Closing the Education Gap
Preparation the next generation of composites professionals requires strong ties between industry and academia.

By Susan Keen Flynn

If you ask owners or managers of composites companies to name their top business challenges, you'll likely hear this among the answers: "I just can’t find enough skilled, educated employees!"

Yet an online search for "composite technology programs in college" yields more than 1.8 million hits. So why do businesses have such a hard time finding solid employees?

There's a fundamental disconnect between industry and academia, says Steve Von Vogt, executive director of the Maine Composites Alliance, a group of more than 60 composites companies. "Education needs industry input to be relevant. Industry needs enlightened science and training to lift the level of technical competency and competitiveness," he says. "But too often, academic institutions and industry are terribly misaligned."

When the two come together in a symbiotic relationship, the results are impressive. There's more than one way to forge a successful partnership between industry and academia, as the following examples from three composites education programs show.

Sharing Assets Benefits College and Companies

When students leave the Composite Science and Manufacturing Program at Southern Maine Community College (SMCC) in South Portland, Maine, they hit the ground running. Andy Schoenberg, department chair for the program, recalls the difference a handful of recent graduates made at a local composites company.

The company, which typically handles small orders, landed a high-volume project. "When they manufactured the first order, they had a 50 percent reject rate," says Schoenberg. One former student told Schoenberg he was afraid of losing his job, even though he had ideas on how to improve the process based on what he learned at SMCC. Schoenberg encouraged the graduate to show initiative at his new company. "So he created standard operating procedures, wrote the chemical mix logs and put together the necessary structure and paperwork," says Schoenberg. "They went from a 50 percent reject rate to zero."

SMCC's Composite Science and Manufacturing Program just finished its fourth academic year. Approximately 30 students are enrolled in the program, which confers an associate in applied science degree upon graduation. Students follow two paths—a straight associate's degree or a pre-engineering path allowing...
them to move into the bachelor’s degree program at University of Massachusetts Lowell. All students leave SMCC able to:

- Use common processes to develop, manufacture and repair composite materials.

- Understand the properties of materials and material selection.

- Apply quality systems to composite manufacturing and product testing.

- Explain the underlying scientific principles relevant to composites.

The aim is to train students who are ready to enter the workforce. SMCC ensures its graduates are prepared in collaboration with the Maine Composites Alliance, which teamed with the community college to found SMCC’s Composite Science and Manufacturing Program. Members of the alliance have helped develop curriculum, supplied equipment and served as adjunct professors.

The real gem at SMCC—and one that would not exist without the help of industry—is its Composites Engineering Research Laboratory (CERL). "We probably have the most advanced composite research lab in any community college in the nation," boasts Schoenberg. "And all of the advanced analytical equipment is owned by the Maine Composites Alliance or its affiliated partners." That equipment ranges from a dynamic mechanical analyzer to parallel plate rheometers and a thermal analysis bench.

SMCC students work in the CERL, which provides testing and development services to regional composites companies. The lab is adept at "short-cycle problem-solving for industry," says Schoenberg. "While most academic institutions do long-term theoretical research, our entire lab is based on the industry timetable," says Schoenberg. "If I can’t get a company their data within one quarter, they won’t be able to use it."

In three years, the CERL has completed projects with 35 companies. It recently helped a large fiberglass manufacturer with a customer in the wind industry that had problems with turbines. The manufacturer was unsure whether the issues rose from the materials or the fabrication process. Team members at the CERL discovered variables in the vacuum infusion process and made suggestions to the manufacturer.

“There is a critical need for a characterizing, prototyping and product development lab,” says Von Vogt. “It has to be industry-driven and focus on real problems and product development. The icing on the cake is to locate it at a highly-focused training facility with bright students available to intern at companies and solve industry problems as part of their academic training.” Von Vogt says CERL is successful because companies and SMCC “execute as true partners, each bringing some assets to the table.”

Less than 10 students graduate from the Composite Science and Manufacturing Program each year. SMCC hopes to attract
more students, and the opening of an 80-person dormitory in the fall may help. The success record of its graduates should sway prospects, too. One former student is a senior engineer at Bath Iron Works working on a DDG 1000 destroyer. Another is in California helping with advanced composites projects for an aerospace company. All seven students in the class of 2015 had jobs lined up prior to graduation.

"Some of our students will be engineering technicians, some will go on to get an engineering degree and others will be really solid operators — the guy on the floor you know can do the job," says Schoenberg. "But in all cases, they are raising the foundational knowledge base within the industry."

Joining Forces Creates Strength in Numbers

If one community college can make a difference training the next generation of composites professionals, imagine the impact of several schools banded together. That's what happened in the state of Washington a little more than two years ago, when 10 community and technical colleges with composites and advanced materials programs formed the Composites Washington Training Consortium (CWTC).

"The primary goal is to increase our workforce capabilities in Washington," says Darren Greeno, dean of professional technical education at Bellingham Technical College, a member of the CWTC located in the Pacific Northwest. While each of the schools builds curriculum to serve the needs of businesses within their districts, there is common ground. "So many skills cross over, so there's no reason we can't work collaboratively to have a common baseline or core curriculum," says Greeno.

Two big market segments in the state — aerospace and marine — led the push for the consortium. The Center of Excellence for Aerospace & Advanced Manufacturing and the Northwest Center of Excellence for Marine Manufacturing & Technology spearheaded the effort to formalize the group. "We wanted to provide an efficient and structured platform to develop and share composites curriculum in an open source format," says Mary Kaye Bredeson, executive director of the Center of Excellence for Aerospace & Advanced Manufacturing.

The CWTC engages in several activities to strengthen education across its state. It facilitates communication between companies and colleges, creates a platform to develop and share curriculum, organizes professional development for instructors and industry and represents Washington at significant conferences and trade shows. The focus spans sectors, including aerospace, marine, automotive, recreation, energy and infrastructure.

The consortium recognizes that the training needs for such diverse market segments are vast, as are the requirements for employees ranging from behemoths like Boeing to mom-and-pop manufacturers. That's why the schools within the CWTC offer operator, technician and engineering pathways. Here are examples of three educational routes:

- **Short-term technical certificates** — South Seattle College offers a composites aviation certificate. The 11-week program prepares entry-level technicians to fabricate, assemble and repair composite materials on aircraft.

- **Short-term stackable certificates** — At Peninsula College, students can stack technical certificates. For instance, they may earn certificates in composites entry level manufacturing and CNC machining and programming, then apply those toward requirements for an associate in applied science degree.

- **A "2 x 3" engineering pathway** — Students at Bellingham Technical College can earn an associate in applied science degree by taking classes in core academic subjects, engineering and composites. After two years, students can transfer to a four-year university and complete an engineering program in three years — hence the "2 x 3" designation.

Industry partners are helping the CWTC standardize courses among its schools. The Center of Excellence for Aerospace & Advanced Manufacturing is currently facilitating a workshop to compare classes among the colleges and create common course numbering, which will help students move more from a program at one college to another with ease and assure potential employers that graduates meet specific standards.

Companies help in other ways, too. They often supply equipment and training. For example, Greeno says Magnum Venus Plastech donated more than $60,000 in equipment and sent a representative to instruct faculty on silicone bag molding. Angeles Composite Technologies donated more than $70,000 in prepreg materials to Peninsula College last year. "These types of contributions and collaborative efforts are what keep colleges on pace because technologies change so quickly," says Greeno.

Staying abreast of industry advancements attracts students. The number of students entering composites and advanced materials programs at each CWTC college annually varies from 10 to 60. Some schools have waiting lists, such as Clover Leaf Technical College's Material Science — Composites program. That's not a surprise considering most graduates transition into well-paying jobs with manufacturers or suppliers.

Greeno sites one graduate of Spokane Community College (SCC) as a great example of how the right training can change lives. Frustrated with a dead-end job in the fast food industry,
the student enrolled in the composites program at SCC. While there, he learned how to test parts and perform quality control on a coordinate measuring machine. After graduation, he was hired as the head coordinate measuring machine operator for a major supplier of composites parts in the Northwest. "These kinds of career opportunities are phenomenal!" says Greeno.

The CWTC also benefits companies by streamlining the hunt for skilled workers. "It provides employers the ability to connect with 10 community and technical colleges offering composites training as a whole rather than having to visit each individually across the state of Washington," says Bredeson. One great tool offered on the Center of Excellence for Aerospace & Advanced Manufacturing's website allows companies to find recent graduates from community and technical colleges. It displays program descriptions, skill sets gained by students, course dates and the anticipated number of graduates for each program.

(Check out the website at composites.com/ recent-program-graduates and click on the "composites" cluster.)

As the composites industry grows, the need for educated employees also will continue to increase. "Instantly filling that demand or creating training programs to fill that demand is challenging because these are really expensive programs to run," says Greeno. "It's difficult for colleges to just jump into composites. That's where I need to commend our industry partners in Washington state for their collaborative efforts as well as our state government for funding that allows colleges in our consortium to build our programs. Now it's our job to make sure they are sustainable."

A Coming Together of the 'Town and Gown'

This May, Winona State University (WSU) hits a milestone: Thirty-two students will graduate from the public university in Winona, Minn., as part of its 25th class in the Composite Materials Engineering (CME) program. WSU is one of only a handful of accredited undergraduate programs in the United States that offer a bachelor of science degree in composite materials engineering.

"The program is a blend of mechanical, chemical and materials engineering," says Fariborz Parsi, Ph.D., professor and chair of the Department of Composite Materials Engineering. "I know there are composites courses at other schools, usually on the mechanics of composites. But we offer both theory and hands-on courses. When students graduate from our program, they have designed, manufactured and tested composites."

More than 460 students have graduated from the program since 1991 and pursued a variety of careers. Some work for large corporations such as the Ford Motor Co., Boeing, Northrup Grumman and Motorola. Many work for composite manufacturers and suppliers. And others have found a way to integrate their favorite pastimes into careers, going to work for companies including TREK Bicycles and Callaway Golf Company.

Graduates who work throughout the United States and as far away as the United Arab Emirates can thank local composites companies for partnering with WSU to create the CME program. In the mid-1980s, area businesses were in dire need of talented engineers. A group of companies approached the university about building a testing center on campus. In 1987, WSU opened the Composite Materials Technology Center (COMTEC), a student-staffed laboratory that provides design and analysis, material characterization, testing and prototyping for local companies.

Around the same time, WSU conducted a national industry workplace survey. "It indicated a need for people who are better educated in composites rather than just craftsmen, who are certainly always needed," says Parsi. "But companies wanted people educated in the science of materials as well." The results of the survey spurred WSU, community businesses and the state legislature to team up and create the first bachelor's degree program in composites materials engineering accredited by the Accreditation Board for Engineering and Technology.

WSU offers nearly 30 courses in composite materials engineering, covering materials, polymer processing, rheology,
Understanding the Science Behind the Applications

A shared concern among many industry companies is that they can't find enough qualified employees, particularly skilled composite technicians to fabricate, assemble and repair parts. But colleges caution companies not to focus solely on shop floor activities when searching for employees: The science behind the materials and processes matter, too.

"We don't do enough science in composites," says Fariborz Parsi, Ph.D., professor and chair of the Department of Composite Materials Engineering at Winona State University. "If we want to increase the volume of composites, we need to be more intelligent about how we use the materials and optimize their properties." He adds that by better understanding the materials and processing parameters, companies could reduce their scrap rate and make composites less expensive. That's why laboratory courses, such as ones on the properties of materials and manufacturing, are so important, says Parsi.

Andy Schoenberg agrees. As the department chair of Southern Maine Community College's Composite Science and Manufacturing Program, he teaches four advanced science courses. In labs, students use scientific principles to solve industry-related problems. For instance, students in an advanced polymers class are redeveloping the basis of marine chemistries for polyester unsaturated resins to solve print-through problems and issues with toxicity in some of the additives.

"We teach about polymers and materials because too often employees don't have a clue," says Schoenberg. "They take verbatim from a salesperson how a material will behave, but when they put it in the field it doesn't work." Employees who are well-educated in the science behind the materials can troubleshoot problems.

finite element analysis, manufacturing systems analysis, advanced microscopy, thermal analysis, mechanical characterization and more. In a course on composites manufacturing, students do hand layup, pultrusion, filament winding, extrusion, injection molding and compression molding.

One of the university's signature classes is a two-semester design course. "In one year, students go through the cycle from conceiving an idea to building a product," says Parsi. Last year, student teams built products ranging from an ice auger to a portable solar-charging device. (You can see videos of projects from 2008-2014 on YouTube by searching "Winona U Composites.")

Students also get hands-on training in the COMTEC organization, where they see real-world problems faced by industry companies. "We have a lot of interaction with the companies in town," says Parsi. "We're not here by ourselves trying to teach only out of the books."

Getting practical experience before graduating is particularly important in today's business environment, adds Parsi. "Companies are looking for employees who can make a difference right away. Nobody has the resources to do extensive training," he says. "Our students don't learn everything in four years, but they can walk into a company and make a difference. They have the right mentality and background."

One alumna who proves Parsi's point is Charles Weber, who graduated from the CME program in 1999. Afterward, Weber joined Composite Product Inc. in Winona as an applications design engineer. He quickly rose through the ranks, becoming president of the company in 2004. In 2011, Weber left the company to work full time at Kaber, a design and prototyping firm in Onalaska, Wis., that he started several years earlier. In four short years, Kaber has added four employees and moved into a larger location.

As company owner, Weber appreciates the value of well-educated students with practical skills. "Between the lab work and onsite testing lab at COMTEC, students at WSU get a great opportunity to go beyond classroom theory," he says. "As an employer, I can say this makes a critical difference."

That's the ultimate goal for all colleges and companies—to make a difference. Working hand-in-hand seems the best way to reach that goal.

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