building the high-tech future

By Charles A. Gargano

Nearly two centuries ago in New York state, the Erie Canal – from Albany to Buffalo – opened a gateway to the west. Today in New York state, Centers of Excellence – from Albany to Buffalo and beyond – are opening a gateway to the high-technology future.

The Erie Canal required men, horses, equipment, and a plan. The Centers of Excellence have required far more, including a vision for high-technology clusters, building new partnerships among universities, government and businesses; and the ability to attract billions of dollars in investments to create jobs and foster growth.

The Centers of Excellence program began in 2001, when New York State Governor George E. Pataki unveiled a strategy so compelling that, in just a few short years, it has catapulted the state into a position as an international leader in high-technology. The goal was straightforward: establish high-tech clusters around the state to support business and create jobs. As the state's economic development organization that seeks to create and retain jobs, Empire State Development (ESD) worked to bring potential partners to the table. It sought to join government and private resources with the research strengths of the state's universities.

Those in the field recognize that successful economic development involves much more than an inventory of sites with access to water, sewer, and transportation. As important as these tangible items are, successful economic development also requires an understanding of the intangibles: community priorities, zoning regulations, government and industry rules, and the marketplace.

Photo by Darren McGee, New York State Empire State Development.

Albany, New York's Center of Excellence in Nanoelectronics.

In addition, the achievement of long-range success requires knowledge of industrial growth patterns and relies on the involvement of business, government, and citizens alike. The Centers of Excellence program takes this involvement one step further, incorporating the research and development capabilities of the state's universities.

The state established five Centers of Excellence in key geographic locations: Albany, Syracuse, Rochester, Buffalo, and Long Island. Each one has a high-tech specialty. A perfect example of a Center of Excellence's potential for innovation and production is the Center of Excellence in Nanoelectronics, located in Albany. This state-of-the-art, 300-millimeter computer wafer pilot and prototyping facility represents the only one of its kind in the world. This unique and elaborate project, which is being developed in collaboration with IBM, Sony, Advanced Micro Devices, Tokyo Electron Limited, and the

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NEW YORK STATE'S CENTERS OF EXCELLENCE PROVIDE PLATFORM FOR BUSINESS GROWTH AND JOB CREATION

The Centers of Excellence have taken prominence as one of New York state's signature programs of the past decade. Unveiled by New York State Governor George E. Pataki in 2001, this program has catapulted the state into a position as an international leader in high-technology in just a few short years. Overseen by Empire State Development, the state's economic development organization, the program's five high-tech clusters are working to join government and private resources with the research strengths of the state's universities to develop scientific knowledge, new cures and life-saving medicines, and job opportunities for this generation and the next.

University at Albany is leading the state's emergence as a leader in the nanoelectronics industry.

CENTER OF EXCELLENCE IN NANOELECTRONICS, ALBANY

Albany, the capital of New York state, was selected as the site for nanoelectronics for a number of reasons. The State University at Albany had research capabilities and room on the campus to expand. The Albany area boasts a concentration of colleges and universities, presenting other potential university partners. In addition, Albany is centrally located with regard to transportation, access to markets, and complementary businesses. For example, IBM, a world-leader in information technologies, is a short distance south in the Hudson Valley.

Nanotech focuses on R&D at the super-small level – beyond what is visible even with a microscope. By working with materials at that level, scientists and engineers are able to control the characteristics of a variety of materials, thereby improving performance in a full array of products ranging from skin creams to jet engines to computers.

The Albany Center in Nanoelectronics is an incredible, spotlessly clean facility that meets the demands of one of the key components of nanoelectronics – semiconductor wafers, or "chips," for information processing. At Albany, engineers can produce the highly advanced 300 mm semiconductor wafers. Cleanliness is paramount in this process, as even a particle of dust can damage the wafers. This 450,000-square-foot complex is world-class and unmatched at the university level.

The Albany center was constructed not simply for the next generation of devices, but for several generations beyond that. Capabilities encompass system-on-a-chip technologies; biochips, optoelectronics, and photonics devices; nanoelectronics; closed-loop sensors for monitoring, detection, and protection; and ultra-high-speed communication components. The facility provides critical laboratory and clean room space for research, builds incubator space for high-tech company spin-offs, and offers a workforce development program.

We wanted to develop a Center of Excellence that was capable of efficiently transferring high-technology developments to the marketplace, from concept to product. As a result, the Albany facility follows a vertical business model. Historically, this type of model has been used to advantage by, for example, the paper manufacturing industry, where a company owns or operates everything from the forest plot to the paper plant. At Albany Nanoelectronics, we have found this same type of vertical integration provides synergy and complementary expertise.

One example of the vertical business model at the Albany center begins at ground level, with M&W Zander, a construction firm for high-tech semiconductor facilities, or "chip-fab" specialists. This company is one of only a few in the world that specializes in this type of construction and brings a global perspective to the rigorous requirements for the physical plant. This German company opted to establish its East Coast operations near our Albany site, and has proven to be a true strategic partner.

Photo by Darren McGee, NYSESD.

Tour of the Albany Nanoelectronics Center in 2005. (left to right) New York Governor George E. Pataki, Albany Mayor Gerald D. Jennings, Quebec Premier Jean Charest, and Empire State Development Chairman Charles A. Gargano.

Moving up the vertical line, the first-level user of the chip-fab facility is Honeywell International, another company with a worldwide reputation. Honeywell utilizes the facility to develop and produce the customized chemicals applied to semiconductor chips.

The chemicals provided by Honeywell International are components of the high-tech tools or systems for semiconductor manufacturing produced by Tokyo Electron Ltd. We were thrilled when this highly regarded Japanese company chose Albany for the site of its only R&D facility outside Japan.

The final point on this vertical business model is the company that defines the projects or uses for the semiconductor chips. IBM, a world-renowned firm that has been our partner in nanotechnology since the onset, has global businesses with a constant demand for semiconductors with a variety of capabilities.

In discussing IBM projects upon committing to Albany Nanoelectronics, Lou Gerstner, IBM chairman and CEO, said, "The world of e-business is driving a massive build-out of the infrastructure of computing and communications. That, in turn, drives demand for critical technical components like chips. Demand is white-hot in three critical segments – chips for big servers, chips to power the explosion in Internet access devices and chips in the networking equipment that ties everything together."

ALBANY NANOELECTRONICS: TIMELINE FOR SUCCESS

The success of Albany Nanoelectronics did not occur overnight. The high-tech Semiconductor Manufacturing Initiative (Semi-NY) program, New

York state's comprehensive effort to encourage semiconductor manufacturing in the Empire State, was the first of many initiatives implemented that worked to draw industry to New York state over the course of the last decade, leading up to the unveiling of the Centers of Excellence program in 2001.

Early Investments

Semi-NY, with its shovel-ready semiconductor fabrication plant sites located across New York state, was established to showcase the state's commitment to the semiconductor industry.

In November of 1997, Governor Pataki and Lou Gerstner, IBM chairman and CEO, announced the largest industrial investment in state history to date – $700 million – to construct the world's most advanced, 300mm semiconductor development facility at the Hudson Valley Research Park in East Fishkill, creating 400 new jobs. In addition, IBM pledged to establish a Global Support Center in East Fishkill, creating another 200 jobs.

Stony Brook, New York's Center of Excellence in Wireless and Information Technology

The following month, the governor committed $25 million over a five-year period in support of the proposed Focus Center – New York, should New York state receive that designation by the Semiconductor Industry Association. He also committed $10 million in support of the new wing of the Center for Environmental Science and Technology Management building to construct a 300 mm pilot manufacturing plant at the University at Albany facility. At the same time, Chip Fab '98, an initiative to pre-qualify a number of sites around the state for the semiconductor manufacturing industry, was launched. ESD matched the local contribution of up to $75,000 to help defray the costs of pre-permitting.

In 1998, the University at Albany and Rensselaer Polytechnic Institute were chosen to participate in the prestigious semiconductor industry Focus Research Center Program. The focus was cutting-edge research on interconnect technologies for a new generation of more powerful computer chips. The consortium also included University at Stony Brook, Cornell, MIT, Stanford, and Georgia Tech.

Trained Workforce

We recognized that while we built up our national and international reputation and developed our sites, New York had to have a ready workforce. ESD and partners worked with seven community colleges to get a SEMATECH-approved Semiconductor Manufacturing Technician degree program up and running in 1999. This effort helped ensure New York has the workforce capacity to fuel the industry's technical labor needs.

Marketing and Advertising

We reached out to the high-technology community in a focused effort to communicate our willingness to host high-tech sites. Representatives from ESD and other local development partners have attended various semiconductor industry trade shows including Semicon West in San Francisco, Semicon Southwest in Austin, and Semicon Europa in Munich, Germany. We have sent individual representatives to Asia to discuss opportunities one-on-one with potential companies.

We developed marketing brochures, enhanced our website, and provided information on New York's commitment to high-technology in national advertisements in Japanese, Korean, and Chinese translations. The Chinese translation targeted Taiwan, which is seen as the next hot bed for semiconductor manufacturing.

We featured New York state advertisements in a number of leading industry publications, including *Semiconductor Business News*, *Semiconductor International*, *Solid State Technology*, *Future Fab* and *Electronic News*. To develop advertisements and promotions showcasing the Semi-NY, we worked closely with local partners, including the Dutchess County Economic Development Corporation, West Seneca Development Corporation, Cayuga County IDA, Orange County Partnership, Rochester Institute of Technology, New York Capital Region Semiconductor Initiative, Onondaga County Office of Economic Development, and Mohawk Valley EDGE.

Personal Contact

Empire State Development's industry directors took on a direct-call marketing effort to personally contact companies in the semiconductor industry. We spoke to more than 320 executives in over 70 companies around the world. We wanted the companies to know, on the one-on-one level, that New York state wanted their business. We retained the services of outside consultants to identify and contact key industry executives, and compare the costs of building a semiconductor site in New York state with other competitors.

ESD, in coordination with the New York Capital Region Semiconductor Initiative, also helped sponsor the Chip Fab Hot Link Seminar in 1999 to focus on business issues for foundries, non-manufacturing semiconductor design companies, and Integrated Circuit designers. A number of companies, domestic and international, attended the three-day seminar to discuss the current and future

Buffalo, New York's Center of Excellence in Bioinformatics

direction of the microelectronics industry. We also presented the attendees with a comprehensive overview of the positive changes to the business climate in New York state and the Semi-NY program.

Shovel Ready

By spring 2000, three sites announced they had completed all aspects of the pre-permitting process and were "shovel-ready." Sites were located in the Hudson Valley and Central New York. This garnered both in and out-of-state publicity and *Technology Digest-Singapore* wrote a full-page article on our initiatives.

A Top-Ten IC Manufacturer Joins

Philips Semiconductors purchased IBM's MiCRUS Semiconductor facility in East Fishkill in New York state's Hudson Valley in June 2000. Philips committed to investing some $100 million at the site to increase capacity and production capabilities over the next few years. ESD and the Tax Department worked diligently with Philips to facilitate this deal and bring one of the world's top-ten IC manufacturers to New York. Since then, Philips has announced about $120 million worth of additional investments in the facility.

"New York was a great partner to Philips in finding a fab location that meets our needs to increase capacity for key markets and customers," said Stuart McIntosh, Philips Semiconductors' executive vice president and chief operations officer.

IBM Makes Investment History

Just a few months later in 2000, Governor Pataki and IBM Chairman and CEO Lou Gerstner announced that IBM would make the largest private-sector investment in New York state history by building the world's most technologically advanced chip-making plant in East Fishkill, Dutchess County. This $2.5 billion investment represents the largest private-sector investment in the United States since 1995. As a direct result of this investment, Planar Semiconductor Inc. (PSI) announced it would invest $20 million to create new jobs at Tech City, Ulster County.

Success Breeds Success

From an economic development perspective, we applied the philosophy that closing the deal on major investments was the beginning of the partnership. We knew that to ensure success we had to keep our commitments to the businesses that shared our vision.

As a result, less than a year after the record-breaking $2.5 billion IBM announcement, Governor Pataki announced with IBM a commitment of $150 million for the Center of Excellence in Nanoelectronics at the University at Albany. IBM committed to more than $100 million to support the center, and the state pledged up to $50 million.

The Center of Excellence was envisioned to become the only university-based 300mm semiconductor pilot prototyping facility in the world. This announcement built upon the state's earlier commitment of nearly $70 million toward micro- and nanoelectronics for the University of Albany's Center for Environmental Science and Technology Management building.

The Center of Excellence provides laboratory and clean room space for research, builds incubator space for high-tech company spin-offs, and creates a state-of-the-art workforce development program to provide the skilled labor critical to attracting microelectronics companies to New York state.

International SEMATECH and Other Successes

In 2002, International SEMATECH – a consortium of the 12 major computer chip manufacturers in the world – announced it would site its next generation 300 mm computer chip research and development center, to be called International SEMATECH North, at the Center of Excellence in Nanoelectronics at the University at Albany.

SEMATECH selected New York after investigating sites in Europe, the Pacific Rim, and across the United States, and it made its decision based on New York's leading position in chip research and development and the state's business-friendly environment. The Albany facility complements the first International SEMATECH facility, which is located in Austin, Texas. The agreement between New York and International SEMATECH included approximately $400 million in state and industry support over five years, consisting of $210 million from the state (including $50 million previously announced for the Center of Excellence at Albany and included in the 2002-03 state budget and $193 million from International SEMATECH and its member companies, including IBM).

Just four months after the SEMATECH announcement, Tokyo Electron Limited (TEL) announced it would establish a $300 million

research and development facility at the Albany Center of Excellence, creating more than 300 jobs. The agreement between New York and TEL included approximately $300 million in state and industry support over a seven-year period. The $100 million state investment will be primarily for capital construction, equipment, and specialized tools for research. The facility will be used by TEL to perform advanced tool design and prototyping for future generations of computer chips.

In 2004, Sony Group announced it would invest $325 million in IBM's state-of-the-art 300mm semiconductor manufacturing facility to facilitate production of cutting-edge, next generation 65 nanometer chips. SONY Group will partner with IBM's Systems and Technology Group to produce the next generation "Cell" microprocessor at IBM's 300 mm chip-fab in East Fishkill.

The following year, IBM, Albany Nanoelectronics, and ASML, the world's leading semiconductor lithography supplier, pledged to invest over $2 billion in separate but related semiconductor/nanoelectronics initiatives, thus furthering the state's position as a leading semiconductor location. These facilities were slated for Albany and the Hudson Valley.

Syracuse, New York's Center of Excellence in Environmental Systems

In a statement that reflects the original Centers of Excellence vision, with university-business-government partnerships, Martin van den Brink, ASML's executive vice president, Marketing and Technology, said, " As a global leader in the semiconductor lithography industry, ASML believes that it is critical to build R&D alliances in order to support and continuously improve our products and services as they are introduced into production facilities around the world."

In spring 2005 at the Semicon Europa Conference in Munich, Germany, Saratoga Economic Development Corp. announced the availability of the 1,350-acre Luther Forest Technology Campus. The Luther Forest Technology Campus, with substantial backing from the state of New York, has completed all required environmental reviews and is now zoned for nanotechnology support enterprises.

In July 2005, four of the world's largest computer chip makers and New York state committed to spending $600 million over the next five years on a research, education, and economic development project focused on creating the next generation of computer microchips while limiting costs. The project will get $200 million in funding and equipment from Armonk-based IBM Corp.; Sunnyvale, Calif.-based Advanced Micro Devices Inc.; Infineon Technologies AG of Germany; and Boise, Idaho-based Micron Technology Inc. The state is contributing $180 million. More than $200 million is coming from numerous companies that provide the materials and equipment used to make semiconductors

In September 2005, the Albany Center of Excellence, IBM, and Applied Materials teamed up on a partnership that will make more than $300 million available for research, development, and economic outreach at the State University of New York's Albany Nanoelectronics site, expecting to add over 80 research jobs.

At the beginning of 2006, University at Albany's College of Nanoscale Science and Engineering was chosen to be the site of a new nanotechnology research consortium, dubbed the Institute for Nanoelectronics Discovery and Exploration. The Institute was formed by the Semiconductor Industry Association, a Silicon Valley-based trade group, and Semiconductor Research Corp., a North Carolina group that links companies with university researchers. The University at Albany has been designated head of the consortium, which includes six other schools: Rensselaer Polytechnic Institute, the Massachusetts Institute of Technology, Harvard University, Yale University, Purdue University, and the Georgia Institute of Technology. The state will be contributing $80 million towards the $435 million project to be housed in a new 100,000-square-foot laboratory and clean room annex scheduled to be complete in 2007.

Also in January 2006, Albany was named the site of a new SEMATECH Extreme Ultraviolet Lithography Resist Test Center (EUV-RTC), a one-of-a-kind research and development center designed to provide the global microchip industry with advanced technology solutions. The new center builds on the partnership, originally announced by the governor in July 2002, that SEMATECH established when it selected New York for the location of its International SEMATECH North operations.

OTHER CENTERS

While the Center of Excellence in Nanoelectronics has gained worldwide recognition, other Centers of Excellence around the state are also poised for progress and generating results.

Center of Excellence in Environmental and Energy Systems, Syracuse

Syracuse has a history of excellence in the air conditioning industry. The Center of Excellence in

Environmental and Energy Systems was established to build on this expertise. The Syracuse facility focuses on clean and renewable energy, as well as on indoor environments in the areas of air quality, comfort, lighting, acoustics, and intelligent controls.

The Syracuse Center of Excellence is experiencing a myriad of partnership successes, such as NuClimate Air Quality Systems, of East Syracuse. In May 2004, NuClimate received a grant through the Syracuse Center of Excellence's Commercialization Assistance Program (CAP) that allowed the company to test its new product, build prototypes, and begin to establish representation in markets across the United States. Most recently, NuClimate has contracted with the YMCA in Rome, N.Y., for installation of about 60 units and is working on a proposed project with the Syracuse City School District that would include the installation of about 200 Q Air Terminals at the former Central Technical High School.

Center of Excellence in Photonics and Microsystems, Greater Rochester

Rochester has long been known for its optics and imaging industry, so it makes sense to expand on this reputation in the Centers of Excellence. The Greater Rochester facility, known as Infotonics, focuses on creating technology transfer and pilot fabrication facilities for high-resolution imaging and ultra-fast communications devices that can be shared by partners to accelerate product development.

The Infotonics Center is making steady progress on its economic development mission. Two high-tech spin-off companies were launched by Infotonics in November of 2005, including SpectralSight, a Canandaigua, N.Y., company developing and commercializing hyperspectral imaging technology – to see what the eye cannot see – in defense, medical, and homeland security applications. Infotonics is also providing critical R&D and prototyping support to six small start-up companies across New York state, including Thermal Gradient, Inc., a Pittsford, N.Y., company that has developed a device that can amplify DNA much faster than anything available in the marketplace.

Center of Excellence in Bioinformatics and Life Sciences, Buffalo

When you think bio-tech, think Buffalo. This center was created to be a hub of life sciences expertise in Upstate New York. The center is managed by the University at Buffalo and the state of New York in partnership with Roswell Park Cancer Institute and Hauptman-Woodward Medical Research Institute. The center and its principal partners are now moving into 400,000 square feet of state-of-art research facilities, designed to optimize interdisciplinary collaboration, in three new interconnected buildings on the Buffalo Niagara Medical Campus.

Greater Rochester, New York's Center of Excellence in Infotonics

The cluster around Buffalo has seen a number of private high-tech success stories. One company, SmartPill Corporation, with the support of the center and the University at Buffalo Center for Advanced Technology, has developed the SmartPill, a medical device that is swallowed, capturing biomedical data from the gastrointestinal system. The pill has successfully completed a final round of clinical studies for FDA approval.

And, by working with a consortium of companies that includes General Electric, Invitrogen, Praxair, Corning, Bristol-Meyers Squibb, and OSI Pharmaceuticals to develop new ways to manufacture individualized biopharmaceuticals, the center is helping to bring individualized medicine closer to reality.

Center of Excellence in Wireless and Information Technology, Stony Brook, Long Island

Long Island's long tradition of developing high-tech defense and space technologies continues to deliver critical avionics and integrated systems, so the center was a logical extension of this expertise in the wireless and information technology arena. The Center of Excellence in Wireless and Information Technology (CEWIT) is dedicated to making "pervasive wireless computing" a reality, with focus areas in networking and communications, devices, "virtual" and other software systems, and applications for the two largest sectors of the U.S. economy, health care and transportation, as well as the explosively growing field of e- and m-commerce.

One CEWIT collaborator, LifeTree Technologies, of Great River, is developing online systems to reduce the enormous cost of clinical trials for new

drugs, while CEWIT's research promise has already attracted eight start-up companies to Stony Brook's incubators and $15 million in venture investment for CEWIT partners.

ACCOLADES AND HONORS

The growth and success of the Centers of Excellence, especially with regard to nanoelectronics, has gained national and international recognition. For example, the May 2001 edition of *Site Selection Magazine* named the 300mm IBM fab as one of the "Top 10 Deals of 2000." The same issue recognized Empire State Development as one of the "Top 10 Economic Development Groups in the Country."

Governor Pataki became the first elected public official ever to receive the Semiconductor Industry Association's (SIA) highest honor – the 2003 Robert Noyce Award – in recognition of his exemplary leadership and steadfast support for semiconductor research, development, and commercialization in New York state. The prestigious award is named in honor of semiconductor industry pioneer and Intel co-founder, Robert Noyce. Governor Pataki was also named by *The Forbes/Wolfe Nanotech Report* (2003) as one of the top ten leaders in the nation in developing nanotechnology as a tool for economic growth.

In another example, *Small Times* magazine ranked the state of New York second (March 15, 2005) in the nation for nanotechnology research and fourth in overall development of nanotechnology, adding that the state was attractive to nanotech companies and investors.

"New York's academic and industrial research is giving California a run for its money," said Candace Stuart, Small Times' editor-in-chief.

CONCLUSION

The Centers of Excellence have taken prominence as one of New York state's signature programs for the past decade. The program was the result of a clear vision and focused strategies on the part of the governor, industry and university leaders, elected officials, and citizens. The partnerships forged and the developments now in the pipeline are catalysts for business growth, the development of scientific knowledge, new cures and life-saving medicines, and the growth of job opportunities for this generation and the next.