and mentoring that CONNECT triggered and continues to make happen.

#### **HOW IT WORKS:**

CONNECT conducts outreach to regional universities and research institutions to help investigators evaluate the commercial potential of their discoveries, negotiate licensing deals and launch companies. They've also taken a lead role in bringing together entrepreneurs and investors, scientists and engineers and movers in government and industry to create a flourishing ecosystem of several thousand high-tech, software and life science companies. It has a board of directors and 14 staff members who work with 220 member companies and institutions. It also has 2,000 volunteers who mentor companies and serve on CONNECT committees. CONNECT supports itself through membership dues, course fees and corporate underwriting for specific programs—not government money.

#### **RESULTS TO DATE:**

Over the years, it has assisted more than 800 technology companies, including wireless giant Qualcomm.

### **MIT: PROMOTING ENTREPRENEURSHIP AT EVERY TURN**

#### **WHAT IT IS:**

Commercialization of research is not an activity limited to the tech transfer office, as it is at many schools. At MIT, more than a quarter of the student body is taking a class in entrepreneurship at any given time; the Sloan School of Management, with its 750 students, provides ideas and services to university researchers; the Enterprise Forum conducts entrepreneurial workshops, meetups and conferences on campus and through its chapters across the country; the Venture Monitoring Service, run by a pair of alumni, annually connects 100 business mentors with students and faculty at the school. The tech transfer office is able to concentrate on core concerns like helping researchers obtain patents and negotiating licensing and material transfer agreements. While some deals produce a lot of money for the school, the larger benefit is that the office is allowed to break even over time, which frees it to work on producing a high volume of patents, licenses and start-up companies.

#### **HOW IT WORKS:**

Among MIT's greatest assets are an entrepreneurial mindset and institution-wide drive to prove its technologies in the marketplace, which are things New York research centers could use more of. For example, MIT has a program, the Deshpande Center for Technological Innovation, that focuses solely on accelerating the process of turning new technologies into start-ups. It started in 2002 with a \$20 million gift from an MIT alumnus. It also receives financial and professional support from alumni, entrepreneurs and investors. The Center makes grants of up to \$100,000 to scientists for "proof-of-concept" research—taking a promising technology and advancing it toward marketability at a stage when it is normally very difficult to find funding for such work.



**RESULTS TO DATE:**

According to the Deshpande Center's Web site, it "has funded more than 80 projects with over \$9 million in grants. Eighteen projects have spun out of the center into commercial ventures, having collectively raised over \$140 million in outside financing."

**STANFORD: VOLUME, NOT DOLLARS, DRIVES TECH TRANSFER****WHAT IT IS:**

Stanford has two main programs—the Center for Entrepreneurial Studies in the business school and Stanford Technology Ventures in the engineering school—for tech transfer, which is less than one might expect and certainly less than the menu of programs at MIT. School officials explain that there is no single correct way to create an atmosphere conducive to commercializing technology. "We're two miles away from Sandhill Road," says Katherine Ku, the director of Stanford's tech transfer office, referring to an area of Palo Alto that is home to hundreds of VC firms looking to back emerging technologies, especially if they come from a Stanford science department. "There are so many people around who have started companies and been successful. They do the mentoring of start-ups. And there's so much networking that occurs without our help. It's true that Silicon Valley is one big business incubator."

**HOW IT WORKS:**

With all those nearby investors competing for Stanford's technology, Ku could push scientists—who can't get that money until they secure a licensing agreement—into signing deals that favor the university, but she chooses not to do so. "We always say that we're involved in very long term relationships," she explains. "Let's say we get max dollars out of a licensing deal and the inventor goes away mad. That company might never want to do business with us again. These are students and grads who might one day become rich and famous. You don't want them to get upset, because someday they'll become donors to the university." As an example, consider the \$400 million gift that William Hewlett, founder of Hewlett Packard and Stanford class of 1934, gave to the school in 2001.

One more recent benefit of Stanford's approach came when the founders of Google originally tried to license their search engine technology to an existing company but nobody wanted it. Ku recalls, "[The founders] were frustrated and wanted to start their own company. We said, 'Fine.' We weren't greedy about the up-front fee. We took equity."

**RESULTS TO DATE:**

Stanford takes in more than 400 invention disclosures a year and annually spends more than \$6 million to file and maintain patents on about 60 to 70 percent of their 2,500 currently active portfolio. They then license 40 percent of those technologies, earning royalties of \$50 to \$60 million a year and produced 10 start-ups in 2006-07.<sup>101</sup>

While Ku maintains that there are limits to Stanford's emphasis on commercializing its discoveries, she also understands

that the university is part of an entrepreneurial "habitat" that presents tremendous opportunities for innovators to create the next great company. "We just try not to perturb it," she says.

**BEN FRANKLIN TECHNOLOGY PARTNERS: INVESTING IN EARLY STAGE TECH FIRMS IN PHILADELPHIA****WHAT IT IS:**

Investment in early-stage companies is inherently risky. This explains why over the past several years many angel and VC groups have increasingly shifted their money away from early-stage companies, making seed money increasingly harder to come by for start-ups. But this shift carries a risk as well: that more companies will die on the vine, even if they have a worthy technology to commercialize.

To guard against this risk, over the last 25 years Ben Franklin Technology Partners, a Pennsylvania state initiative, has invested \$16 to \$20 million a year in early-stage companies, plus whatever it has earned in the previous year from such investments. Four governors, from both parties, have maintained the state's support. "The founding principle was that there is a lot of knowledge and innovation laying around the universities that need to be brought out of the lab and into the marketplace," says Terry Singer, Ben Franklin Technology Partners' director of statewide affairs. "That, and we always need to diversify our economy."

**HOW IT WORKS:**

The process is managed by volunteer teams of experts in finance, university research, various technology sectors and intellectual property. Notable successes include companies AccuWeather; OraSure Technologies, which makes orally-based diagnostic tests, including a rapid HIV test; and Vivisimo, a software company that helps users organize online search results.

The program works extensively with the state's seven large research universities to identify promising technology. In the words of Singer: "We coordinate and collaborate very, very closely with the universities in terms of knowledge and innovation transfer and working to spin out companies."

**RESULTS TO DATE:**

Ben Franklin has not earned back all the money it has invested, but its investments have stimulated local economic development. An independent study found that Ben Franklin Technology Partners had created or retained 46,500 jobs since 1988, paying wages that are 28 percent higher than the state average, and that the program's direct and indirect economic impact between 1989 and 2001 was \$8 billion. The study also concluded that additional state tax revenue generated by that activity more than covered the cost of program.

With the VC market increasingly risk-averse, Ben Franklin is designed to serve as a bridge from a company's inception to the point where it can draw later-stage private investment. For example, companies in which the program invested between 2004 and 2006 went on to raise more than \$1.1 billion in private funding.

# A Tech Strategy for NYC?

The Bloomberg administration has taken promising steps to support entrepreneurs and grow a tech sector, but more could be done to help turn the city's research institutions into an economic engine

IT MIGHT HAVE TAKEN THE IMPLOSION OF SEVERAL Wall Street giants and the prospect of long-term job losses in the finance sector to press them into action, but city economic development officials are finally taking meaningful steps to support technology-based entrepreneurship in New York. Though these efforts are as refreshing as they are overdue, they represent only the beginning of what will be needed to help harness the economic potential of the city's academic research institutions and grow an "innovation economy" in the five boroughs.

For years, city economic development policies largely served to foster growth in traditional industries like finance and media, with initiatives designed to retain major corporations and encourage large-scale real estate projects. Local economic development officials spent little energy or focus on nurturing start-up technology companies, helping to cultivate a more entrepreneurial ecosystem or devising strategies to harness the economic potential of the city's academic research institutions. "The city has never really understood or been interested in technology-based economic development or the innovation economy," said one New York-based economic development official in an interview in mid-2008.

Fortunately, this approach to economic development has begun to give way to a more proactive stance.

In February 2009, in response to the shockwaves set off by the Wall Street meltdown, Mayor Bloomberg unveiled a series of promising initiatives to support entrepreneurship. The administration's new programs include at least two new incubators for start-up companies, where fledgling ventures will be able to sublease space at inexpensive rates while having access to mentoring services and business seminars provided by entrepreneurship experts from Polytechnic Institute of NYU. The mayor's entrepreneurship agenda also features a new city-funded angel fund, overseen by private fund managers, to provide early-stage financing to 250 New York-based start-ups over the next eight years, and a "VC Connect" online in-

formation portal designed to create a central clearing house and support network for entrepreneurs and startup companies.

These new city projects substantially build upon a handful of other key policies and projects initiated by the Bloomberg administration. In June 2008, the administration announced the creation of a new \$2 million seed fund for early-stage information technology and digital media companies in the five boroughs. The new entity, called NYC Seed, is a joint venture of the city's Economic Development Corporation (EDC); the New York City Investment Fund; Polytechnic Institute of NYU; the New York State Foundation for Science, Technology and Innovation (NYSTAR); and ITAC. As of May 2009, NYC Seed had made two \$200,000 investments—with Path 101, an online career development site, and PlaceVine, a Web-based product placement service.<sup>99</sup> The fund is small—\$2 million can only go so far when each investment is for around \$200,000—but it should help a handful of local technology firms to address the financing hurdles common to tech startups here, and could signal to entrepreneurs in the city and across the nation that New York is becoming a more supportive environment for technology firms.

The administration's recent focus on tech ventures represents a worthy if overdue follow-up to steps Mayor Bloomberg took earlier in his tenure to expand the city's biotech sector. Hardly a blip on the city's radar before 2002, biotech soon emerged as a key part of Bloomberg's strategy to diversify New York's economy. Under his leadership, EDC created a bioscience desk with three full-time staffers, two of whom came directly from the sector. The team reached out to most of the bioscience firms across the city and stepped up efforts to promote New York within the industry as a hub of innovation and a good place to do business. Additionally, top EDC officials have flown around the world attending conferences and meeting with bioscience CEOs to send the same message.

Even more important, EDC pushed through a project crucial to New York City's hopes to jump-start

a true bioscience cluster: the development of a major bioscience research park. The city's decades-long lack of commercial wet lab facilities has prompted many fledgling companies to go elsewhere. But in 2005, EDC struck a deal with the country's leading developer of biotech facilities, Alexandria Real Estate Equities, to construct the East River Science Park, a major new facility at the site of Bellevue Hospital Center in Manhattan. When it's fully built, the facility will add 1.1 million square feet of lab space—a nearly tenfold expansion of a local inventory previously limited to 100,000 square feet at the perennially booked-up Audubon Business and Technology Center in Upper Manhattan, which opened in 1995, and the 24,000 square feet at the SUNY Downstate Advanced Biotechnology Incubator in Central Brooklyn.

The city provided the land for the new development, but Alexandria has assumed the lion's share of the financing for the \$400 million project. The first building is now under construction and is scheduled to open by the end of 2009. EDC has also smartly backed BioBAT, a bioscience research park now being developed at the city-owned Brooklyn Army Terminal in Sunset Park that could ultimately bring another 450,000 square feet of commercial lab space.

"In the four years I've been at Poly, I've seen a significant increase in the eagerness of New York City business leaders and the mayor's office in joining the science and technology of the city's universities with entrepreneurship and venture capital," says Jerry Hultin, president of Polytechnic Institute of NYU. "This has been very exciting for our students and faculty, because it's meant that they can create companies and pursue inventions and ideas all the ways from the laboratory bench to the doors of a customer. It's exactly the right way to build an entrepreneurial capacity for New York City that can match the power of Silicon Valley and [Boston's] Route 128 [Corridor]."

These city efforts represent a meaningful break from the past. But most of the Bloomberg administration's initiatives are still at a very early stage, and will need sustained support even after the finance sector rebounds. And a major piece remains missing: the connective tissue that can link researchers and would-be entrepreneurs with investors and executives who have the knowledge and experience to guide their business ideas to prosperous fruition.

One step the city could take in this direction is to follow the example of state and local governments

around the country that have devoted time and resources to building a community of innovative technology entrepreneurs. The new civic entities that emerged from their efforts have helped to bridge gaps between local scientific institutions, forge stronger linkages between scientists and investors and push universities to be more entrepreneurial in their approach to technology transfer. Organizations such as Innovation Philadelphia, the Massachusetts Technology Transfer Center (MATTCenter) and CONNECT (begun at the University of California-San Diego) have succeeded in creating "connective tissue" between scientific researchers and the business community—linkages absent in New York and most other regions outside of Silicon Valley. Their programs have helped regional economies to register gains in capitalizing on innovations coming out of local research institutions.

Innovation Philadelphia, for example, was begun in 2001 by Dr. Judith Rodin, then the president of the University of Pennsylvania and now head of the New York-based Rockefeller Foundation, in collaboration with local companies like Comcast and GlaxoSmith-Kline and funded with \$2.5 million in seed capital from the city of Philadelphia. The new entity set and achieved specific goals, such as increasing the number of companies emerging from research at Philadelphia universities from seven to 25 per year and doubling the amount of annual Small Business Innovation Research (SBIR) award money going to firms in the city from \$25 million to \$50 million.

The MATTCenter, created in 2003 by Massachusetts' legislature and governor, works with more than 30 university tech transfer offices to help launch startups in the state. The center has helped more than 20 companies to launch, acquire financing and forge industry partnerships.<sup>100</sup> It also organizes conferences in fields like nanoscience at which faculty researchers with patented technology and university-generated startups pitch their ideas to investors. "The conferences get high volume compared to what schools can do on their own," says center director Dr. Abigail Barrow.

New York City has no comparable "innovation intermediary" to help grow its tech sector, and neither of the city's economic development agencies—EDC and the Department of Small Business Services (SBS)—has the mandate or means to grow the tech sector from the ground up in New York. High-tech analyst David Hochman, among others, believes that noth-

ing less than a New York City version of CONNECT or MATTCenter will have the capacity to tackle the complex task of building tech industry clusters here. “EDC is a business recruitment agency, not a nurture-your-sector agency, and SBS works with dry cleaners and bodegas. Realistically, they’re not going to have a lot of time for technology entrepreneurs,” says Hochman. “What’s needed is an office that builds linkages and structures to grow and retain the city’s own technology businesses, and not just in the life sciences. We need an office willing to interact intensively with the universities—to be in their face all the time—and to court the entrepreneurial community.”

Several leading technology experts believe that City Hall should be leading the effort to create such an entity, with city money possibly helping to seed its creation. EDC took a tentative step in this direction in 2003, when it developed an initiative designed both to

increase the number of start-ups coming out of the innovative life science research at city institutions and to create a supportive climate for those new ventures to prosper. Under the proposal, called “Catalyst,” EDC would have worked more closely with the city’s scientific research institutions to develop entrepreneurs and, like MATTCenter, made small grants to startups while helping their founders hone business plans and prepare for pitch sessions with VCs.

Unfortunately, the program never got off the ground and now appears to be dead. To be sure, the idea wasn’t without its flaws. One concern was that Catalyst would have focused solely on bioscience, rather than supporting new ventures across the full breadth of scientific research emanating from city institutions. But many tech experts in New York saw it as a critical start, and its abandonment left a void that remains unfilled six years later.

## PORTAL COMBAT

Intellectual capital developed by academia is a hot commodity in the innovation economy: university patents are acquired, licensed, cross-licensed and even sold at auction. Is it any surprise, then, that a successful technology state like Massachusetts has pioneered a Web portal to consolidate and display ideas in its academic R&D pipeline? Or that New York State has fallen behind in an effort to copy it?

The Massachusetts Technology Portal, launched in 2005, is an easily searchable database of licensable technologies from 17 research institutions in Massachusetts. Previously, if a venture capitalist or scientific investigator was looking for research relevant to an emerging market or field of study, he or she would have to search the websites of individual institutions for information that was often hard to find or, in some cases, not publicly available.

The Portal solved the problem by deploying a “spider” program to reach into computers at participating schools and download their latest breakthroughs. The information, updated daily, is available to anyone with a computer. Now VCs and investigators can efficiently search the state’s promising technologies, which has led to greater scientific collaboration and investment in emerging technology.

To give a hypothetical example, a nanotechnology researcher at MIT with an idea for developing a sustainable building material could visit the Mass Tech Portal and find that a Harvard researcher has already done half the needed work with a federal grant. The MIT researcher might still decide to forge ahead on his own; but knowing about the Harvard research at least gives him the option of seeking a licensing deal between the two universities, or even a partnered spin-off.

The Mass Tech Portal averages about 2,000 hits a month. It also compiles valuable search origin data, such as the number of searches performed by in-state vs. out-of-state users and which countries are paying the most attention to Massachusetts research. A portal administrator says each of the participating institutions initially plunked down \$300 to buy and install the necessary software at their end.

Since 2000, New York State officials have talked about creating a similar vehicle for collecting and promoting state research. At one point, it appeared that the state was making real progress. In August 2006—nearly three years ago—the State University of New York (SUNY) and the state Commission on Independent Colleges and Universities (CICU) held a press conference to announce that they would develop the Knowledge 4 NY online portal to connect New York’s higher education resources with businesses and investors. But the project has encountered numerous obstacles and is still far from coming to fruition. “It’s hit several snags that I can’t talk about,” says a SUNY official who wished not to be identified. In May 2009, SUNY finally issued a Request for Proposals (RFP) soliciting bidders to build out the portal.

# Is High-Tech a Low Priority in Albany?

State economic development officials could be doing far more to support the growth of a meaningful technology sector in the five boroughs

GOVERNOR DAVID PATERSON CAME INTO OFFICE a few months after a report commissioned by his predecessor called for reorganizing the state's economic development strategy to focus more on developing an "innovation economy." The July 2007 report for the state's Empire State Development Corporation (ESD) by consulting firm A.T. Kearney found that the state has neglected the task of nurturing its tech sector and urged ESD to home in on "New York's rich and diverse assets to encourage the growth of the Innovation Economy, statewide and within every region." The first assets listed were the state's "educational and research institutions."

Unfortunately, the report's strong recommendation that New York fundamentally reshape its economic development strategy to boost emerging technology sectors has not prompted much state action.

To his credit, Governor Paterson recently unveiled some promising steps that his administration would take to bolster the new economy. In a June 2009 speech, he announced the creation of an Innovation Economy Matching Grants program, in which the state will provide a 10 percent match for every stimulus dollar the federal government awards through competitive grants to academic research facilities in the state. The governor also outlined other initiatives for renewable energy, smart grid technology and scientific research.

While certainly welcome, the governor's proposals weren't as comprehensive as many technology advocates had hoped and didn't detail how the state would follow through on the recommendations of the Kearney report. Indeed, it's still far from apparent that Paterson and his top economic development advisors will usher forth a "complete overhaul" of ESD, as the Kearney study recommended, or make the innovation economy a central part of the state's economic strategy.

ESD has deeper problems. As of June 2009, the agency has gone more than a year without hiring a downstate president, the person who is supposed to oversee initiatives in New York City and the surrounding region. "ESD is completely paralyzed since

last summer," says one knowledgeable official. "Nothing is getting done. They haven't been moving [on the Kearney report's recommendations]."

Another longstanding problem is that most of the resources committed by ESD over the past decade to support technology-based economic development have been spent outside the five boroughs. Since 2001, the state has committed \$586 million in funds to create six Centers of Excellence to encourage the commercialization of scientific breakthroughs in areas such as nanoelectronics, bioinformatics, photonics and information technology—but none of them are in New York City. "There's been a lot of investment outside of the city, but not a lot in New York City," says one local economic development expert.

New York has made sporadic but occasionally significant efforts to support technology-based economic development over the past few decades. In 1983, the state established the Centers for Advanced Technology (CAT) program to encourage technology-based applied research and economic development and foster greater collaboration between the state's universities and industry. There are now 15 CAT centers across the state, including three in New York City. The state also created Regional Technology Development Centers to provide entrepreneurial assistance and help scientists translate academic innovations into business ventures. And beginning in 2001, Governor George Pataki established the Centers of Excellence.

While some of these programs offered real value, most were too small-scale to have a major impact and didn't require sufficient industry participation. Some, like the Centers of Excellence, were not tied into a broader framework for growing technology sectors. And these high-tech initiatives never became a cornerstone of the state's economic development strategy, which remains more focused on supporting large-scale development projects and providing financial incentives to large employers—typically in "old economy" sectors—than on nurturing the growth of emerging industries.



# RECOMMENDATIONS

New York City's leading academic research institutions have the potential to be an integral new source of sustainable job growth in the years ahead and a major component of efforts to diversify the city's economy. But much still needs to be done to realize the full potential of the city's research institutions and develop a vibrant innovation economy. As the following recommendations detail, it will require the leaders of the city's universities and nonprofits as well as city and state policymakers to build upon some promising efforts already underway and, in many areas, break with old ways of doing business.

## UNIVERSITIES AND NONPROFIT RESEARCH INSTITUTIONS

**Strengthen and expand local engineering programs.** The presidents of Columbia, NYU and CUNY should dedicate new funds to increase the number of engineering faculty, attract more top students and commit more of their overall R&D budget to engineering—with the goal of creating at least one first-rate engineering program in the five boroughs. For too long, engineering has been a relatively low priority among the city's academic leaders. The recent merger between NYU and Polytechnic University is a good sign that things are moving in the right direction, but this in itself is not enough.

**Make it a clear institutional priority to convert scientific research into start-up ventures.** The leaders of each of the city's scientific research institutions should send a strong message to their deans, technology transfer officers, faculty and students that the commercialization of research into newly formed start-ups is a desired outcome—on equal footing with licensing technologies to existing companies. They should back up this policy by doing more to support scientists that wish to go the start-up route, such as setting up or expanding proof-of-concept centers, giving faculty time off to pursue business opportunities and signing reasonable licensing agreements with researchers.

**Promote and support a more entrepreneurial culture among faculty and post-doctoral researchers.** The leaders of the city's universities and nonprofit research centers should take a page from MIT and initiate a series of measures aimed at creating a more entrepreneurial mindset among their scientists. While some of the city's institutions have already taken several positive steps in this direction, most could do more. The institutions should offer courses in entrepreneurship, writing business plans and how to access financing—and routinely bring in outside tech entrepreneurs, angel investors and industry leaders to provide advice and share ideas. The city's universities could also create stronger linkages between their scientists and the students and faculty at their business schools.

**Place a greater emphasis on spin-offs that aren't researcher-led.** Not all scientists are interested in or capable of forming a start-up venture to commercialize their research. But that doesn't

mean that their research discoveries can't be spun off and developed by other tech entrepreneurs. The city's research institutions should commit to get promising technologies into the hands of local entrepreneurs who would lean on the faculty inventor for scientific advice but use their own know-how and drive to bring a technology to market.

**Bolster technology transfer offices.** Several of the city's tech transfer offices have made strides in recent years, but many of them could benefit from additional resources and more institutional support.

**Strengthen ties between tech transfer offices and the city's investment community.** New York's tech transfer officers must develop closer relationships and regular partnerships with angel investors, venture capitalists and other local investors who might be interested in funding new technology ventures.

**Create a public policy center at a university focused on the growth of the local technology-based economy.** New York's efforts to develop a large, sustainable technology sector would benefit from the creation of a local policy center devoted to data gathering and policy analysis focusing on the growth of the region's tech economy. This center, which requires institutional commitment and faculty recruitment, would provide a regular spotlight on the city's progress in building a tech sector and capitalizing on New York's scientific assets.

## CITY GOVERNMENT

**Establish an innovation intermediary—perhaps called Innovation NYC.** As this report has detailed, New York City has no shortage of scientific talent. Where it falls short is in providing an environment in which networking among scientists, engineers, investors, entrepreneurs, business executives, tech transfer officials and intellectual property lawyers is common and expected. Casual encounters of this sort are often where ideas are honed, collaborations are hatched and deals struck. City economic development officials would be wise to help launch an innovation intermediary that could take the lead in fostering these linkages among the individuals and institutions that are important to the development of a self-sustaining tech cluster. It could start by duplicating the successes of entities like the Massachusetts Technology Transfer Center. Once established, the entity could be supported by research institutions, entrepreneurs, business groups and member fees.

**Make science and technology a priority in economic development.** The Bloomberg administration deserves significant credit for undertaking a comprehensive effort to support and grow the city's bioscience industry, but until very recently it largely neglected other emerging technology sectors and did little else to leverage the city's considerable science and tech-

nology assets for economic development. City economic development officials should continue and expand recent initiatives like NYCSeed, the new city-funded angel fund and the VC Connect information portal. They also should consider establishing a science and technology desk at EDC to support all technology sectors that have the potential for growth in New York, from cleantech to gaming.

**Leverage city support to get New York's academic research institutions to support local technology spinoffs.** The city often provides crucial support to academic research institutions, through specific zoning policies and tax benefits. While the city undoubtedly benefits from the activities of these institutions, policymakers should expect more from the institutions. One way to leverage city assistance is to get the institutions to ramp up their support for local spinoffs.

#### STATE GOVERNMENT

**Reorganize the state's economic development agency to include a greater focus on growing the innovation economy.** Governor Paterson recently announced a promising plan to provide Innovation Economy Matching Grants as a way of maximizing federal stimulus dollars for the state's research institutions, but the state still needs a much more comprehensive strategy to bolster New York's tech sector. The Paterson administration should start by implementing the recommendations of the 2007 report conducted by consulting firm A.T. Kearney, which called upon the state to overhaul its economic development agency, Empire State Development (ESD), and

institute a new approach with much greater emphasis on supporting the innovation economy. The recommendations, which include "partnering with academic institutions and private sector firms to build up activity with and among Innovation Economy businesses," have not yet been implemented, in large part due to the early departure of then-Governor Spitzer and internal turnover at ESD.

**Expedite the launch of Knowledge 4 NY, a long-awaited online portal that would provide scientists, investors and businesses with updated information about the state's scientific resources and patented technologies.** State officials should accelerate the development of the Knowledge 4 NY portal, which was proposed nine years ago and funded with more than \$2.5 million but still hasn't seen the light of day. By contrast, the Mass Tech Portal, started by the state of Massachusetts for far less money, has been up and running since 2005 and averages 2,000 hits a month—mostly from VCs and scientists looking for opportunities to invest or collaborate scientifically. Nothing beats one-stop-shopping for that kind of information, currently scattered among the Web sites of New York's research institutions—when it's available at all.

**End the practice of steering the lion's share of state funding for science and technology development to areas outside of New York City.** A statewide strategy to grow the innovation economy will have little success if it excludes New York City. Unfortunately, this has been the pattern for much of the last decade.

## NEW YORK CITY'S FIRST-EVER INNOVATION INDEX

This study is accompanied online by New York City's first-ever Innovation Index, a compendium of data that demonstrates where New York stands compared to other cities and regions on a broad range of indicators measuring both existing science and technology assets and the city's level of success at commercializing these assets. Our Innovation Index includes more than 45 charts that measure how New York City institutions stack up against institutions in other regions on everything from the number of members of the New York Academy of Sciences to the amount of R&D expenditures made in fields such as environmental sciences, physics and mathematics. It also examines how the city institutions have fared in R&D funding by the federal government, state and local governments and industry. And it includes detailed breakdowns of how New York City institutions have done in technology transfer compared to institutions located upstate and in the rest of the downstate region. The Center's full Innovation Index is available at [http://www.nycfuture.org/images\\_pdfs/pdfs/InnovationIndex.pdf](http://www.nycfuture.org/images_pdfs/pdfs/InnovationIndex.pdf)

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13. Ibid.
14. Center for an Urban Future analysis, using data from National Science Foundation/Division of Science Resources Statistics, Survey of Research and Development Expenditures at Universities and Colleges, FY 2006.
15. National Science Foundation/Division of Science Resources Statistics, Survey of Research and Development Expenditures at Universities and Colleges, FY 2007. While our figure for New York City (\$90 million) is low compared to other leading regions, the actual amount of engineering R&D expenditures in the city is likely even lower. We counted \$31 million in spending by Cornell, which is 40 percent of the school's engineering R&D expenditures. We used the same 40-60 allocation for Cornell in all R&D calculations for this report, at the suggestion of school officials, since its medical school is in Manhattan. This provides a decent estimate for some research areas, but not engineering; most of Cornell's engineering research occurs in Ithaca. Without including the \$31 million from Cornell, New York City's engineering R&D total would be a meager \$59 million.
16. Association of University Technology Managers (AUTM), "U.S. Licensing Activity Survey: FY 2007." NYU's high licensing income figure was largely due to the \$650 million sale of an undisclosed portion of its worldwide royalty interest in Remicade, the monoclonal antibody that was derived from discoveries made by NYU scientist Jan Vilcek.
17. Ibid.
18. AUTM, "U.S. Licensing Activity Survey: FY 2007." Boston's much larger total is in large part a result of having institutions that produce a high number of start-ups; MIT alone spawned 24 start-ups in 2007. But Boston's total also comes from 11 universities and nonprofit research institutions reporting data to AUTM, compared to just five in New York City. Our start-up total for New York (21) does not include Rockefeller University, which did not allow AUTM to publish their data, or Weill Cornell Medical Center. Cornell University produced 2 start-ups in 2007, but it is not clear how many of those emanated from research at its Manhattan medical school versus its main campus in Ithaca. The New York Academic Consortium, a group of the tech transfer offices of the seven major academic research institutions in the five boroughs—including the five we counted in our analysis (Columbia, NYU, Mount Sinai, Sloan-Kettering and Einstein) as well as Rockefeller and Weill Cornell—boasts that the institutions collectively were responsible for 20 start-ups in 2007.
19. Ibid.
20. Ibid.
21. Rockefeller University.
22. PricewaterhouseCoopers and the National Venture Capital Association, "MoneyTree Report: Full-year 2007."
23. Business Facilities magazine, March 2008; "Science and Engineering Indicators 2008," National Science Board: <http://www.nsf.gov/statistics/seind08/>.
24. Center for an Urban Future analysis, using data from National Science Foundation/Division of Science Resources Statistics (NSF), Survey of Research and Development Expenditures at Universities and Colleges, FY 2006. While the NYC metro area is the clear leader among all U.S. regions in R&D expenditures by colleges and universities, the Boston metro area blows away all other regions in total amount of R&D expenditures by nonprofit research institutions. The NYC metro region is defined here as the New York-Northern New Jersey-Long Island, NY-NJ-PA Metropolitan Statistical Area, which includes the five boroughs of New York City along with five other surrounding counties in New York, 12 counties in Northern New Jersey and one county in Pennsylvania.
25. NSF, 2006.
26. Interview with Swedish Consulate, May 2008; Center for an Urban Future analysis of data from the HHMI website, January 2009.
27. HHMI website.
28. National Academy of Sciences membership directory, February 2009.
29. NSF. A seventh New York City institution, Memorial Sloan-Kettering Cancer Center, is among the nation's leaders in R&D spending in the life sciences, but it is not included in NSF's ranking of universities. It is counted as a nonprofit research institution.
30. Ibid.
31. National Institutes of Health. The data we used for the ranking of institutions receiving NIH grants lists university's medical schools separately from their main campuses. If we had combined the totals for both Columbia University Health Sciences (# 16 on the list) and Columbia's main campus (#114), the university's overall ranking would be higher than 16. The same would be the case for NYU; its School of Medicine was ranked 47th and its main campus was ranked 139th.
32. Ross DeVol and Armen Bedroussian. "Mind to Market: A Global Analysis of University Biotechnology Transfer and Commercialization," Milken Institute, September 20, 2006.
33. New York City Bioscience Initiative, NYC Investment Fund.
34. Columbia University Science and Technology Ventures.
35. U.S. News & World Report, "Best Hospitals: Neurology & Neurosurgery," 2008.
36. "The World's Most Influential People," *Time*, 2008.
37. Matthew L. Wald, "A Plastic Wrapper Today Could be Fuel Tomorrow," *New York Times*, April 9, 2007.
38. "Entrepreneurial Impact: The Role of MIT," Ewing Marion Kauffman Foundation.
39. AUTM, "U.S. Licensing Activity Survey: FY 2007."
40. Ibid. As mentioned previously, Boston's total is taken from 11 universities and nonprofit research institutions reporting data to AUTM, compared to just five in New York City which reported data to AUTM.
41. Ibid.
42. Ibid.



43. Rockefeller University.
44. AUTM, U.S. Licensing Activity Surveys 1998 through 2007.
45. Albert Einstein College of Medicine of Yeshiva University Office of Biotechnology Newsletter, Spring 2006.
46. AUTM, "U.S. Licensing Activity Survey: FY 2007."
47. Vivek Wadhwa, Richard Freeman and Ben Rissing, "Education and Tech Entrepreneurship," Ewing Marion Kauffman Foundation, May 2008.
48. Interview with Orin Herskowitz, chief operating officer at Columbia Science & Technology Ventures, Fall 2008. Herskowitz said that 10 of the 84 companies maintain significant operations in New York City. However, our investigation found that only seven of those 10 firms actually remain in New York.
49. Rockefeller University.
50. New York City Investment Fund, "Market Demand Study for Commercial Biotechnology, Biomedical and Bioinformatics Facilities in New York City," February 2001. Jonathan Bowles, Center for an Urban Future, "Biotechnology: The Industry That Got Away," October 1999.
51. 2003 estimates from the U.S. Census; NSF/Division of Science Resources Statistics, Survey of Research and Development Expenditures at Universities and Colleges, FY 2007.
52. NSF, FY 2007.
53. NSF; David Hochman, "Engineering a Tech Sector," Center for an Urban Future, August 2007.
54. NSF.
55. Hochman.
56. U.S. News & World Report, Best Engineering Schools, 2008.
57. Hochman.
58. Ibid.
59. National Science Foundation, R&D expenditures at universities and colleges, by state, control, and science and engineering field, FY 2006. The figure we use here for engineering R&D expenditures in NYC is most likely higher than it really is; for all R&D data, we allocated 60 percent of Cornell University's total expenditures to their Ithaca campus and 40 percent to their medical school in NYC—a formula suggested to us by Cornell officials. However, it's likely that well over 60 percent of their R&D expenditures in engineering occurred in Ithaca.
60. "Buried Treasure: New York City's Hidden Technology Sector 2007," Industrial + Technology Assistance Corporation, Executive Summary, p. 4.
61. The Brooklyn Paper, September 1, 2007: Vol. 30, No. 34.
62. Diane Palminera, Innovation Associates, "Technology Transfer and Commercialization Partnerships," October 2007.
63. AUTM, U.S. Licensing Activity Survey: FY 2007; Rockefeller University website: <http://www.rockefeller.edu/techtransfer/whoWeAre.php>
64. Ben Butkus, "Cornell Medical Debuts 'Startup Boot Camp' To Educate, Motivate Would-Be Entrepreneurs," Biotech Transfer Week, November 19, 2008.
65. Ibid.
66. Milken Institute University Technology Transfer and Commercialization Index, 2000-2004, p. 14.
67. Interview with David Day, director, Office of Technology Licensing, University of Florida
68. "MIT, Caltech—And the Gators?: How the University of Florida moved to the major league of technology startups," BusinessWeek, May 21, 2007.
69. Andrew Mytelka, "Robert Cade, University Researcher Who Invented Gatorade, Is Dead at 80," The Chronicle of Higher Education, November 27, 2007.
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71. Butkus, "Cornell Medical Debuts 'Startup Boot Camp' To Educate, Motivate Would-Be Entrepreneurs."
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73. Ibid.
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77. San Diego Regional Economic Development Corporation: [http://www.sandiegobusiness.org/article\\_template.asp?ArticleID=655](http://www.sandiegobusiness.org/article_template.asp?ArticleID=655)
78. E&B DATA, Greater Toronto Information & Communications Technologies Industry Profile; 2004.
79. "Deloitte Technology Fast 500," November 2008.
80. Our definition of the New York City Metro Region is the New York-Northern New Jersey-Long Island, NY-NJ-PA Metropolitan Statistical Area, which in addition to the five boroughs includes five other neighboring counties in New York State and 13 counties in Northern New Jersey.
81. Massachusetts Biotech Council; BayBio; BIOCUM.
82. Terry Pristin, "AIDS Research Gets a Home at Brooklyn Army Terminal," New York Times, June 20, 2007.
83. Ross DeVol, Perry Wong, Junghoon Ki, Armen Bedroussian and Rob Koeppe, "America's Biotech and Life Science Clusters: San Diego's Position and Economic Contributions," Milken Institute, June 2004. The study's rankings of metro areas are based on two broad factors: the biotechnology innovation—infrastructure that allows a metro area to capitalize on its biotech knowledge and creativity, such as the quality of its workforce and amount of research and development dollars it receives; and the current impact assessment—an area's success in bringing ideas to the marketplace and creating companies, jobs and products.
84. There were 44,700 "computer systems design and related services" jobs. New York State Department of Labor.
85. Silicon Valley Economic Development Alliance.
86. "Buried Treasure: New York City's Hidden Technology Sector," Industrial + Technology Assistance Corporation, prepared by Bayer Consulting and Mt. Auburn Associates, September 2007.
87. PricewaterhouseCoopers and the National Venture Capital Association, "MoneyTree Report: Full-year 2007." The only two New York City firms on the list of most active VC firms in 2007 were Venrock Associates, which completed 47 deals, and Goldman, Sachs & Co., which finished 32 deals. The only other VC firm on the list from New York state, Bessemer Venture Partners, is located in Larchmont.
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89. Ibid.
90. Ibid.
91. PricewaterhouseCoopers and the National Venture Capital Association, "MoneyTree Report," Q1 and Q2 2008.
92. Ibid.
93. Ibid.
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97. Ibid.
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99. [www.nycseed.com](http://www.nycseed.com), "NYCSeed Makes First Investments in New York City Start-Ups," March 2, 2009.
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