

RESEARCH at RIT

The Rochester Institute of Technology Research Report

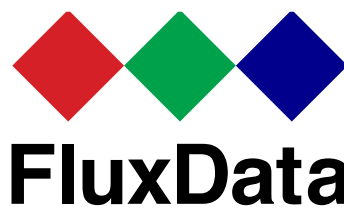
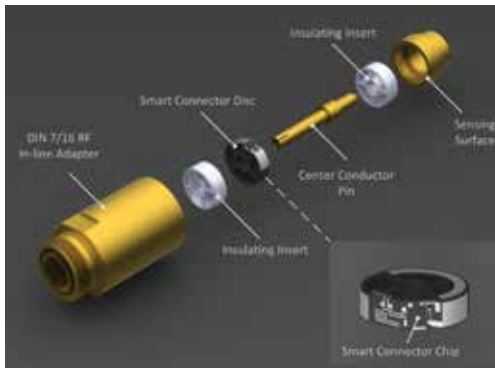
Fall/Winter 2012

SPOTLIGHT ON

INNOVATION & ENTREPRENEURSHIP



An
Entrepreneurial
Mindset



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RESEARCH at RIT

The Rochester Institute of Technology
Fall/Winter 2012

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Creating Successful Innovators and Entrepreneurs

After arriving on campus in 2007, RIT President Bill Destler set a goal of transforming RIT into the first innovation university. Utilizing our unique combination of industry connections, technological expertise, and prominence in the creative arts, RIT would become a center for entrepreneurship and technology transfer. It would also be a model for how universities could transform ideas into real-world innovations.



Today, RIT is poised to meet those goals thanks to the creation of an increasingly robust entrepreneurship pipeline. Through a host of academic degree programs, applied research

efforts, and business incubation initiatives, students and faculty can transform ideas into practice. Pipeline participants can gain instruction in how to start a business, assistance in testing out ideas and prototyping products, and support in identifying potential corporate partners and investors. The outcomes include the creation of educated and successful entrepreneurs, the development of new technological innovations, and the formation of startup companies that promote both societal and economic growth.

The success of this effort is evident through the increasing national recognition our innovation and entrepreneurship activities are receiving. For example, BestCollegesOnline.com recently selected our Simone Center for Student Innovation and Entrepreneurship as the number one college student incubator in the nation.

In this 10th edition of *Research at RIT* we highlight a host of initiatives that exemplify the four main facets of the

entrepreneurship pipeline: student entrepreneurship, technology development, technology transfer, and company creation.

This edition includes a feature on RIT's comprehensive programs in student entrepreneurship, led by the E. Philip Saunders College of Business, and profiles on several of our increasingly successful young innovators. It also showcases our efforts to promote the 3D imaging and food processing industries and the continued development and distribution of C-Print, copyrighted classroom captioning technology. Finally, we highlight the firms Vnomics and Black Box Biometrics, startup companies that have spun out of RIT research.

I value your feedback and support as we continue to expand our innovation and entrepreneurship activities and further develop RIT as an innovation university. Please feel free to contact me regarding these stories or other issues related to research on campus.

Enjoy the breadth and depth of Research at RIT!

Best Regards,

A handwritten signature in black ink that reads "Ryne Raffaella". The signature is fluid and cursive.

Ryne Raffaella, Ph.D.
Vice President for Research

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RIT promotes access to university innovations through licensing of its patents, copyrights, and trademarks to existing corporations or new startup businesses. C-Print, classroom-captioning technology developed by the National Technical Institute for the Deaf, is a prime example of the benefits university innovation can provide to the broader community.



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RIT's Venture Creations incubator provides a business creation outlet for the RIT community and an economic driver for the region. Its Clean Energy Incubator (CEI), as well as tenants Blackbox Biometrics and FluxData Inc., exemplify this transformation of academic research and ideas to economic development.

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RIT's faculty, staff, students, and alumni have made significant contributions to the development of new technology, creative arts, and education. Here we highlight specific areas of accomplishment in innovation and entrepreneurship.

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Creating an Entrepreneurship Pipeline

by William Dube

RIT is seeking to transform university research and intellectual capital into innovations that can spur the development of new products, businesses, and industries. The goal is to transfer the enthusiasm and ideas of students and faculty into real-world applications.



The Entrepreneurship Pipeline: RIT's comprehensive programs in innovation and entrepreneurship seek to transform the creativity and enthusiasm of students and faculty into new innovations, technologies, and startup businesses. This pipeline seeks to take ideas to market and develop our next generation of innovators and entrepreneurs.

A Vision for the 21st Century University

Through the creation of a symbiotic relationship between education, research, technology transfer, and business creation, RIT is developing an entrepreneurship pipeline that can transform university innovation into business innovation and directly impact economic and community development.

“Consider RIT not just as a teaching university or a research university, but as the first innovation university,” says President Bill Destler.

To accomplish this, RIT is utilizing its historic expertise in industry-focused, applied research to create entrepreneurship curricula, business development programs, and technology transfer initiatives that can more directly connect university ideas with the needs of the real world.

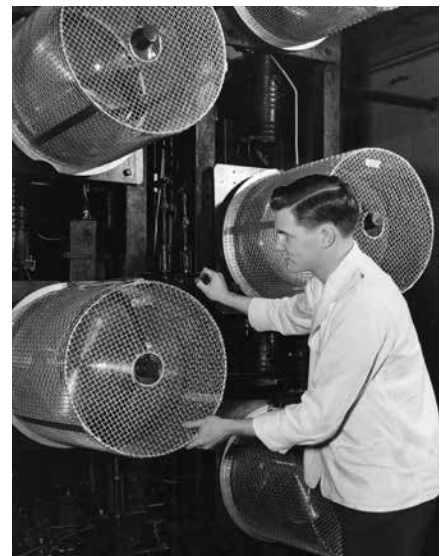
“We are committed to creating the next generation of entrepreneurs, inventors, and artists who can develop the value-

added innovations, which will spur economic growth and make the world a better place,” Destler adds.

A Historical Precedent

RIT's traditional expertise in applied research with an industry focus goes back to its founding as a technical training school for Rochester's burgeoning manufacturing base in the late 1800s. Moving into the 20th century, the university was an essential source for highly trained engineers and scientists at local corporations such as Eastman Kodak, Xerox, and Bausch & Lomb, a pipeline that was enhanced by RIT's cooperative education program—one of the oldest and largest in the nation.

The university has also been a longtime source for testing, design, prototyping, training, and industrial education. In fact, innovative programming offered through the School for American Crafts, School of Media Sciences, School of Photographic



A History of Corporate Engagement:

A cooperative education student examines equipment in a local factory circa 1950. RIT's current efforts in innovation and entrepreneurship build on a century of corporate engagement, including one of the largest and oldest co-op programs in the country.

Arts and Sciences, and Center for Imaging Science has played a central role in the development of the arts and crafts, printing, imaging, and remote sensing industries.

“RIT is uniquely situated to be a center for innovation and entrepreneurship because we have been focused on helping industry innovate for over 100 years,” adds Ryne Raffaele, vice president for research. “Through the utilization of this inherent expertise we are creating an environment that can easily transfer technologies to market, while also creating a strong base of engaged and educated entrepreneurs.”

The Pipeline in Practice

RIT’s entrepreneurship pipeline connects the technology and creativity being developed on campus with the needs of industry. It also focuses on developing curricula and class projects that promote the entrepreneurial spirit and ideas of RIT’s students.

“We want all students and faculty at RIT to have the opportunity to be entrepreneurs,” adds Richard DeMartino, the Albert J. Simone Chair for Innovation and Entrepreneurship. “By creating a stronger connection between the classroom, research, and technology transfer we can more directly translate the creativity on campus into business opportunity.”

The pipeline begins in RIT’s comprehensive curricula in entrepreneurship. Through a host of entrepreneurial focused majors, minors, and concentrations, students learn how to start and run their own businesses, while also receiving hands-on experience with current entrepreneurs and



C Print: Classroom captioning technology developed by RIT engineers to improve communication and accessibility for deaf students. The system has been copyrighted and distributed to numerous school districts and service agencies around the world.

business leaders in a host of industries. The next phase involves the transition of innovations developed on campus into new products and processes. This includes the licensing of intellectual property developed by students and faculty to existing companies and startups, as well as the creation of numerous corporate partnerships designed to enhance technology development in targeted industries. These efforts, which include the development of C-Print, a copyrighted classroom captioning system, bring the latest innovations to market for the betterment of the economy and society.

The pipeline often concludes with the creation of stand-alone businesses out of the innovations developed on

campus. This includes the spin-off of RIT research into startup companies, and the transition of student business ideas into new companies through programs offered by the Simone Center for Student Innovation and Entrepreneurship. All RIT startups can also receive support from the Venture Creation’s Business Incubator, which assists entrepreneurs in market and commercialization planning, prototype design, and production.

“The entrepreneurship pipeline being developed at RIT provides a better educational environment for our students and increases the impact of university research,” Raffaele says. “The examples featured in this issue of *Research at RIT* highlight this process and the potential of university innovation and entrepreneurship.”

The Simone Center for Student Innovation and Entrepreneurship:

The center provides mentoring and support for student startups, serving as the “connective tissue” between entrepreneurship course work and the university’s business incubator resources.





From Student to Entrepreneur:

RIT student Sean Petterson and his faculty mentor Carl Lundgren demonstrate the Strong Arm Ergonomic Lifting Safety System. The device, developed by Petterson and partner Justin Hillary, greatly reduces stress caused from heavy lifting and is now being marketed to numerous companies in the material handling industry. Strong Arm is just one example of the innovative ideas and potential businesses being developed through RIT's comprehensive course work and mentorship programs in student entrepreneurship. The effort seeks to transform students into educated and confident businessmen and women.

STUDENT ENTREPRENEURSHIP

An Entrepreneurial Mindset

by William Dube

RIT's multifaceted programming in student entrepreneurship serves as an entry point for the entrepreneurship pipeline. It seeks to transform ideas and creativity into

VIDEO LINK



concrete technology development, business creation, and product commercialization. The university-wide effort is designed to produce knowledgeable, experienced graduates and successful entrepreneurs who can be the economic drivers of our increasingly complex and technical society.

An Innovation Environment

"RIT is uniquely situated to provide strong programming in innovation and entrepreneurship because of our traditional strength in experiential learning and the diversity of our programs in technology, design, art, and business," notes Richard DeMartino, the Albert J. Simone Chair and director of the Simone Center for Student Innovation and Entrepreneurship. "Our degree programs, course work, research efforts, and multidisciplinary projects focus on engaging students in the learning and discovery process with a real-world, entrepreneurial bent."

The overall goal is to imbue entrepreneurship and innovation training into multiple aspects of the student experience and offer numerous outlets for student creativity.

"We seek to build entrepreneurs from the 'ground up' using our students' innate curiosity and ingenuity to assist them in becoming society's next innovators," says DeMartino.

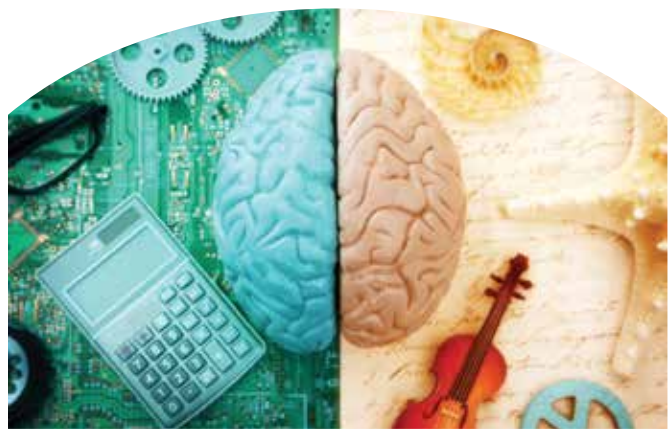
Putting the Left and Right Brain to Work

Experts note that the central problem in entrepreneurship revolves around the need to take good problem-solving ideas and turn them into workable solutions, prototypes, and products and then create a business that can successfully market and sell these innovations. RIT's academic programs in entrepreneurship and innovation attempt to meld "left brain" analysis with "right brain" creativity to provide students with the balanced skills they will need to be successful in all aspects of entrepreneurship.

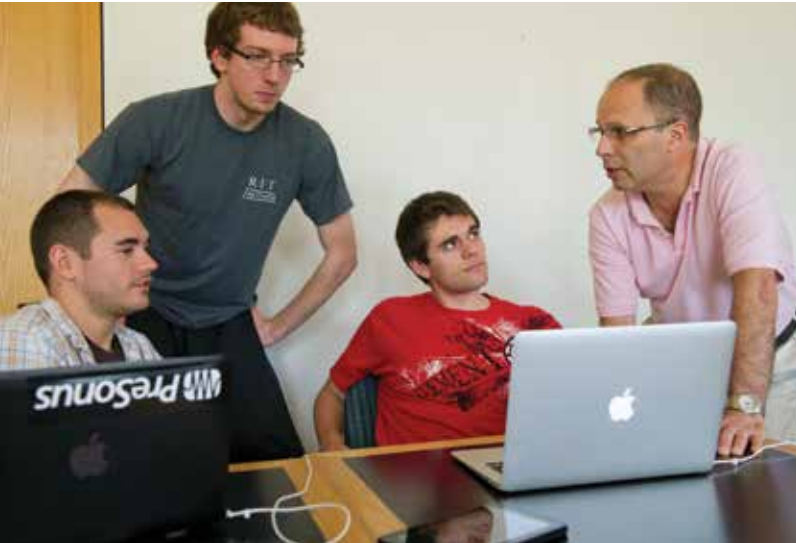
"Entrepreneurs need to be dreamers and managers, artists and engineers, designers and product developers—all at the same time," says dt ogilvie, dean of RIT's E. Philip Saunders College of Business. "So our academic efforts in this area need to focus not just on business or management but on the technical skills, design skills, artistry, and imagination that are essential to creating true innovation. What we at Saunders teach our students is not only idea generation, but the science of entrepreneurship so that they can take these creative ideas and turn them into viable businesses."



A Unique Classroom Model: Richard DeMartino, the Simone Chair for Innovation and Entrepreneurship, second from right, works with a student team to develop a startup business plan. At RIT, entrepreneurship training begins in the classroom. The university offers a wide variety of entrepreneurship-focused majors, minors, and classes that allow students to test out their business ideas and learn from mentors in the field.



Engaging the Left and Right Brain: Entrepreneurship and innovation classes seek to engage both the "left brain" and the "right brain," providing students with the broad skill set necessary to be successful entrepreneurs.



Commercializing Technology: Richard Notargiacomo, right, co-manages the Technology Commercialization Clinic, which pairs student teams with entrepreneurs looking to develop commercialization strategies for currently held patents. The effort seeks to promote the further development of innovation, while training students in real-world settings.



Future Business Leaders Experience: Patience Ibezim, left, a second-year physician assistant student, presents a draft business plan as part of the Future Business Leaders Experience. Now in its fifth year, this entrepreneurship-training program pairs inner-city high school and RIT students with minority-owned startups.

The Saunders College offers a number of entrepreneurship-focused academic initiatives such as an experientially based entrepreneurship minor, a master's degree in innovation management, and MBA concentrations in product commercialization and technology management. These programs are unique, ogilvie says, because of the experiential, coach-enabled, and multidisciplinary nature of the learning process.

The curricula are offered to all RIT students and feature multidisciplinary course work in management, design, and technology as well as group development projects consisting of students from different backgrounds and expertise areas.

An example of the college's real-world, multidisciplinary focus is its Field Experience in Business Consulting course, which is open to undergraduate and MBA students and is part of the entrepreneurship minor. It pairs multidisciplinary student teams with startup firms to develop business plans or market analyses for potential products. The class provides real-world experience for students, while assisting current entrepreneurs in further developing their businesses.

"By putting together scientists, engineers, artists, and managers in these types of courses we get better idea generation and more diverse methods for addressing problems," says Richard Notargiacomo, adjunct professor and manager of the Saunders Student Consulting Group. "We also ultimately produce more well-rounded, innovative, and valuable graduates."

The Saunders College also offers a number of outreach initiatives that give students the opportunity to work in the community and experience entrepreneurship first hand.

For example, the Technology Commercialization Clinic, co-managed by DeMartino and Notargiacomo, pairs student teams made up of MBA and innovation management master's degree students with entrepreneurs and universities to develop commercialization plans based on currently held patents or intellectual property. The program is in partnership with Syracuse University and is funded by New York's Empire State Development Corporation.

In addition, Del Smith, an assistant professor of management, is working

with current RIT entrepreneurship students and the Rochester City School District to engage inner-city high school students in business planning and development. The Future Business Leaders Experience Program, now in its fifth year, pairs high school and RIT students with a faculty mentor to assist minority-owned businesses in market planning, product assessment, and intellectual property analysis. The program introduces inner-city students to entrepreneurship, while also enhancing the mentorship and team-building skills of RIT students.

"Our students get to interact with a diverse set of entrepreneurs, which can inspire their own business ideas," adds Smith, who also integrates real-world business planning assignments into his graduate entrepreneurship class.

Turning Ideas into Business Motivation

RIT's entrepreneurship programming also gives students an opportunity to take what they have learned, and the ideas they have generated, and turn them into their own business ventures.

"The best way to develop good entrepreneurs is practice, practice, practice,"



DigEnt: Vic Perotti, left, director of the Digital Entrepreneurship Network, or DigEnt, works with student startup APPLICABLE SOLUTIONS, which is creating a secure “virtual briefcase” to better store and transmit confidential files. DigEnt is an online, social network that can assist student companies in identifying mentors, business contacts, and potential investors.



From Classroom Project to Global Social Network: Steve Shapiro, center, originally developed the social networking application Digsby, during an entrepreneurship course at RIT. With the help of the Simone Center he later created the company dotSyntax to further develop and sell the technology. In 2011, Shapiro sold the firm to Tagged.com, the third largest social network in the world.

says Victor Perotti, associate professor and academic area leader of entrepreneurship, digital business, and innovation within Saunders College. “We try to give students numerous avenues to come up with business ideas and test them out.”

For the last five years Perotti has led the Digital Entrepreneurship Program, developed with funding from the National Collegiate Inventors and Innovators Alliance (NCIIA). The effort involves both classes in digital business development and a unique social networking arm, the Digital Entrepreneurship Network (or DigEnt). DigEnt allows students to communicate their digital concepts, seek complementary partners, and locate business mentors.

“DigEnt serves as a real-world digital laboratory in which participants can learn by doing without significant risk,” Perotti adds. “And as digital business becomes a larger portion of the economy, our students will have a leg up on how to operate in this environment.”

Students wishing to advance their business concepts to real startups can apply to the Applied Entrepreneurship and Commercialization course. The class

pairs student teams with entrepreneurial mentors who assist them in transforming ideas into an initial business plan. Teams with the best plans are encouraged to join the Simone Center’s business development program to further the creation process, with the chance to eventually join Venture Creations, RIT’s startup business incubator, which is open to students, faculty, and RIT alumni.

One of the more powerful success stories of the RIT approach is the software firm dotSyntax, LLC, which produces the social networking platform Digsby. The company was originally conceived during an MBA class by student Steve Shapiro, who also received mentorship support from the Simone Center. dotSyntax later spent three years as a tenant with Venture Creations before being purchased by the social networking company Tagged in 2011.

“The curricula offered through the Saunders College is a tremendous gestation environment for future entrepreneurs,” adds Bill Jones, director of Venture Creations. “dotSyntax is a great example of the potential that exists on the RIT campus.”

Taking Motivation to Market

In an effort to increase campus opportunities for entrepreneurs and enhance connections to external resources, the Simone Center for Student Entrepreneurship and Innovation was formed in 2007. Today the center houses numerous programs, which serve as the “connective tissue” between entrepreneurship degree programs and business development through Venture Creations.

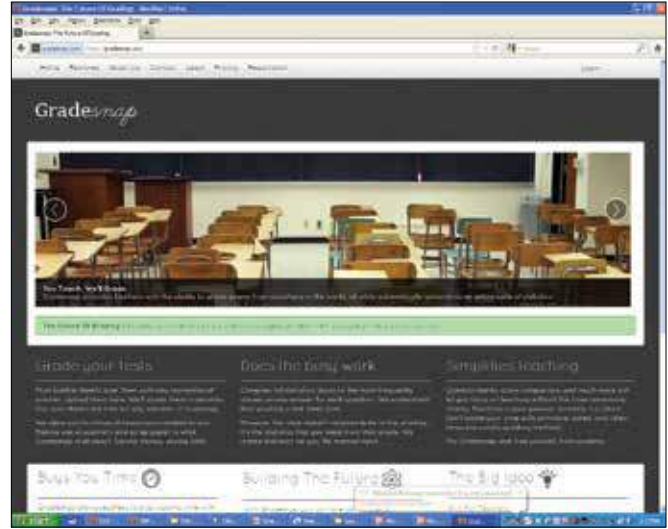
“The Simone Center seeks to enhance early entrepreneurship activities by providing mentorship, commercialization facilities, seed funding, and access to external capital that can transform our students into professional businessmen and women,” notes DeMartino.

The center hosts the RIT Student Incubator, which allows potential entrepreneurs to test out business ideas and create commercialization plans with the support of mentors and faculty associates. Participants can receive course credit or cooperative education credit allowing them to spend three months focusing on maturing their concept.

The Simone Center also runs Entrepreneurs Hall, an “entrepreneurs



Summer Startup: The three-month program helps student startup companies create a product for sale and court potential investors. Above, student participants work on initial financial planning that is a key component of the startup phase.



GradeSnap: The 2012 Summer Startup participant is developing a Web application that will allow teachers to more easily grade multiple-choice tests and derive statistical data on student performance.

community” in the RIT Global Village, which includes a residence hall, entrepreneurship courses, cooperative education opportunities, business mentoring, and access to the student incubator.

Finally, students can test out ideas and designs through the Simone Center’s innovation testing and prototyping program in partnership with the Brinkman Machine Tools Laboratory in RIT’s Kate Gleason College of Engineering. The program provides lab space and faculty mentors who can assist in technology development, product testing, and design for manufacturing.

Sean Petterson, a fifth-year industrial design student, and Justin Hillery, a fifth-year multidisciplinary studies major, worked with the Simone Center to design and prototype Strong Arm, a lifting assist vest. The device, which could greatly reduce ergonomic risk for workers in the material handling industry, won the Best Cutting Edge Innovation Award at the 2012 NCIIA Open Minds Student Design Competition. The team has also been accepted into the 2012 MassChallenge Startup Accelerator, an entrepreneurial training institute and business plan competition.

“One of the biggest issues many student entrepreneurs face is not having

enough time or assistance to develop their ideas,” says Carl Lundgren, professor of mechanical engineering technology and a faculty mentor in the Simone Center. “We provide the resources and technical expertise to make entrepreneurship possible.”

More recently, the Saunders College and the Simone Center created Summer Startup, a three-month concept development program designed to help student teams advance their businesses and, in particular, flesh out the elements of the business concept that go beyond the product or service to be sold. It includes business coaching, assistance with market and product planning, and a chance to present to potential investors at the culmination of the program.

2012 Summer Startup participant GradeSnap began as a project in Saunders’ Applied Entrepreneurship course. The firm is developing a Web application that will allow teachers to more easily grade multiple-choice tests and derive statistical data on student performance.

“I have always been interested in running my own business and RIT’s support of venture creation was a major draw,” says Nikko Schaff, a third-year computer science major and co-founder of GradeSnap.

Taking Entrepreneurship to the Next Level

RIT is developing additional course work in entrepreneurship, while seeking to expand opportunities for students and faculty to conduct external design and development projects. The Saunders College is also working to enhance partnerships with other academic programs on campus, such as the Department of Industrial Design, to further entrepreneurship avenues for its students.

DeMartino does stress that the entrepreneurship program at RIT is focused primarily on education. And success is not measured by the number of businesses created but by the number of students it reaches.

“We are centrally focused on creating educated, experienced graduates who can enter the entrepreneurial world with the skills necessary to succeed,” he adds. “The creation of successful companies and technologies is just an added bonus.”

On the Web

Saunders College of Business
saunders.rit.edu

The Simone Center
www.rit.edu/research/simonecenter

Venture Creations
www.rit.edu/research/vc



Steven Gold

StoreWorld: A “Fashionable” Business Game

The fashion industry has become big business for StoreWorld—a reality-driven social networking game making its debut on Facebook this fall.



David Schwartz

The game is a multidisciplinary effort developed by RIT faculty and students from the E. Philip Saunders College of Business, the B. Thomas Golisano College of Computing and Information Sciences, and the College of

Imaging Arts and Sciences.

StoreWorld is based on the success of Facebook’s FarmVille and It Girl, but with an entrepreneurial twist: players own a clothing store and must learn how to advertise, operate, manage, and compete against other mall stores and their owners.

According to Steven Gold, economics professor in the Saunders College, similar games cost \$6 to \$9 million to produce by private companies, so the competition is fierce.

“We devised the game to use in the classroom and it has all the elements of RIT’s introductory business course,” Gold adds. “It’s also a potential recruiting tool for high school students interested in coming to RIT.”

Three years in the making, approximately 30 student artists and programmers worked side by side in developing of the RIT-funded project.

“Artists developed the male and female avatar prototypes—drawing each frame like you would a cartoon; they also created the store, plaza, and clothing designs,” explains David Schwartz, associate professor in the School of Interactive Games and Media in the Golisano College. “And our student programmers added detailed directions to the basic recipe—testing and debugging until everything moved properly.”

According to Matthew Critelli, producer of the project and a fourth-year student in game design and development, programmers developed a database of 100,000 lines of code in 400 different classes for StoreWorld.

Fair warning: Don’t be fooled by the fun



StoreWorld is an online retail game designed to operate on the Facebook platform—where students can enhance skills in business, design, art and programming.

aspect of the game.

“Mistakes in marketing, inventory, and budgeting can be costly,” Gold says. “If you don’t know what you are doing, you will be out of business. The good part about StoreWorld is you aren’t losing a penny of your own money.”

Making Your Locker Your Own



Jason Shanley

Jason Shanley, a second-year business management student, owns the startup firm UrLocker, which allows students to express their individuality through specially designed covers for school lockers, cellphones, and laptops. The firm,

which Shanley started in high school, is in many respects an outgrowth of his own personality.

“I was always the person who painted myself blue for high school basketball games,” Shanley says. “I realized my locker couldn’t stand out from everybody else’s so I started making locker skins for myself, which led to other students asking, ‘Hey where can I get one of those?’”

Shanley further developed the idea and decided to start his own firm through his participation in the Young Entrepreneurs Academy (YEA), a regional entrepreneurship training program for middle and high school students. Through YEA he would also enter and ultimately win the Saunders Scholars Bright Ideas Business Plan Competition, beating out 589 competitors and earning a scholarship to RIT.

Since then, Shanley has continued to build the firm, expanding beyond lockers to include a wide variety of product types, and developing his own unique niche in the market.

“When I went to college, I didn’t have a locker but I realized ‘I have a laptop, I have a wall for a dry erase calendar, a mini fridge,’” Shanley adds. “Uniquely designed skins could be created for all of these devices and specifically target college students who are particularly interested in individualizing their ‘stuff.’”

Shanley notes that there are several companies currently making similar products but UrLocker is the only one targeting the student market. In addition, the company’s skins utilize a novel adhesive substrate, which makes them removable and reusable, and employ a unique pattern on the back that significantly reduces air bubbles.

The firm is already earning national attention. UrLocker was featured on an episode of the public television series *Biz Kids* and has been contacted by Cirque du Soleil, which is interested in ordering a shipment of skins for its workplace lockers. The firm is also in talks with several retail chains, including Staples and Barnes & Noble, to begin selling in their stores.

Shanley is currently participating in the Saunders College Summer Startup business training program, in which he is further developing his marketing plan, revenue model, and venture capital strategy. He also hopes to bring on additional employees and sales reps



UrLocker, a startup firm created by RIT student Jason Shanley, produces individually designed “skins” for all manner of devices, including laptops and cell phones.

and start marketing products at different universities around the country.

“UrLocker is a perfect example of how entrepreneurial drive can be developed into a successful business opportunity,” notes Rich Notargiacomo, a mentor for the Summer Startup program. “The Saunders College is dedicated to helping students like Jason take their ideas to the next level!”



**Rochester, New York—
A 3D Bird's-Eye View:**

The Consortium for 3D Innovation, a university/industry partnership led by RIT, seeks to produce novel 3D imaging technologies that can enhance data analysis in a host of fields, including navigation, disaster response, and environmental management.


TECHNOLOGY DEVELOPMENT

Accelerating Innovation

by Kathy Lindsley

A key factor in transforming ideas into innovation is connecting to the current needs of businesses and consumers. RIT is utilizing its historical closeness to industry to transform university research into technologies that can assist numerous companies in developing new products and processes. University researchers are currently working with industry partners and government sponsors to implement new technology innovations for use in 3D imaging, food processing, and cooling technology.

Focus on the Third Dimension

We live in a three-dimensional world. And yet, most images—think of maps and photos—are still 2D.

Imagine the uses for high-quality, real-world 3D imagery: navigation, emergency response, national defense, agriculture, environmental science, public safety, entertainment, tourism, transportation, municipal planning—these are only a few of the areas that could benefit.

In fact, the market for 3D technology could reach \$20 billion by 2015, according to industry analysts.

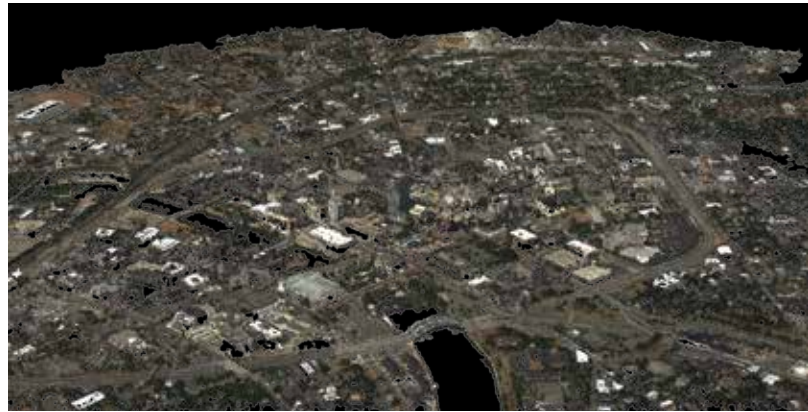
To build on research in this promising field, RIT's Chester F. Carlson Center for Imaging Science (CIS) has teamed up with three industry partners to create the Consortium for 3D Innovation. The consortium is funded through a \$1 million National Science Foundation Accelerating Innovation Research (AIR) grant and matching funds from corporate partners Exelis, Pictometry International, and Lockheed Martin.

"We are developing novel, semi-automated methods to extract 3D models from remote-sensing information," says Jan van Aardt, principal investigator and associate professor in the Digital Imaging and Remote Sensing group in CIS. "While 3D imaging has been available, producing the images has been labor-intensive and, therefore, expensive. We are focusing on increasing the automation, geographical extent, and quantifiable content for measuring 3D objects."

Creation of the 3D images involves use of 2D images captured using various remote-sensing techniques, such as airplane-mounted cameras and LIDAR (light detection and ranging). By using a large number of overlapping images, high-quality 3D is possible.

"This is beautiful data," says van Aardt. "We've all seen 3D movies; this is better, a 3D bird's-eye view with high-quality actual images. It's very exciting."

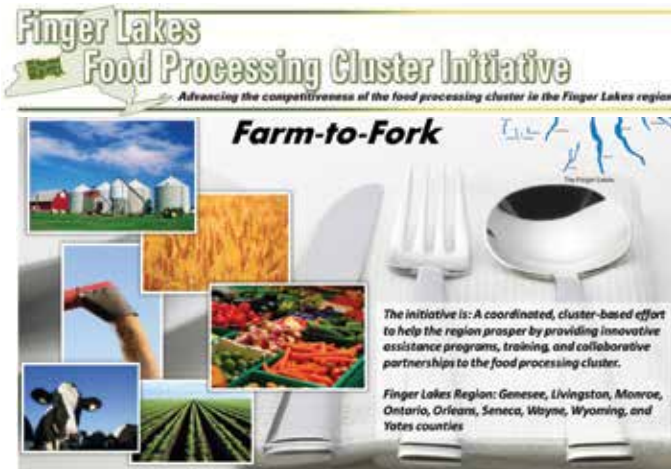
The RIT group includes scientists Carl Salvaggio, John Kerekes, and David Messinger, project manager Mike Richardson, and graduate students in the Center for Imaging Science, who will focus on 3D algorithm and product development. They will be



Promoting Industry Innovation: High-resolution, three-dimensional imagery, such as this image of the City of Rochester, is just one of the many technical innovations being developed by RIT and its industry partners. These efforts seek to transfer university research and expertise to industrial applications, develop better products and processes, and ultimately promote economic development and job creation.



Constructing the Three Dimension: The team is collaborating with Cornell to generate 3D images out of multiview, two-dimensional photos. Extracting data using sophisticated algorithms allows the team to construct a 3D version pixel by pixel, while retaining the quality of the original image.



Enhancing Food Processing: The Finger Lakes Food Processing Cluster Initiative is a multi-agency public/private collaboration led by RIT’s Center for Integrated Manufacturing Studies. The effort seeks to promote technology innovation and economic development in all aspects of food processing, from farm to fork.



Connecting the Dots: RIT hosted the Finger Lakes Food Cluster Conference on July 25, which showcased area firms and provided a host of information sessions on new innovations and best practices in the field.

joined by professor Hans-Peter Bischoff and students in computer science from RIT’s B. Thomas Golisano College of Computing and Information and Sciences who are working on coding of the algorithms for translation to industry partners’ product workflows. Richard DeMartino, director of RIT’s Simone Center for Student Innovation and Entrepreneurship, will direct students from the E. Philip Saunders College of Business working on market analysis for potential 3D products.

Noah Snavelly from Cornell University’s Computer Science Department has partnered with RIT to provide his expertise in generating 3D images from multiview 2D imagery. Snavelly is co-inventor of the technology used in Microsoft’s Photosynth.

This multidisciplinary team is focused on very specific goals: development of useful technology that can be put into

practical use as soon as possible.

“NSF and our partners want to see impact,” says van Aardt. “There’s a need for these products, both in terms of markets and societal impacts—it’s a win-win.”

Food and Jobs

LiDestri Foods, a Rochester-based manufacturer of sauces, salsas, and dips, buys huge quantities of tomato paste packed in plastic bags.

The company would like to recycle the empty bags, but they’re not clean enough. Washing the bags contaminates the water with tomato residue, which adds excess solid material to the wastewater treatment system. But if the water could be filtered, it could be reused for industrial purposes and the tomato residue could go into production of biofuel. And the bags could be recycled.

RIT’s Center for Integrated Manufac-

turing Studies—the technology transfer arm of RIT’s Golisano Institute for Sustainability (GIS)—is working with LiDestri to investigate potential recycling solutions as part of a broader effort to address these types of technology challenges and enhance productivity and competitiveness in the food processing industry.

The Finger Lakes Food Processing Cluster Initiative, led by CIMS, is an economic development project focused on businesses involved in any aspect of food production—from farm to fork. The effort is funded through a \$1.5 million grant through the U.S. Jobs and Innovation Accelerator Challenge and was created in 2011. It was the result of a competitive application process through the Department of Labor’s Employment and Training Administration, the Department of Commerce’s Economic Development Administration, and the



A Multi-Agency Effort: David Fister, right, a senior staff engineer at CIMS, discusses waste to energy research with Seth Harris, the Deputy Secretary of Labor, during a tour at RIT in May. Other cluster partners include the Department of Commerce and Small Business Administration.

This project is funded by a grant from the Small Business Administration, Department of Labor, and Department of Commerce. This funding should not be construed as an endorsement of any products, opinions, or services. All SBA/DOL/DOC projects are extended to the public on a nondiscriminatory basis.

Small Business Administration.

“The Finger Lakes Food Processing Cluster Initiative will provide the support, tools, and resources to jumpstart the local economy, linking our farms to food processors across the region, creating a sustainable workforce for our small businesses and helping bring our locally grown food to market,” says U.S. Senator Kirsten Gillibrand, a member of the Senate’s Agriculture Committee.

The project is an excellent fit for CIMS, says Nabil Nasr, director of the Golisano Institute for Sustainability and RIT Assistant Provost. “The center focuses on technology development and technology transfer, key aspects of this program. CIMS and the New York State Pollution Prevention Institute [another research center within GIS] have been working with companies in the food- processing industry for many years and we recognize the needs and opportunities.”

The center is working with a number of partners in the effort, including Monroe Community College, Genesee County Career Center, Finger Lakes Works, RochesterWorks!, three Small Business Development Centers, and the Cornell Agriculture and Food Technology Park. Services provided include specific technology transfer efforts to assist companies in developing more efficient and sustainable manufacturing processes, broader workforce training initiatives based on industry needs, and efforts to better connect individual businesses with area service providers.

“We seek to connect the dots between the needs of the food-processing industry and the government and university resources that are available to assist firms in this field,” explains Andy Harlan, assistant director of operations at CIMS and manager of the initiative.

As part of the effort, RIT hosted the

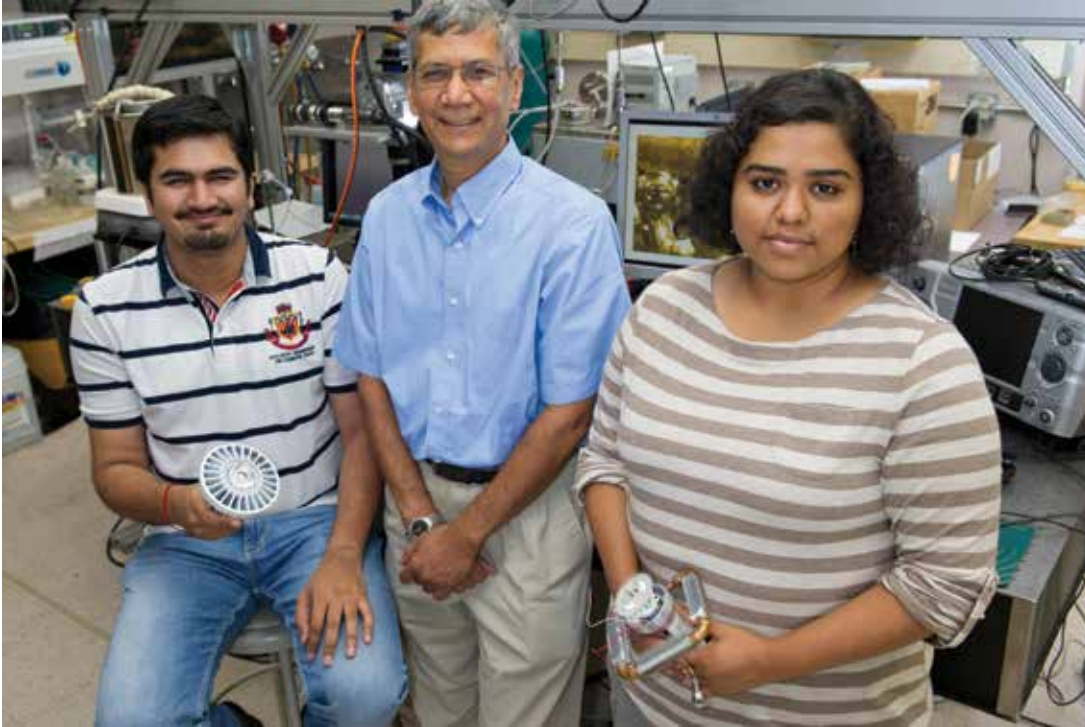
Finger Lakes Food Cluster Conference on July 25, which sought to enhance coordination between local agriculture and food processing businesses, area service agencies, and higher education institutions. Sessions focused on the development of local waste to energy initiatives, the use of innovative packaging designs, and the improvement of logistics and supply chain processes.

Seth Harris, U.S. Deputy Secretary of Labor, says the diverse range of connections that the initiative is able to leverage is essential to the program’s success.

“What I have found is where businesses come together with higher education, that’s where you have success,” Harris said on a visit to RIT in May. “That’s what we have here in Rochester.”

Teaching Future Entrepreneurs

Satish Kandlikar—the James E. Gleason Professor of Mechanical Engineering



Learning the Business Development Basics:

An RIT team that consisted of, from left to right, Ankit Kalani, Satish Kandlikar, and Kirthana Kripash, was one of only 21 in the nation selected to participate in the I-Corps program. They worked with NSF trainers and local mentors to assess the commercialization of novel cooling technology for the LED lighting industry.

in RIT's Kate Gleason College of Engineering—and two graduate students spent 12 weeks in “entrepreneur boot camp” offered by Stanford University last fall as part of the inaugural class of the Innovation Corps (I-Corps) sponsored by the National Science Foundation. They were one of only 21 teams selected nationally for the program.

“The United States has a long history of investing in—and deploying—technological advances derived from a foundation of basic research,” says NSF Director Subra Suresh. “And the NSF mission connects advancing the nation's prosperity and welfare with our passionate pursuit of scientific knowledge. I-Corps will help strengthen a national innovation ecosystem that firmly unites industry with scientific discoveries for the benefit of society.”

Kandlikar's team included Ankit Kalani, an MS student in mechanical engineering, and Kirthana Kripash, who in May received her MBA from Saunders College of Business.

The commercialization training course

was aimed at teaching the teams how to bring an idea to market, and included an assessment of the innovativeness of the technology and the marketability of potential products.

Kandlikar had developed a promising heat-transfer concept for cooling LED (light-emitting diode) lamps. The team's mentor was Rochester entrepreneur Suresh Sunderrajan, former president of NNCrystal Corp., an advanced materials company focused on the lighting industry.

“One of the key challenges facing the industry today is LED cooling,” says Sunderrajan, former director of Kodak's venture capital division. Kandlikar's research “looked like a fertile and timely opportunity to solve a fairly significant problem in the industry.”

As part of the process the team investigated other technology solutions that were being developed, potential competitors that were entering the market, and the startup capital that would be needed to commercialize their technology. They also were able to assess the overall business climate and other potential

roadblocks in creating a business.

“An important part of the entrepreneurship process is deciding if your innovation meets economic need,” adds Sunderrajan. “The I-Corps effort allowed us to undertake that assessment in a ‘safe’ environment. It also provided a better understanding of where opportunity might exist.”

In part due to his I-Corps experience, Sunderrajan's new company, Rochester-based Coolerix, is focusing on developing cooling technology for high-power semiconductor devices. Kandlikar, Kalani, and Kripash also stress that the I-Corps program was a tremendous learning experience that will greatly impact their future career paths. Kandlikar plans to fold the entrepreneurial training he received into his engineering classes and senior design project assignments.

“I was honored to have had this opportunity, and am very excited to be able to bring these new experiences to my students moving forward,” Kandlikar adds.

The Future of Packaging Technology

RIT has a long history of expertise in an extremely important if little thought of component of product delivery: packaging. From spaghetti sauce to televisions to medicine to nuclear materials, the packaging used to hold and transport items is nearly as important as the contents themselves. The university is currently partnering with American Packaging Corporation (APC), a longtime industrial leader in the field, to develop innovations in packaging science that can improve the overall quality of an innumerable variety of products.

"The physical failure of a package can destroy the value of an entire product," notes Dan Johnson, chair of Department of Packaging Science. "RIT and APC are combining their expertise in the field to develop novel materials, designs, and processes that will improve packaging quality and product delivery."

Thanks to an initial \$1 million gift from APC, RIT established the Center for Packaging Innovation in 2007. Earlier this year, APC committed to an additional \$1.2 million gift to upgrade equipment and facilities and enhance research and training programs being conducted through the center.

"The development and implementation of new materials and applications is critical to the continued success of both APC and the packaging industry as a whole," says Peter Schottland, CEO of American Packaging. "Our continued collaboration with RIT just makes good business sense."

The center conducts work in applied research, industrial training, and education with a particular focus on sustainability. This includes efforts to develop and test novel green materials such as biodegradable polymers and recyclable plastics. It has also partnered with other organizations to advance multiple aspects of packaging design, including a collaboration with NASA to develop flexible protective packaging for critical space hardware.

"Packaging design can be an extremely complex task because numerous factors play into how a

package looks and the materials that must be enclosed," notes Changfeng Ge, professor of packaging science at RIT. "We are creating scientifically accurate and reliable methods for assessing the needs of a particular product and then designing a package that meets that need, sustainably and inexpensively."



Next-Generation Packaging: Professor Chanfeng Ge, center, oversees an experiment being conducted by packaging science students Kai Lei, left, and Robert Aldi in RIT's Center for Packaging Innovation.

The center also works closely with RIT's bachelor's and master's degree programs in packaging science to assist students in improving design thinking, analysis, and prototyping skills. For example, the center has partnered with RIT's Department of Industrial Design to host an annual student design competition that pairs student teams with corporate partners to improve the packaging for current products. Previous company participants for the competition include General Mills, Kraft, and Colgate-Palmolive.

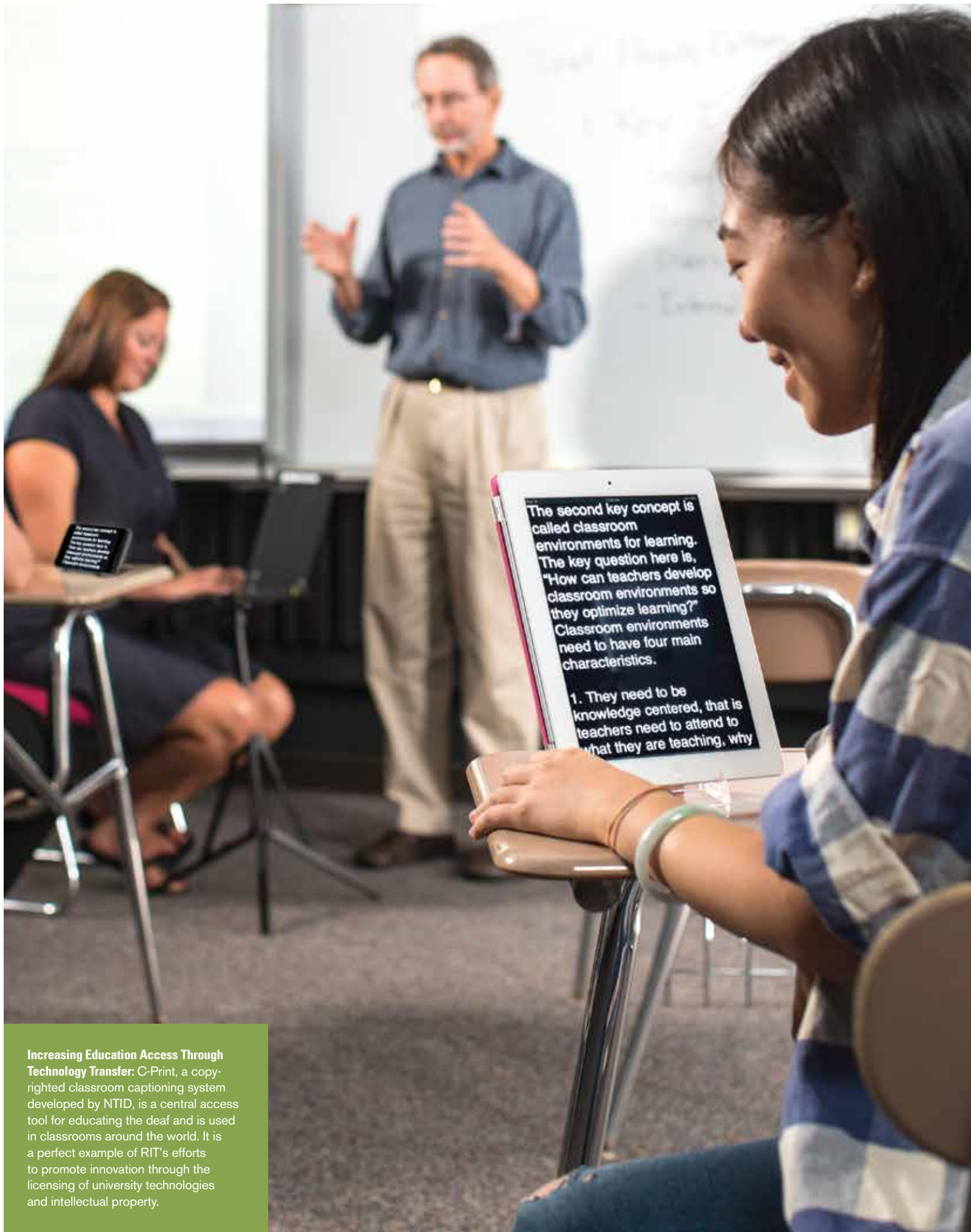
"One of our central goals is creating a new generation of packaging scientists and engineers who have the skills and expertise necessary to develop the next novel technology," adds Johnson. "Our students are one of the most important 'innovations' we produce." Moving forward, RIT and APC hope to

expand their research program with the development of a new center devoted to sustainable packaging. The effort will include multiple corporate sponsors and will focus on the implementation of materials and designs that specifically lower the overall environmental footprint of products.

"In many cases, the package contains the most waste of any portion of a product," Ge says. "We want to expand on our previous work in green materials and design to produce leaner, greener packaging designs that accomplish the same goal with less waste."

Johnson notes that the future direction of the center is in part based on the continued feedback on industry trends the partnership with APC provides.

"APC is on the front lines and understands the current needs of the industry," he adds. "Through our partnership we can take that knowledge and infuse it through the education and research we conduct on campus, providing innovative and timely solutions to the pressing problems the industry faces."



The second key concept is called classroom environments for learning. The key question here is, "How can teachers develop classroom environments so they optimize learning?" Classroom environments need to have four main characteristics.

1. They need to be knowledge centered, that is teachers need to attend to what they are teaching, why

Increasing Education Access Through Technology Transfer: C-Print, a copyrighted classroom captioning system developed by NTID, is a central access tool for educating the deaf and is used in classrooms around the world. It is a perfect example of RIT's efforts to promote innovation through the licensing of university technologies and intellectual property.


TECHNOLOGY TRANSFER

Access to Innovation

by Greg Livadas

RIT promotes access to university innovations through licensing of its patents, copyrights, and trademarks to existing corporations or new startup businesses. These commercialization efforts promote the transfer of research into real-world applications and can lead to the development of new product lines and business opportunities. C-Print™, classroom-captioning technology developed by the National Technical Institute for the Deaf, is a prime example of the benefits university innovation can provide to the broader community.

A Resource for Innovators of All Shapes and Sizes

A key facet of innovation is the identification, capture, and development of intellectual property (IP), whether the IP is a patent, copyright, or trademark. Innovation is realized when these novel technologies, designs, and inventions provide commercial value to society and creators. The development and commercialization of university IP, through technology licenses, can enrich the academic as well as financial returns to students, faculty, and staff.

“By properly assessing the value of innovations being developed on campus we can help creators maximize the impacts of their inventions and potentially promote business expansion and economic development,” notes William Bond,

director of RIT’s Intellectual Property Management Office (IPMO). “We also assist potential entrepreneurs in navigating the IP assessment and patenting process, which can be a major factor in the success of a startup.”

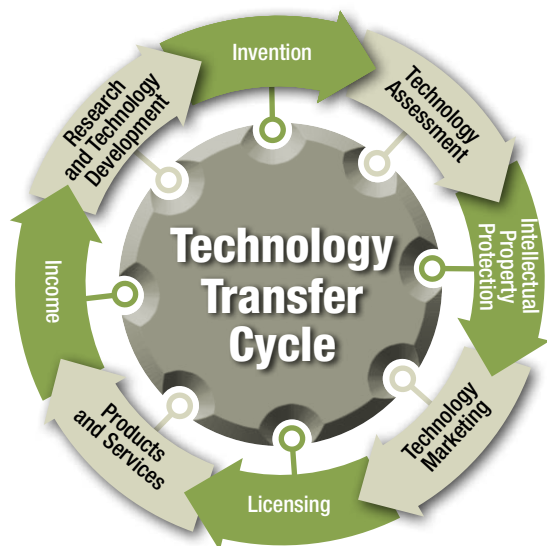
IPMO assists faculty, staff, and students in investigating potential patents, developing patent applications, and negotiating licenses with corporate partners. They also provide training for researchers on the steps they can take to properly manage IP they create and analyze the uniqueness and marketability of their research.

“A key component of innovation is determining whether what you have created is novel,” adds Bond. “We assist the RIT community in determining how its research and development can be applied and what commercialization avenues have the greatest potential for success.”

Over the years, IPMO has assisted in licensing numerous technologies to businesses around the world. It has also aided in the creation of several spinoff companies, including Vnomics, a maker of fleet-monitoring software for the commercial trucking industry, and Black Box Biometrics, a manufacturer of sensor devices designed to detect potential brain injury.



Promoting the Use of IP: William Bond, left, participates in a signing ceremony licensing technology to Vnomics, an RIT spinoff company led by David Chauncey. Bond directs RIT’s Intellectual Property Management Office, which promotes the use of RIT IP through the licensing of technology to a wide variety of businesses.



The Tech Transfer Cycle: Universities seek to expand the impact of faculty and student innovations through the licensing of patents, copyrights, and trademarks to existing corporations or new startup businesses. The process enhances real-world application of university research and promotes the development of new products and businesses.



Improved Captioning Systems for the Deaf: The C-Print system allows captionists to type in phonetic abbreviations that are then translated into wording by system software. It reduces stress on typists and allows students to keep pace with the classroom discussion.



Expanding Utilization: C-Print has been distributed to numerous service agencies and schools around the world and is now used in a wide variety of settings, including classrooms, laboratories, and work places.

One of RIT’s most successful technology transfer efforts has been C-Print, a copyrighted software package and captioning system developed at the National Technical Institute for the Deaf (NTID), which has greatly improved communication for deaf students in the classroom. The software package has been distributed to numerous school districts and service agencies around the world and current enhancements of the technology may only further its use in the future.

Increasing Communication Access

C-Print was first developed at RIT in the late 1980s as a way to help deaf and hard-of-hearing students understand what’s being said in the classroom.

At the time, the main form of classroom captioning was CART (Communication Access Real-time Translation), which uses trained stenographers and courtroom equipment to provide verbatim notes in classrooms. The stenographer produces

a display of the spoken words and the students may glance on a nearby computer screen to see what was typed to better follow along. Although CART is still used in schools around the country, the cost can often be prohibitive and it is difficult to find qualified stenographers because there are so few trained individuals available, especially in rural areas.

C-Print was created as a potential alternative to CART. The initial project was led by Michael Stinson, now professor at the National Technical Institute for the Deaf’s Center for Access Technology, as well as NTID colleagues Pamela Francis, Jeanette Henderson, and Barbara McKee. The concept was the same as other captioning systems—having a hearing individual provide information for deaf and hard-of-hearing students in the classroom—but the information was a meaning-for-meaning translation of the spoken word rather than verbatim.

Instead of typing in every word uttered,

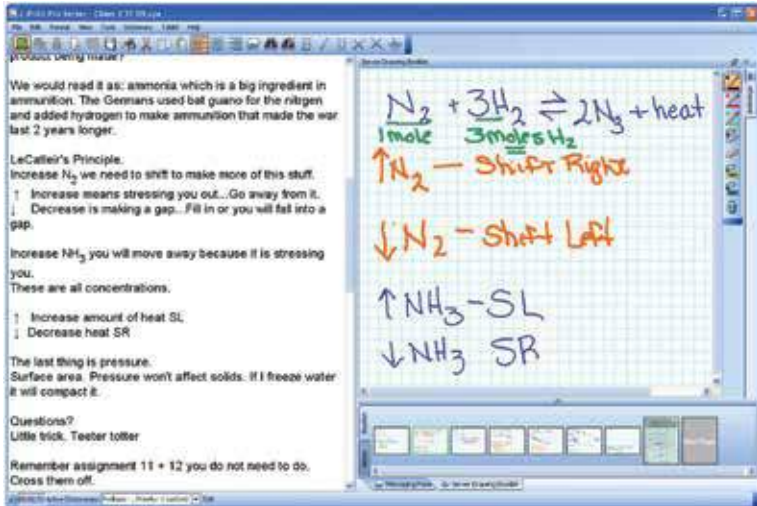
C-Print captionists type in phonetic abbreviations that are then translated into wording by system software. For example, typing “kfe” will lead to “coffee” appearing on the screen of the student. This saves the captionist time and keystrokes while allowing the deaf student to keep pace with the classroom discussion.

Through research from a 1993 grant from the U.S. Department of Education’s Office of Special Education, C-Print’s internal dictionary was refined to enhance the number and quality of its phonetic abbreviations. Today, the C-Print general dictionary contains a host of commonly used words, and technical terms can be added as necessary to assist captionists and students in more STEM-focused settings.

Improving Learning and Integration

Kaitlin Hoyt, 21, a biology major from Verbank, N.Y., had her first experience with C-Print her first day as a freshman at RIT.

“It was quite the experience,” she says.



Not Just Text Anymore: The latest research version of C-Print software allows users to make notations and utilize graphics and even video, further enhancing the uses for and impact of the technology.



C-Print Tablet: NTID engineers have created a version of the technology allowing for expanded mobility and use in lab settings, tours, and informal meetings where a laptop is infeasible.

“I didn’t know what C-Print would look like or how it would work. But it was really cool to see it in action the first time.

“I find it really helpful because it makes it easier to catch everything the professor says,” Hoyt continues. “If I miss a word while lip reading or while taking notes, I can look down at the C-Print computer screen and catch what I missed.”

Hoyt says C-Print also helps her communicate with her fellow students. “If I can’t understand what they’re saying, the captionist usually does and types it out for me. It’s a lot easier than saying ‘What?’ all the time!”

In 2005, a research prototype of the C-Print software that works with a tablet PC was added to C-Print’s portfolio to further expand the information available to student users. The tablet prototype allows graphics, including charts and formulas, to be drawn and shown on the screen. Voice recognition technology also has been experimented with—using the

captionist to re-speak the spoken words into a dictation mask.

Expanding Use at RIT and Beyond

Demand for C-Print services is increasing at RIT, not only because more deaf and hard-of-hearing students are cross-registered in RIT’s other eight colleges, but because more students arrive without knowing sign language and wouldn’t benefit from an interpreter.

Last year, RIT’s 55 captionists provided 22,600 hours of real-time classroom captioning. The numbers are increasing steadily, from 15,000 hours in 2007 to 19,000 hours in 2010, says Rico Peterson, NTID’s assistant dean and director of Access Services. Personnel have been added to accommodate the demand for C-Print services.

“Now students want both interpreters and C-Print captioning,” Stinson says. “The notes produced with C-Print are just as important.”

And the benefits of C-Print aren’t limited to classrooms. It is requested and used in nonacademic settings on the RIT campus, including sorority meetings, open houses, student club meetings, orientation programs, and financial aid sessions.

In addition, the system is now utilized by schools and agencies across the country and has become one of the more popular captioning systems in use. In fact, more than 20 years after its inception, C-Print is now used in classrooms in 48 states, and more than 1,800 captionists have been trained to use the technology, Stinson says.

“The reward is that you really are helping deaf students in the classroom,” Stinson adds.

C-Print 2.0

What already is a good accessibility tool will become even better, as more changes are in store for C-Print. The next genera-



Two Decades of Research: Pamela Francis and Michael Stinson, with a team of researchers, engineers, and students, have spent 20 years developing and expanding the C-Print captioning system.

tion will help align captions with videos and other graphics.

“The next generation of C-Print software currently is under development,” says James J. DeCaro, director of NTID’s Center on Access Technology. “If you like C-Print, you haven’t seen anything yet.”

Testing is underway for a mobile C-Print service. Funded by the National Science Foundation’s Research in Disabilities Education program, 30 students nationwide—20 at RIT, and the rest at Tulsa Community College, Louisiana State University, and the University of Wisconsin at Milwaukee—have experimented with C-Print mobile the past two years.

The system is more suited for active situations, where students aren’t sitting in one spot, but moving where it would be difficult to continuously stay near a computer screen.

To provide remote service, teachers wear a Bluetooth microphone, and the C-Print captionist—who is in another location—types in the same way as when providing in-class service. The student sees the typed information on the screen of a smartphone, iPad, or another type of communication device.

“What is unique about this is the ability to view the information on many different devices,” Stinson says.

Making a Difference for Students

So far, C-Print mobile is getting rave reviews from the students who have tested it.

“I couldn’t understand why the mobile version wasn’t used before!” says Edgar Triano, an RIT/NTID student from Spring Valley, N.Y. “It’s not only easier to use, but it takes up less space and can easily be moved around, which is

extremely convenient for me, especially for lab assignments where I constantly have to move around.”

Stinson also sees a potential for remote captioning, where the captionist is in another city than the teacher or student, allowing rural districts to take advantage of services that may be miles or states away.

As technological advancements are created and adopted to provide better access in classrooms for deaf and hard-of-hearing students, an increase in their participation and motivation for learning can be expected.

“C-Print really does make a difference,” Stinson says. “Students feel like they have support that helps them succeed.”

On the Web

To learn more about C-Print visit www.ntid.rit.edu/cprint

Enhancing Mobile Phone Access for the Deaf



Gary Behm

A team of faculty and students with NTID's Center on Access Technology (CAT) has developed a new intelligent electronic platform that could greatly increase the use of a host of technologies by the deaf and hard-of-hearing. The platform CAT CLAW, named in honor of RIT's Tiger mascot, provides a cost-effective customizable technical solution for different applications that will benefit deaf and hard-of-hearing people.

"Many electronic device functions, such as vibration settings on a smartphone or the sound notification on hematology instrumentation, have not been designed with deaf people in mind," notes Gary Behm, director of the CAT Innovation Lab and lead developer on the project. "The CAT CLAW, based on a micro-controller with Blue Tooth technology, can connect with these devices and provide a more robust, easily discernible alert."

The CAT team worked with ZVRS, Inc., a relay service provider, to produce a customized application for use with smartphones.

The team worked with RIT's Intellectual Property Management Office to license CLAW technology to ZVRS and worked with the firm to develop specs, hardware components, and software code for the device.

"The project had multiple design components and required a significant amount of collaboration between software and hardware designers at RIT and engineers at ZVRS throughout the product development phase," notes Brian Trager, assistant professor of information technology.

The finished solution, which now is being produced by ZVRS, includes a pocket-sized device that looks like a memory stick and a smartphone application. It remotely links to the phone ringer and can provide a wide variety of alerts, including robust vibration and blinking lights.

"The device we developed is easy to use, relatively inexpensive, easily portable, and meets a significant market need," adds Joseph Stanislaw, assistant professor of information and computing studies.

The team will continue to work with ZVRS on next-generation versions of the solution and will also look to partner with other corporations on additional applications for the technology.



NTID's Center for Access Technology developed the CAT Claw, a software/hardware application that integrates with a smartphone to provide enhanced signal-alerting solutions for the deaf and hard of hearing.

"It is our hope that this technology can ultimately be used to improve access to a wide variety of electronic and communication devices, while meeting CAT's mission to develop access technologies for individuals who are deaf and hard-of-hearing," Behm says.

Making Telecom Smarter



Robert Bowman

RIT engineers are working with the telecommunications industry to develop new technology that could improve the quality of telecom networks and reduce the overall costs associated with these systems.

A team led by Robert Bowman, professor of electrical engineering, has been conducting a multiyear effort with PPC Corp., a maker of telecommunications connectors, to develop the Smart Sensor. Installed in the connecting units of coaxial cables, the sensor system can provide information about equipment degradation and signal integrity and report the status to managers or crews in the field.

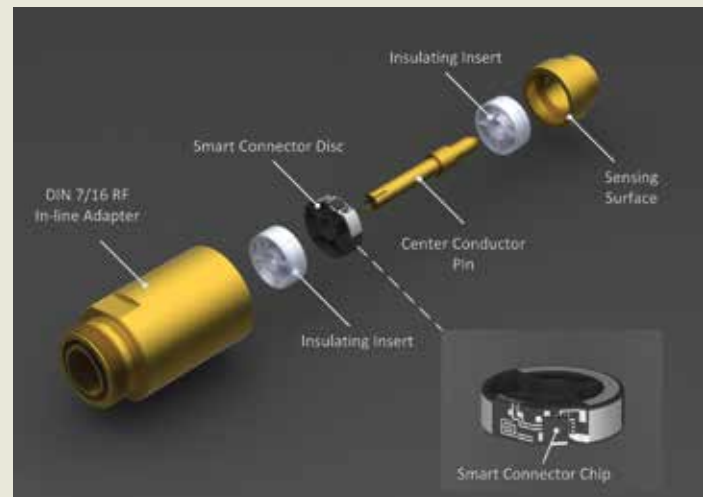
"A key issue in the management of telecommunications systems involves the telecom connectors that are used to link coaxial cable on cellphone towers," notes Bowman. "A failure with a connector, which can be caused by a loosening connector or excess moisture, can knock out an entire telecom network."

The Smart Sensor uses sophisticated, self-diagnosing technology and diagnostics to assess overall system quality and predict component failure. Using backscatter telemetry, the sensor can report the exact location of

connectors needing repair. It is also designed to extract energy from a radio frequency source, which is converted to power the IC chip or "brains" of the sensor, eliminating the need for an external power source.

"This technology is really exciting, and the impact it could have on the industry is only just becoming apparent," says Noah Montena, principal engineer at PPC who worked with Bowman on design and prototyping of the device. "Up until now, connector and equipment failures could be detected only after tower capacity had been diminished, and only pinpointed on-site with the system shut down."

Following the success of the initial effort the team worked with RIT's Intellectual Property Management Office to patent technology developed through the project and license it to PPC. The company is currently developing the Smart Sensor for use in its existing products, while the RIT team is investigating other potential applications for the technology.



The Smart Sensor, pictured in the above design schematic, was developed by RIT and PPC, Inc., to improve the quality and durability of telecommunication networks.

"We are now conducting extensive testing on an array of designs to verify our mathematical models and to provide a set of guidelines to aid prospective companies or organizations interested in building their own smart sensing equipment," Bowman adds.



Creating Economic Value:

RIT's efforts in innovation and entrepreneurship often culminate with the creation of new companies based on university research or student ideas. Blackbox Biometrics, a startup firm in the Venture Creations Incubator, was spun out of electrical engineering research conducted by RIT professor David Borkholder. The company is developing dosimeter devices for the U.S. military that could assist in reducing the incidence of traumatic brain injury suffered by soldiers in the field.

COMPANY CREATION

From Research to Business Creation

by William Dube

RIT's Venture Creations (VC) business incubator represents the culmination of the innovation pipeline, providing a business creation outlet for the RIT community and an economic driver for the region. Its Clean Energy Incubator (CEI) as well as tenants Blackbox Biometrics and FluxData Inc., exemplify this transformation of academic research and ideas to economic development.

Enhancing the Entrepreneurship Environment

"Venture Creations works with RIT faculty, students, alumni, and staff to transform university R&D and business ideas into concrete development plans and working companies," notes Bill Jones, the incubator director. "We really try to take the entrepreneurial spirit created on campus and transform it into business development."

Jones' team works closely with the Simone Center, the Intellectual Property Management Office, and other university departments to identify potential entrepreneurs and marketable technology. They then assist incubator companies in developing a business model, assessing potential competitors, and analyzing the components necessary to bring a product to market. Venture Creations also assists in identifying RIT expertise that can assist with product testing and process improvement.

Notable graduates of Venture Creations include Opticool Technologies, a maker of novel cooling systems for large computer data centers, Cerion Energy, a manufacturer of eco-friendly diesel fuel additives, and Sweetwater Energy, which produces low-cost, concentrated sugars for use in biodiesel and biochemical manufacturing. All three have set up stand-alone facilities in the Rochester community that are producing jobs and economic development for the region.

In addition, several incubator firms have been purchased by larger companies, showcasing the growing national recognition for RIT's business creation efforts. For example, the social networking company dotSyntax was purchased by Tagged.com in 2011, the third largest social network in the world. Also, in 2012 the software firm Palantiri Systems was acquired by the app development company ThinkWorx.

"The success of our graduates illustrates the potential for university-led incubation as well as the potential that exists on campus," Jones adds.

The Clean Energy Incubator, BlackBox, and FluxData further exemplify how the incubation process works in practice and showcase the positive outcomes of technology transfer.



biodiesel and biochemical manufacturing. All three have set up stand-alone facilities in the Rochester community that

Venture Creations



Connecting R&D and Economic Development: RIT Venture Creations, led by Bill Jones, assists faculty and students in assessing the economic potential of their innovations and creating concrete development plans that can lead to successful startups.



An R&D Resource: Mark Coleman, CEI's manager of technical development at the Clean Energy Incubator, discusses incubator activities during Earth Day celebrations on campus. CEI works closely with RIT research labs to provide tenants with the needed expertise to improve the quality and commercial viability of clean energy technologies.

The Clean Energy Incubator



The Clean Energy Incubator The New Energy Economy

RIT has long been a center of alternative energy innovation featuring cutting-edge research in sustainable mobility, solar energy, and fuel cell design. The university's Clean Energy Incubator (CEI), a partnership between Venture Creations and the Golisano Institute for Sustainability (GIS), builds on that track record by helping to transition these innovations into clean energy startups and utilizing RIT's expertise to assist additional early stage companies.

"A common resource that many potential startups lack is the technical capacity to test and improve designs, prototype products, and conduct detailed market assessments," notes Nabil Nasr, director of GIS. "CEI helps RIT researchers investigate the business potential of their clean energy innovations, while also providing access to the technical skills incubator tenants need to be successful."

CEI was founded in 2009, thanks to a grant from the New York State Energy Research and Development Authority (NYSERDA). It is one of six NYSERDA incubators in the state and focuses on promoting job creation and clean energy business development in the Finger Lakes Region. CEI's nine tenants and three recent graduates currently account for 79 jobs and have raised over \$22 million in private capital.

"The state's clean energy incubator program is fostering ideas from concept to commercialization, thereby supporting the growth of the clean energy industry in New York," adds Frank Murray, CEO of NYSERDA.



A Statewide Effort: Frank Murray (center), president of the New York State Energy Research and Development Authority, conducts a tour of RIT's energy research facilities. NYSERDA funded the Clean Energy Incubator to promote the new energy economy in the Finger Lakes Region. It is one of six new energy incubators in the state.

A Platform for Success

"CEI exemplifies the symbiotic relationship between university-based innovation and commercialization," says Mark Coleman, a senior program manager with the Golisano Institute and the incubator's manager of technical development. "We work with RIT faculty, researchers, staff, and students to support tenants in transforming new technology into marketable products that can ultimately lead to sales, production buildup, graduation, and the creation of stand-alone facilities."

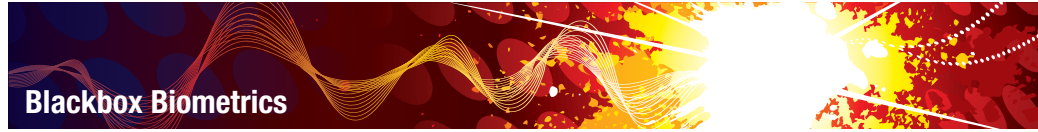
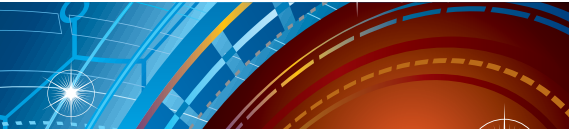
For example, incubator tenant RNY Solar is utilizing RIT expertise to enhance the development of novel solar cell technology that could greatly increase the efficiency and quality of traditional solar energy systems. The firm is working with Seth Hubbard, associate professor of physics and a researcher in the NanoPower Research Labs, on a NYSERDA-funded effort to test a prototype spectral-splitting concentrated photovoltaic system. It splits light into

multiple spectral bands, which are then focused on specific components of the solar cell, greatly increasing the efficiency in which light is converted to electricity. The system's solar-to-electrical efficiency could reach 40%, compared with the 28% efficiency of current commercial systems.

"Professor Hubbard's expertise along with the access to RIT lab facilities has been invaluable as we develop and test our second-generation prototype and prepare to offer products for market," adds Jim Munro, RNY Solar's chief technology officer.



A Leader in Telematics: Vnomics was spun out of research conducted by RIT's Golisano Institute for Sustainability. The firm produces sensor systems that can enhance the efficiency and quality of large vehicle fleets.



Blackbox Biometrics



Research to Innovation: Vnomics initially developed out of fleet management research conducted by RIT's Golisano Institute for Sustainability. Above, GIS engineer Allan Luccitti tests vehicle sensors created through a grant from the Office of Naval Research.

From Startups to Small Businesses

As firms graduate from the incubator they are able to move out of the startup phase and ultimately branch out to become successful small businesses.

Recent graduate Vnomics is considered a leader in the growing field of telematics, the integration of telecommunications and informatics. It has developed novel fleet monitoring technology, which integrates vehicle sensor systems and information on potential mechanical issues into a single communication flow that can be transmitted to drivers and fleet managers. The system can greatly improve preventive maintenance, driver training, and overall fleet management, and has the potential to increase fuel efficiency and enhance the integration of alternative fuel vehicles into large public and private fleets.

The company currently has business relationships with a host of corporations and government agencies, including the Department of Defense, AmeriQuest Transportation Services, and Klein Steel

Service. In 2011, its software package FleetKnowSys was a finalist for an International Telematics Award in the Best Telematics Service for Commercial Vehicles category.

Vnomics was initially spun out of research conducted by the Golisano Institute and has licensed several patents and software copyrights developed by the center. The company continues to partner with GIS researchers for assistance in initial prototyping and testing, software support, and new product development.

"Being located in CEI has been critical to our success," says Ed McCarthy, vice president for engineering at Vnomics. "The incubator gave us all the conditions we needed to grow, from office space, to access to university resources, to a networking infrastructure. These resources have been invaluable to us."



Blackbox Biometrics (B3) Reducing Traumatic Brain Injury

According to the Defense and Veteran's Brain Injury Center, close to 200,000 American servicemen and women have suffered a traumatic brain injury over the last decade. David Borkholder, RIT associate professor of electrical and microelectronic engineering and founder of Blackbox Biometrics, notes that a large number of these injuries are caused by the supersonic waves that accompany a blast, which can move through the cranial cavity, causing stress and strain on the brain.

"This wave can affect people who are not in close proximity to the explosion and often leaves little physical evidence that an injury has been suffered, making it difficult to identify individuals requiring immediate treatment," he adds.

Borkholder founded B3 to assist the Defense Advanced Research Projects

Agency (DARPA) in producing a portable dosimeter sensor or blast gauge, which can be worn on the helmet or uniform. The device monitors wave exposure and alerts personnel if further medical review should be pursued. The company, which is just over a year old, currently has 13 full-time and four part-time employees and is ramping up to support over 13,000 troops currently serving on active duty.

Designing a Solution

Borkholder and a team of RIT professors and students originally worked with DARPA to research, develop, and pilot the blast gauge. The initial device was field tested and validated by RIT in concert with DARPA engineers and military personnel in 2011. Following the successful completion of the testing phase DARPA was interested in expanding deployment of the blast gauge and discussed potential options with Borkholder and RIT.

"I had been involved with several previous startup companies and saw good market opportunities for the blast gauge," Borkholder says. "In addition, I was committed to ensuring the technology would be widely available for our troops and wanted to see it through to its implementation phase."



Protecting Soldiers in the Field: The blast gauge was originally developed through a research project funded by DARPA to better analyze the impact of concussive forces and reduce injury to soldiers. Above, a soldier wears a head-mounted blast gauge while on patrol.



A Stand-Alone Small Business: Blackbox Biometrics, which is just over a year old, currently has 13 full-time and four part-time employees and is ramping up to support over 13,000 troops currently serving on active duty.

Borkholder ultimately decided to start B3 and worked with RIT's Intellectual Property Management Office to license the technology developed under the research contract to the new startup. RIT has also applied for three patents related to the project.

The company joined Venture Creations in June 2011 and incubator staff assisted Borkholder in developing design and manufacturing space, while also supporting his search for a president and chief operations officer.

"The assistance of RIT and Venture Creations in the initial development of the company was extremely helpful in getting this off the ground," he adds.

Producing a Product

B3 brought on Joe Bridgeford, a veteran business executive, to serve as President

and COO in June of 2011. The company received its initial contract in July, and began shipping blast gauges to DARPA in October of that year. Having completed the initial delivery cycle, B3 is currently ramping up production to provide additional gauges to DARPA and transition to additional customers in the Department of Defense. DARPA and B3 will use the data collected from this deployment to assess the overall accuracy of the gauge and implement additional design improvements.

Borkholder and Bridgeford are now investigating new markets for the technology, including additional military and medical applications. They are also using the gauge to test novel ultra low power accelerometers, which could greatly increase battery life of the blast gauge.

"B3 currently has the technical and

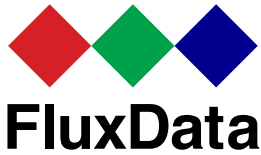
operational competency and capability to further develop and deploy this custom device and data recording solution to assist in reducing brain injury," Bridgeford says. "The proximity to RIT allows access to talent and research resources that will enable further advancement of our technology and our overall development as a company."

Note:

The views, opinions, and/or findings contained in this article are those of the author and should not be interpreted as representing the official views or policies, either expressed or implied, of the Defense Advanced Research Projects Agency or the Department of Defense.

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FluxData Inc.

**FluxData Inc.****Enhancing Multispectral Imaging**

Multispectral imaging captures data at multiple frequencies along the electromagnetic spectrum and can be used to collect information beyond the range of the human visual system. It is a central technique used in space-based remote sensing and imaging science research and the systems created need to be highly sensitive and calibrated on a task-specific basis.

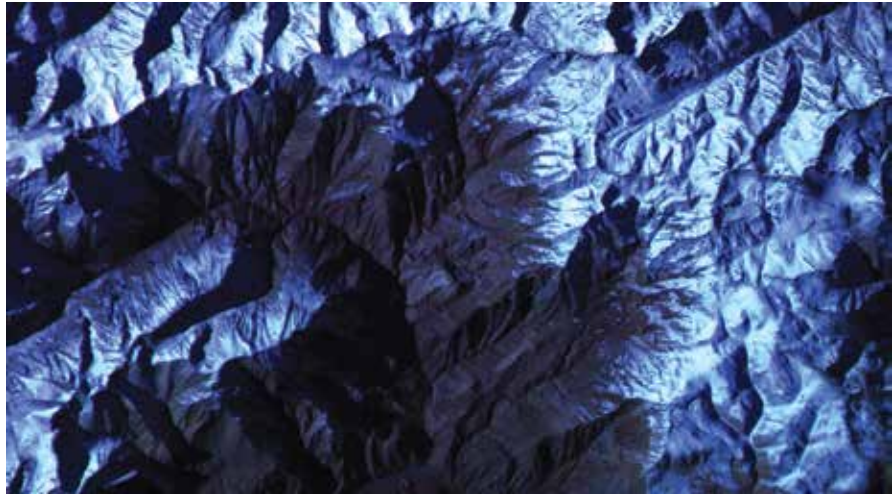
Pano Spiliotis and Lawrence Taplin are using their unique knowledge of the needs of imaging scientists to provide state-of-the-art multispectral imaging systems through their company FluxData Inc., which was founded in 2006 and is currently housed at Venture Creations.

Spiliotis holds a BS in imaging science from RIT and previously worked for several imaging equipment designers, while Taplin holds a master's degree in RIT's color science program and is a former staffer with the Munsell Color Science Lab.

"Our backgrounds and continued closeness to researchers at RIT gave us a unique perspective of the types of



Imaging Entrepreneurs: RIT alumni (from left to right) Pano Spiliotis, Lawrence Taplin, and Tracie Spiliotis founded FluxData in 2006. Today the company is a leading developer of high-quality, multispectral imaging systems for the military, environmental, remote-sensing, and astrophysics industries.



A View from the Space Station: FluxData collaborated with NASA and the University of North Dakota to develop and install the International Space Station Agricultural Camera. Above is an image of the Andes Glacier taken earlier this year.

systems that the community required," notes Spiliotis, who also holds an MBA from RIT. "Lawrence and I felt there was an opportunity to develop higher quality, more sensitive sensors that could increase the possible applications for multispectral technology."

A Leader in the Field

The company, which was co-founded with Spiliotis' wife, Tracie, an RIT MBA graduate, has become a key supplier of multispectral imaging systems with a host of national and international customers. These include the Department of Defense, NASA, and General Electric.

"We work with our clients to customize multispectral cameras and spectroradiometers, which measure illumination power, for use in medical imaging, remote sensing, and satellite imaging," Taplin says. "Our systems can capture three to nine spectral bands simultaneously and 30 frames per second."

FluxData earned major notice in 2011 when it collaborated with NASA and the University of North Dakota to develop and install the International Space Station Agricultural Camera. It is being used to study dynamic Earth processes around

the world, including melting glaciers, ecosystem responses to seasonal changes, and the development of natural disasters.

"The Space Station project was particularly exciting because it gave us a chance to modify our technology for an unusual environment, while also allowing us to contribute to an important scientific project that will have major benefits for society," Spiliotis adds.

A Continued Connection

Over the years the company has also continued to work with the Munsell Lab to improve design of its product lines and worked with MBA students through RIT's E. Philip Saunders College of Business to investigate additional market opportunities. RIT recently licensed novel multispectral image capture technology, based on a patent by Roy Berns, director of the Munsell Lab, to FluxData. Spiliotis and Taplin hope to incorporate it into the development of new multispectral sensors they are currently designing.

"The Munsell Lab and RIT have been a central resource for FluxData since our founding and we hope to continue to expand that relationship as we move the company forward," Taplin says.

Innovation and Entrepreneurship

Interesting Facts and Figures

by William Dube

RIT's faculty, staff, students, and alumni have made significant contributions to the development of technological innovations, creative arts, and education. Below we highlight specific areas of accomplishment in innovation and entrepreneurship.



RIT founded the Innovation Hall of Fame in 2010 to recognize faculty, staff, alumni, and partners who have greatly advanced the artistic, creative, and/or technical development of a profession or industry. The 2012 inductees include:



Dean Kamen is one of America's most prominent inventors, creating the first drug infusion pump and the Segway Human Transporter. Kamen was RIT's 2005 commencement speaker.



Patricia Moore '74 (design) is an internationally renowned gerontologist and designer, and a pioneer in the development of Universal Design theory.



Kevin Surace '85 (electrical engineering technology) is a leading technology entrepreneur and the cofounder and chairman of the board of Serious Energy, a sustainable building materials firm.



Aileen Osborn Webb (1892-1979) was a leading figure in the American Arts and Crafts Movement and was instrumental in bringing the School for American Crafts to RIT in 1950.

Corporate Engagement and Tech Transfer:

- ▶ RIT brought in \$9.3 million in corporate research, which is 24.8% of total research funding, for fiscal year 2012.
- ▶ Over the last five years, faculty and staff have been issued 26 patents and signed 14 technology license agreements with corporate partners.
- ▶ In 2012, the Simone Center for Student Innovation and Entrepreneurship was named the number-one student incubator by BestCollegesOnline.com.

Student Achievements

The multi-university, student team inSight, which includes imaging science doctoral student

Siddharth Khular, received an IDEAS Global Challenge Award presented by MIT. The team developed an electronic retina imager that allows for early diagnosis of diabetic retinopathy.



Suzanne Lefevre, a senior graphic and interior design major, was selected as one of four winners of the 26th annual Surtex DesignNext Competition, which called for innovative surface designs centered on Outdoor Celebrations in the Year 2020.



Industrial design graduate students **Jason Liu** and **Danwei Ye** and computer graphic design graduate student **Yakun Zhang** received a Best 100 Award as part of the 2012 International Forum Design Concept Competition.



Tom Zogas, a fifth-year glass major, and **Dan Ipp**, a 2012 industrial design graduate, were the first college students to be selected to participate in the Corning Museum of Glass' GlassLab. The performance-based initiative pairs designers and artists in public design sessions and work-



shops, which are focused on creating unique and innovative forms and design prototypes using glass as the central medium.

RIT students **Sean Petterson** and **Justin Hillery**, inventors of the Strong Arm Ergonomic Lifting Safety System, placed first overall at the 2012 Open Minds Competition, sponsored by the National Collegiate Inventors and Innovators Alliance. The team also won the 2012 New York State Business



Plan Competition, and were accepted into the 2012 MassChallenge Startup Accelerator, one of the nation's most prestigious student incubators.

The video game *Fade: Case of the Stolen Diamonds*, developed by RIT students **Dan Sternfeld** and **Frank Tufano** and alumnus **Benjamin Saxe**, was named one of the 20 Best iPhone and iPad Games of 2012 by slidetoplay.com. The game is currently available through iTunes.



Alumni Inventors and Entrepreneurs



The online shopping website Milo.com, cofounded by **Ted Dziuba** '06 (computational math), was purchased by eBay for \$75 million in 2011.



Serial entrepreneur **Robert Fabbio** '85 (MS computer science) has started multiple startups over a 30-year career, including Tivoli, which was purchased by IBM, and DAZEL Corp., which was acquired by Hewlett Packard. His current startup, the telemedicine firm Whiteglove Health, announced in 2012 that it had secured \$29 million in venture capital funding.



Alex Kipman '01 (software engineering) was selected as the 2012 National Inventor of the Year by the Intellectual Property Owners Education Foundation. The Microsoft engineer is the primary inventor of Kinect, the motion-sensing input device developed for the Xbox 360 and Windows PCs.



Pictometry International, cofounded by **Stephen Schultz** '89 (computer science), is the world's largest digital, oblique aerial photography company. Schultz and his wife Vicki '94 (management) received RIT's outstanding alumni award in 2012.

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RESEARCH opportunities for your products and systems

RECRUIT talented RIT students and alumni to work for you

RIT's Corporate Gateway is the online starting point for reaching corporate partnership groups within RIT. Whether you want to find the best co-op student or graduate to fill a post at your company, leverage RIT's unique skills through joint research projects, or connect with RIT faculty or alumni to further your business goals, the Corporate Gateway will start you on the right path.

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Rochester Institute of Technology is internationally recognized for academic leadership in computing, engineering, imaging technology, sustainability, and fine and applied arts, in addition to unparalleled support services for deaf and hard-of-hearing students.

For two decades, *U.S. News & World Report* has ranked RIT among the nation's leading comprehensive universities. RIT is featured in *The Princeton Review's* 2012 edition of *The Best 376 Colleges* as well as its *Guide to 322 Green Colleges*. *The Fiske Guide to Colleges 2011* lists RIT among more than 300 of the country's most interesting colleges and universities.

Contact Information

To learn more about research opportunities on campus, contact us directly or through the RIT research website at www.rit.edu/research.

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