ALL ABOUT COMPOSITES

Purdue Institute Leading the Way

By Tom Schuman

R. Byron Pipes, Ph.D., points to two shelves on the bookcase in his office. They contain dissertations from students while he was at the University of Delaware (1976-1993). A third shelf features similar work from students since he has been in his current role (starting in 2004).

R. Byron Pipes has spent the last 14 years of his 48-year career working in composites at Purdue.

Students are able to engage in hands-on learning at the Indiana Manufacturing Institute (IMI).

"The goal is to make that one bigger than those two," emphasizes the 76-year-old Pipes, the John L. Bray Distinguished Professor of Engineering and executive director of the Composites Manufacturing & Simulation Center (CMSC) at Purdue University. "I'm at the same level of productivity as I was in my 40s. If you have money and good people, you can do amazing things. And we do."

The office where this interview takes place and the accompanying CMSC space total 32,000 square feet of the Indiana Manufacturing Institute (IMI). The building, completed in 2016, is part of the expansive Purdue Research Park that is located a few miles north of the main West Lafayette campus.

"This is owned by the Purdue Research Foundation. It's not on the campus, yet I am a campus entity," Pipes explains. "I like to think of it as the first time we put an academic unit out in a building where you can't tell whether they're industry or academic."

Below are insights from Pipes, who proudly notes his 50th year of working in the composites space will be 2019. "There are others who have been at it longer, but not too many," he proclaims.

BizVoice®: When has the greatest progress been made in the area of composites (most simply defined as a material made from two or more different materials that, when combined, is stronger, lighter weight and/or possesses other advantages than the individual elements)?

Byron Pipes: "There have really been three eras. First, the Air Force decided it needed to make high-performance systems out of something other than aluminum. Carbon fiber was invented, in the 1960s, in Japan. It was half the cost, much more durable and easier to use. For U.S. weapons systems, there is a huge investment in carbon fiber systems today. That's the first era – 1965 to 1985.

"The next step was commercial aviation – small planes at first. Then Boeing developed the 787, the Dreamliner. Its wings, fuselage, tail were all composites. There was very little metal in those airplanes. The commercial era was primarily 1985 to 2005 and it's still ongoing.

"In 2005, as a country, we realized we needed less weight in automobiles for fuel savings and electrification. Aluminum was a first choice; you can buy a (Ford) F150 today that is all aluminum. Carbon fiber and glass fiber are right in the mix and they're coming next. From 2005 to today, it's been the automotive era. The electric vehicle, for range, has to weigh less. It has to.

"Here (at the CMSC) today, we do aerospace but we do mostly automotive."

BV: What does this new facility allow you to do?

BP: "One thing was clear to me; If you brought a visitor to campus and he said, 'I'd like to see what you do in manufacturing,' you would go: 'Where do I go?' You would go everywhere. There were probably 20 sites you'd have to take someone to. I said, the stake in

IMI is working to attract industry partners to utilize portions of the facility that opened its doors in 2016.

the ground needs to be a physical facility that has manufacturing on the door. It's a place to convene the community around this idea.

"We have many visitors from industry coming to talk to us. Our long-term goal is that they actually occupy part of this building. They rent here; they live here; there are spinouts; there's interactions. We're not there yet."

BV: What are some of the ways students are benefitting?

BP: (In addition to Pipes teaching courses each semester in composites testing and manufacturing), "There is a lot of interest in the young people we train. Typically, when doing research at a university, it's graduate students. You're buying half their time – four hours a day; the other four hours they go to class. You don't have to take loans to go to engineering graduate school if you work on a research project. We have money to pay them; we hire them.

"We also seek out a bunch of advanced undergraduate students and employ them as research assistants and they work closely with the graduate students. We also have post-doctoral fellows. They come here and spend one or two years and mature as a researcher before they launch themselves into a faculty position or an industrial position."

BV: What is the biggest CMSC focus?

BP: "We have interest in what piece of this puzzle do we dominate. Today, we have opportunities beyond basic science and one of them is simulation and computation. That's the one we defined for ourselves to be best in the world at – so the industry would come to us for that because they couldn't do it as well as we could. We want to build a platform where you can do a manufacturing process virtually."

BV: I've heard the term virtual factory used. What does that mean?

BP: "In composites, there are many more options than there are in metals. Metals is bend it, form it, weld it, mold it. That's it. On the other end, go to aerospace where they hand make it from this fiber-reinforced material. In between those methodologies, there is an infinity almost of various choices. In the past, industry has guessed what is the best way to make it, built a prototype system, answered its own question by doing a smaller scale trial, but has the problem by the time it has done that, it might have chosen the wrong one (production method).

"It's invested an enormous amount of money, but it has to start over with another process to produce the same thing. Our idea – you build a virtual version of that … and its alternative … and its alternative … so you can look at them and look at all the physics going on and make the right choice. Once you have done it virtually, you've only spent computer time. One of the reasons we have this lab back here is for validation of computer simulations. It's not for building large things; universities don't do that well. We don't build cars. But we understand how they should be built or could be built.

"Then we hand that off to industry. The tool they need most is the simulation tool."

BV: What's next for the composites industry?

BP: "I respond to opportunity; I don't make it. You're asking the wrong person to give you the future, but I will say this: The automotive industry we have today has to change significantly and the electric car industry is going to be located somewhere – and that society is going to benefit by that economic development. Right now, it's happening in California. There's stuff going on in Detroit for sure. What we have to think about in Indiana is how do we get ready for the automotive industry that's coming."

Space Available for Industry Partners

While the CMSC occupies just over one half of the IMI, industry opportunities await in the remaining 30,000 square feet.

Paul Moses, director of business and economic development for the Purdue Research Foundation, describes his role.

"Basically, what I do is build bridges between smart people like Byron and industry partners – finding places to enable companies to be able to interact with these folks. We have companies that are here, not just this building but in other parts of the park, to purely get their brand in front of the super smart students who are here.

"We have programs that enable students to work for them part time. It gives companies a chance to see their work ethic, their quality of work," Moses continues. "It gives students an opportunity to put a real company on their resumé and sample their culture."

Purdue does just that throughout its system of five research parks located throughout the state. Its offerings in office spaces and wet labs are well known, but less so for the composites industry.

"We don't have general market knowledge about this kind of space being available. Whenever you are dealing with something new, it can be challenging," Moses admits. "What do they want to do? How do they want to interact with us? Purdue is very large, thousands of faculty members. The companies we are working with are often very large – reaching in and touching different people.

"This is a very scientific environment, but making the matches is more art than science," he shares with a chuckle.

The open space in the Indiana Manufacturing Institute is ready to be customized for industry partners. Short-term leases of less than a year are a possibility, providing companies with additional flexibility.

"Most of the prospects on the board in my office are related to composites," Moses affirms. "We just want to fill this (building) up, build another one and keep growing."

RESOURCE: Paul Moses, Purdue Research Foundation, at www.prf.org

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