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Aerospace Production

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About the Cover: Spirit AeroSystems manufactures the frame for the Boeing 787, which contains 50 percent advanced composite materials.
Photo Courtesy of Spirit AeroSystems
From the ACMA Chair

Embracing the ‘What Ifs?’

As a business executive, you are faced with a lot of “what if?” scenarios. What are the opportunities – and risks – if I pursue this market segment? What will happen if I add a new piece of equipment or manufacturing process?

In this month’s feature article “From Startup to Industry Leader” on page 16, several composites professionals share stories of moving from entrepreneurs with great ideas to executives running thriving businesses. They provide glimpses into moments when they weighed the “what if” questions, sometimes making good choices – and sometimes not.

Through my experience, I can add two pieces of advice to their insight. The first is the importance of having a plan. Sustainable growth requires purposeful planning. When I think back to the humble beginnings of Core Molding Technologies, we started with one customer. We wanted to get all the customers in that same niche, and we developed a step-by-step plan on how we were going to do that.

My second piece of advice seems counterintuitive to the first: Even though you have a plan, you need to recognize opportunities when they arise – even if they aren’t part of that plan. Then you need to ask, “What if?” You have to be willing to pursue some unexpected opportunities to reap the rewards they may provide.

Several years ago, I took a professional leap and joined the ACMA Board of Directors. I certainly have been rewarded in ways I couldn’t have imagined. As I wrap up my term as ACMA Chair, I am most thankful for the relationships I’ve built with both ACMA staff and my peers in the association. The dedication, drive and passion of the staff help us focus on our main initiatives. Together with ACMA members who volunteer their time, we are moving the industry forward.

As I draft my last message as ACMA Chair, I encourage you all to ask “what if?” not just to benefit your company, but to advance the industry as a whole. The future is bright: What if you committed more time and energy to ACMA? I can attest to the fact that you will be glad you did.

Sincerely,

Kevin Barnett
Core Molding Technologies
ACMA Chairman of the Board
kbarnett@coremt.com
There are three main components to economically viable fiber recycling: low cost recovery of the fibers, aggregating the fibers in one or more formats that can be used in composites processing and designing composites processes that can utilize the recycled fibers in the manufacture of commercially valuable end products. In all these stages, it is of key importance that the fibers incur minimal damage and attrition of mechanical properties. Various fiber recycling technologies have been developed and adopted by several companies over the last few years, including re-sizing and chopping scrapped virgin tow (Barnet, ELG); reclaiming fiber from uncured thermoset prepregs by pyrolysis (Carbon Conversions, ELG) or by solvolysis (Vartega, R&M International, Shocker Composites); and recovery of fibers from cured end-of-life composite parts by pyrolytic methods (Carbon Conversions, ELG, CHZ Technologies) or wet-chemistry approaches (Adherent Technologies).

Immediately after the recovery process, the fibers will usually be in the form of fluffy, entangled bundles, which cannot be directly fed to a composite manufacturing process. Typically, the fibers are chopped (to lengths ranging from 4 mm to 12 mm) and either processed into fiber webs, which can be infused or impregnated with a resin, or aggregated into pellet-like bundles in which the fibers are held together by a few weight percent of binder and/or sizing. The “pellets” can then be fed by hopper to an injection molding machine or other thermoplastic compounding process. In practice, the formation of a pellet that may be fed consistently at commercial throughput rates can be challenging, if fiber damage and the addition of excessive sizing is to be avoided, but technical developments over the past two to three years have largely resolved this issue.

An important route to lowering the costs of composites – and increasing their competitiveness against metals – involves the utilization of recycled fibers in thermoplastic matrices. Whereas injection molding is a valuable option, limitations of part size and control of properties mean that there is a range of high-value applications for which this technology is not suited. Fiber-reinforced additive manufacturing has great potential, but is currently a low throughput technology, not yet well-adapted to high-volume commercial manufacturing.

An attractive alternative is the incorporation of recycled fibers in thermoplastic sheets, which can then be laminated to different thicknesses and formed into final parts by short-cycle molding operations, similar to metal sheet stamping, widely used to produce automotive parts at high volumes. However, methods which attempt to impregnate molten thermoplastic polymers in nonwoven fiber mats generally result in poor fiber wet out, which cannot be remedied in short cycle-time molding processes, and sheet casting processes using traditional extrusion methods lead to considerable attrition of fiber length (with fibers typically below 1 mm) and/or non-uniform fiber dispersion.

The Composite and Nanocomposite Advanced Manufacturing Center (CNAM Center) at the South Dakota School of Mines and Technology (SD Mines) has developed a patent-pending extrusion-based process which incorporates discontinuous recycled fibers in continuous thermoplastic sheets (called DiFTS - Discontinuous Fiber Thermoplastic Sheets). In the DiFTS process, the fibers are thoroughly encapsulated by the resin, are uniformly
dispersed and retain fiber lengths in the range of a few millimeters, depending on feedstock length and the fiber-resin system. Moreover, the fibers in the sheets are preferentially oriented, conferring high anisotropic strength and stiffness properties to the composite.

Table 1 shows the measured 0° direction tensile and flexural properties (modulus and strength) of laminates produced from PA6 DiFTS incorporating 30 wt % carbon fibers from different sources: recycled standard modulus, virgin standard modulus and recycled intermediate modulus. Given that the virgin fiber included a sizing for thermoplastic resins and the recycled fiber did not, the properties of the two laminates with standard modulus are quite close, whereas the properties of the laminates comprising recycled intermediate modulus fibers are significantly higher.

Using measured DiFTS mechanical properties, a truck-bed case study was undertaken using a laminate model with quasi-isotropic layup of the sheets. The results demonstrated that, in comparison with 16 Ga. high strength sheet steel, PA6 DiFTS with 30 wt % recycled carbon fiber gives weight savings of 56% and an increase in bending strength of 30% at an equivalent bending stiffness. Another important feature of DiFTS technology is that the sheet format permits facile hybridization with continuous fiber sheets and tapes, and/or different fiber types, for tailoring cost/performance to meet the specifications of a given application. In addition, the laminated sheets can be combined with lightweight core materials.

The DiFTS process can be scaled-up to produce sheets several feet wide, and a laminator can be used to seamlessly join sheets (laterally) and to laminate any number of sheets (vertically), as demonstrated at the PolyOne Advanced Composites facility. Successful industrial-scale molding trials of laminated DiFTS have been carried out by the CNAM Center and various partners using a range of processes, including thermoforming, vacuum thermoforming and compression molding. Cycle time is typically one or two minutes. Importantly, the sheets do not depend on the molding process to complete fiber wet-out.

To compete effectively with metals, where the vast majority of materials are recycled, it is crucial that the composites industry implements commercially attractive recycling strategies from reclaimed fiber to new composite end products. CNAM’s DiFTS process has been designed to provide a high-throughput, cost-effective step in the value chain, helping to enable the vision, for example, of “end-of-life composite product in, new composite product out,” in a single facility.

David R. Salem is director of the Composite and Nanocomposite Advanced Manufacturing (CNAM) Center and a professor at the South Dakota School of Mines and Technology.

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Table 1: A comparison of PA6 DiFTS mechanical properties incorporating three different carbon fibers from recycled and virgin sources.
The Volvo Car Group has turned to CFRP construction for the first time with production of the Polestar 1 two-door coupe. Polestar, Volvo’s solo performance brand, has developed an energy-efficient hybrid electric vehicle that can travel up to 93 miles on electric power alone. (By comparison, the popular Chevrolet Volt maxes out at 53 pure electric miles.) Polestar 1 features a predominantly CFRP body to produce weight savings of 507 pounds and improve the car’s handling, according to the company.

Polestar and Volvo collaborated on the design, working closely with their material supplier and attracting a small team of experts in the CFRP field. CFRP is used extensively in the car’s exterior, including the hood, fenders, tailgate, trunk lid, side panels, doors and the entire roof structure. In the vehicle’s interior, the cowl (front part of the car frame), the parcel shelf located behind the back seats and the floor reinforcement are also manufactured with CFRP. The largest CFRP parts on the Polestar 1, a body side inner molding and body side outer molding, are 118.1 x 44.9 inches while the smallest is an A-pillar extension, measuring 15.2 x 12.5 inches.

The inclusion of CFRP parts offers many advantages, including weight reduction and higher specific stiffness compared to metallic materials. “Because CFRP is mainly used in the upper body, the lowering of the center of gravity resulted in better handling of the car,” says Zef van der Putten, Polestar’s team member responsible for carbon fiber development. “The Polestar 1 is an electric performance hybrid where performance and range are at the core of its design.”

While Polestar holds the details of its materials and production methods close to the vest, van der Putten says the CFRP parts are constructed from a high modulus carbon fiber prepreg in three different architectures, including two-dimensional woven prepregs and a biaxial non-crimp prepreg with unidirectional tapes, all relying on an epoxy matrix.

“All of the parts except the braided tube for the cant rail in the roof are made using prepreg material and by means of hand lay-up, putting the prepreg into the molds,” says van der Putten. “We use an automated plotter to cut our raw material to minimize waste.” For the exterior where finish is critical, the team produced many test panels to achieve Class A parts and opted to use a surface film rather than a gel coat.

Two of the vehicles’ CFRP parts, the cant rail and floor reinforcement, pushed the team to design unique solutions. Developed to meet crash and safety requirements, the cant rail uses a co-cured braided tube structure. The structural tube travels through the cant rail from the A-pillar all the way to the quarter glass over the B-pillar. The cross section of the tube changes along the length of the cant rail to maximize structural performance and packaging space.

To manufacture the cant rail structure, a layer of triaxial fabric is braided over a foam core in one shot. “Once we have braided the required amount of fabric over the foam, we load the preform into a tool and impregnate it with an epoxy matrix using a high-pressure resin transfer molding process,” says van der Putten. “In order to secure the position of the cant rail section, we embed the finished braided tube within the interior body side during the prepreg lay-up process, which in turn helps us integrate three parts into one. This is a very intricate process that requires extreme precision during manufacturing.”

The roof structure is thinner and stronger than a steel equivalent while still meeting safety and performance requirements, according to Polestar. It also allows for a lower roof line, creating a sleeker profile.

Polestar seems most excited about its unique floor reinforcement, which engineers call the “dragonfly.” It plays an instrumental role in creating the Polestar 1’s
The rear portion of the chassis viewed from above reveals the “dragonfly” CFRP floor reinforcement, which helps improve torsional stiffness.

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reactive dynamics by improving torsional stiffness at a critical point in the body structure, between the middle of the floor and rear construction, says van der Putten. He adds that the dragonfly couldn't have been made with steel due to certain parameters of the platform.

“When you combine this strengthened framework with the CFRP body and roof structure, you get a stiff and communicative chassis which translates driver input into superb driving characteristics,” says Christian Samson, head of product creation at Polestar.

The design team was challenged to achieve the desired crash behavior, according to van der Putten. In contrast to a steel body, where bending helps the integrated crumple zones to reduce the crash energy that reaches the vehicle’s occupants, CFRP dissipates energy by cracking and shattering. During crash tests for the Polestar 1, the team paid close attention to the way the CFRP body reacted to extreme impact forces.

The Polestar 1 verification prototype was propelled into a stationary barrier at approximately 35 miles per hour, simulating a front collision. Most of the energy was absorbed by the car’s crash structure, with the remaining energy mitigated by the CFRP body panels into the body structure, which didn’t show signs of bending or misalignment after the crash. “The outcome of the first crash test validated the decision to build the body of Polestar 1 in carbon fiber,” says van der Putten. “It confirms that carbon fiber supports the highest safety standards.”

Production of the Polestar 1 will gear up by mid-2019, with the all-electric Polestar 2 available to the market by late 2019. The company plans to build a maximum of 500 cars each year at its new production center in Chengdu, China.

van der Putten is confident that the automotive industry will remedy challenges associated with widespread use of CFRP. He notes that pricing is one barrier, but expects the cost of raw materials to decrease in the future. In addition, he believes the industry will figure out how to meet demands for higher volumes.

“Composite parts will make it to high-volume applications,” says van der Putten. “The demand and drive for us to make cars lighter is becoming more and more persistent. We are actively developing techniques and solutions to make this possible.”

Patrice Aylward is a freelance writer based in Cleveland. Email comments to paylward@aol.com.
Composites are on display everywhere you look, from cars on the road to boats in the water and airplanes in the sky. But one museum in Belgium took it a step further by making composites the sole focus of an exhibit that ran from Oct. 26, 2018, through April 21, 2019. The Fibre-Fixed: Composites in Design exhibit at Design Museum Gent, which strives to raise awareness of the impact of design on daily life, featured 80 objects made from composites.

The exhibit provided a gateway to introduce people to the world of materials and engineering, specifically composites, according to co-curators Ignaas Verpoest and Lut Pil. But it went beyond mere introduction to composite materials, says Verpoest. “We wanted to show how the interaction between designers and new materials, like composites, inspires designers to come up with novel concepts – breakthrough answers to societal challenges like climate change, sustainability, mobility, the increasing urban character of our societies and the aging population,” he says.

Verpoest and Pil are ideal co-curators of Fibre-Fixed. Verpoest is emeritus professor in the department of mechanical engineering at Katholieke Universiteit Leuven (KU Leaven). He holds the Toray Chair in Composite Materials at KU Leaven and is involved in research projects on CFRP and natural fiber reinforced composites. He also is co-founder and a board member of Econcore, a worldwide producer of honeycomb cores. Pil is a professor at the LUCA School of Arts in Gent, Belgium. The two have organized exhibits on composites and design since 2002. Produced in collaboration with Envisions, a Dutch design collective, the latest exhibit featured items made from both synthetic fibers (carbon fiber and glass fiber) and natural fibers (flax, hemp, jute and silk) combined with epoxy, polyester, polypropylene and other resins.

“The exhibition showed a large number of objects and projects where designers have used composites in surprising, but innovative ways,” says Verpoest. Among the items on display were a CFRP violin, a flax fiber cello, the Hummingbird foldable bike, a model of the Solar Impulse solar-powered airplane, car panels, a lower leg prosthesis and chairs.

The objects were obtained either from designers or the companies that produce them. Verpoest and Pil had a hard time narrowing down the items for the exhibit from an initial list twice as long as the final display. “All of the objects we finally selected have some unique features which make them particularly attractive, and we could have selected many more,” says Verpoest.

One of Pil’s favorite pieces in the exhibit is “Desert Stool (Salts – Vegan Design)” by Erez Nevi Pana, who designs vegan furniture using salt and soil. One method of letting organic materials grow into composite materials is to immerse branches in salt water until the salt has crystallized onto and in between the branches. The wood used to make the stool was entwined and submerged in the Dead Sea for several

In addition to end-use applications, the Fibre-Fixed exhibit included raw materials, such as the synthetic and natural fibers shown here, as well as videos of composite production methods.
months. “I really appreciate Nevi Pana’s commitment and how he conveys it to a wide audience through a poetic project,” says Pil. “We need not only new technical realizations and developments, but also a fundamentally different approach to raw materials.”

In addition to the end-use applications, the Fibre-Fixed exhibit also displayed raw materials and featured videos showing 10 composites manufacturing methods. While final numbers weren’t yet available, the exhibit drew crowds. During the two weeks around the Christmas holiday, the exhibit had 4,000 visitors—a very high number for Design Museum Gent, according to Verpoest. Many groups also organized visits, including companies, schools and cultural groups.

The hope is that “people get enthusiastic about the interaction between designers and new composite materials, and that they discover how such interactions can help to address many societal challenges,” says Verpoest. Consider the problem of material waste: A chair on display by Christien Meindertsma was made from locally grown flax and a thermoplastic aliphatic polyester derived from renewable sources. The 100 percent bio-based chair is lightweight and biodegradable, thereby eliminating material waste during its production and at end-of-life.

Verpoest and Pil would like to see the Fibre-Fixed exhibit travel around the world. They are optimistic about the future of composites. “Because of their intrinsic technical properties, composites have a great future in all applications where lightness — and hence low environmental impact and sustainability — are crucial,” says Verpoest. “But even more importantly, what the exhibition clearly shows is that the creativity and imagination of designers will bring many more surprising applications and even lead to new composite material concepts.”

Susan Keen Flynn is managing editor of Composites Manufacturing magazine. Email comments to sflynn@keenconcepts.net.

"The interaction between designers and new materials, like composites, inspires designers to come up with novel concepts."

-Ignaas Verpoest, co-curator of Fibre-Fixed
In 2015, Solvay Composite Materials began using simulation tools from MultiMechanics to simplify testing of materials used in high-performance applications. The global business unit of Solvay recognized the benefits of conducting computer-simulated tests to accurately predict the behavior of advanced materials, such as resistance to extreme temperatures and loads. Two years later, Solvay invested $1.9 million in MultiMechanics to expedite development of the Omaha, Neb.-based startup company’s material simulation software platform, which Solvay predicts could reduce the time and cost of developing new materials by 40 percent.

Commitment to – and investment in – composites simulation tools isn’t unusual for a large company like Solvay, which recorded net sales of €10.3 billion (approximately $11.6 billion) in 2018 and has 27,000 employees working at 125 sites throughout 62 countries. What may be more surprising is the impact composites simulation can have on small to mid-sized companies. “Simulation tools are for everyone,” asserts Flavio Souza, Ph.D., president and chief technology officer of MultiMechanics.

The team at Guerrilla Gravity would agree. The 7-year-old mountain bike manufacturer in Denver began using simulation tools from MultiMechanics to simplify testing of materials used in high-performance applications. The global business unit of Solvay recognized the benefits of conducting computer-simulated tests to accurately predict the behavior of advanced materials, such as resistance to extreme temperatures and loads. Two years later, Solvay invested $1.9 million in MultiMechanics to expedite development of the Omaha, Neb.-based startup company’s material simulation software platform, which Solvay predicts could reduce the time and cost of developing new materials by 40 percent.

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software from Altair more than a year ago to develop a new frame technology made from thermoplastic resins and carbon fiber. “We were the first ones to figure out how to create a hollow structural unit with a complex geometry out of thermoplastic materials,” says Will Montague, president of Guerrilla Gravity.

That probably wouldn’t have been possible without composites simulation tools, says Ben Bosworth, director of composites engineering at Guerrilla Gravity. Using topology optimization, which essentially finds the ideal distribution of material based on goals and constraints, the company was able to maximize use of its materials and conduct testing with confidence that the new materials would pass on the first try. (They did.)

Afterward, the company was able to design its product for a specific manufacturing process – automated fiber placement.

“There is a pretty high chance that if we didn’t utilize composites simulation software, we would have been far behind schedule on our initial target launch date,” says Bosworth. Guerrilla Gravity introduced its new frame, which can be used on all four of its full-suspension mountain bike models, on Jan. 31, 2019.

**The Language of Innovation**

There are dozens of simulation solutions, some geared specifically to the composites industry and other general finite element analysis (FEA) tools. But they all share the common end goal of helping companies bring pioneering products to market faster – whether those companies are Fortune 500 corporations or startup entrepreneurships.

“Composites simulation is going to be the language of innovation,” says R. Byron Pipes, executive director of the Composites Manufacturing & Simulation Center at Purdue University. “Without it, a company’s ability to innovate in the composites field is going to be quite restricted.”

Those innovations can be at the material level or within end-product applications. “If you really want to improve the micromechanics of your materials, you can use simulation to tweak the properties of the fibers, the resin, the combination of the two or even the coating of fibers,” says Souza. “For those who build parts, simulation can help you innovate in terms of the shape of the part and the manufacturing process.”

One of the biggest advantages that design simulation has over the traditional engineering approach is time, says Jeff Wollschlager, senior director of composites technology at Altair. He calls conventional engineering the “build and bust” method, where companies make samples, then break them to test their viability. It’s a safe method, producing solid – although often conservative – designs. “But the downside of traditional approaches is they take a lot more time and many more dollars,” says Wollschlager. “And everything in this world is about time and money.”

In addition, simulation tools allow companies to know more about the materials they use and the products they make, which in turn facilitates the manufacturing of more robust products. “You have to augment your understanding of your product with something else,” says Wollschlager. “And that something else is simulation.”

**A Leap Forward in Manufacturability**

Four years ago, Montague and Matt Giaraffa, co-founder and chief engineer of Guerrilla Gravity, opted to pursue carbon fiber materials to make their bike frames lighter and sturdier.

“We wanted to fundamentally improve on what was out there in the market. That required rethinking and analyzing not only the material, but how the frames are made,” says Montague.

The company also was committed to manufacturing its
products in the United States. “To produce the frames in-house, we had to make a big leap forward in manufacturability of the frames,” says Montague. “And thermoplastics allow for that.” Once Montague and Giaraffa selected the material, they had to figure out exactly how to make the frames. That’s when Bosworth – and composites simulation – entered the picture.

Bosworth has more than a decade of experience with simulation software, beginning as an undergraduate student in mechanical engineering as a member of his college’s Formula SAE® team to design, build and test a vehicle for competition. While creating the new frame for Guerrilla Gravity, he used Altair’s simulation tools extensively, beginning with early development to prove the material feasibility for the application.

“We had a lot of baseline data from our previous aluminum frames, so we had a really good idea about how strong the frames needed to be and what performance characteristics we wanted,” says Bosworth. “Once we introduced the thermoplastic carbon fiber, we were able to take advantage of the software and use it to its fullest potential.” He began with simple tensile test samples and matched those with physical tests. Next, he developed tube samples using the software and again matched those to physical tests.

“It wasn’t until I was much further down the rabbit hole that I actually started developing the frame model,” says Bosworth. Even then, he started small, first developing a computer model for the front triangle of the bike frame, then adding in the rear triangle. Afterward, he integrated the boundary conditions and the load cases and began doing the optimization.

“Wading into the Simulation Waters

The sophistication and expense of composites simulation tools can be daunting, but Wollschlager encourages people not to be put off by the technology. “The tools are not prohibitive to small and medium-sized companies – at least not to the level people think they are,” he says.

Cost is often the elephant in the room, but Wollschlager says it’s misleading to think packages will cost a fortune. “A proper
suite provides you simulation in all facets of composite life cycles – in the concept, design and manufacturing phases,” he says. “The cost of such a suite is approximately 20 to 25 percent of the yearly cost of an average employee. Looking at it in those terms, I just don’t see the barrier to entry for small to medium-sized businesses.”

As you wade into the waters of simulation, consider the following:

- **Assess your goals before searching for a package.** Depending on what you are trying to accomplish, you may need a comprehensive suite of design and analysis tools or only a module or two to get started. “If you want a simplified methodology because you don’t feel comfortable with a more advanced one, there are mainstream tools I would recommend,” says Souza. “But if you really want to innovate and be at the cutting-edge of your industry trying to understand how materials behave and reduce costs, then I would go with a more advanced package.” Decide upfront if you want tools to analyze materials, conduct preliminary designs, optimize the laminate schedule, predict the life of composite materials, simulate thermo-mechanical behaviors and so on.

- **Find programs that fit your budget.** Many companies offer programs for startups and small businesses that include discounts on simulation software and a limited number of hours of free consulting. Guerrilla Gravity purchased its simulation tools through Altair’s Startup Program, which is designed for privately-held businesses less than four years old with revenues under $10 million. The program made it fiscally feasible for the mountain bike manufacturer to create a high-performing solution, says Bosworth. “If we had not been given that opportunity, we probably would’ve gone with a much more rudimentary design – probably an isotropic, black aluminum material just to get us somewhere in the ballpark of what we were trying to do,” he says.

- **Engage with vendors to expedite the learning curve.** Don’t just buy simulation tools from suppliers. Most companies offer initial training, plus extra consultation and access to experts as needed. “We like to walk hand-in-hand with our customers,” says Souza. “For smaller companies that don’t have a lot of resources, we can work as a partnership. We help them create the models and teach them the technology behind the product.”
The Future of Composites Simulation

Simulation technologies have been around for more than 50 years. Through the years, they have allowed companies to simulate the geometry and shape of parts, then predict the performance of those parts: How strong is part X? How far will it bend, without breaking, under certain constraints? How efficient is the part? But technology companies and researchers are pushing the envelope in terms of what can be done within the simulation world. Here are some of the advancements on the near – and distant – horizon.

- **Material characterization at the microscale level.** “It’s very challenging to characterize composite materials at the microscale level, but we are moving in that direction,” says Flavio Souza, Ph.D., president and chief technology officer of MultiMechanics. “I feel very confident that in a few years we will know a lot more about these materials and have more streamlined simulation workflows.” Understanding materials at the microscale level will help optimize products. For example, companies will be able to understand where and how micro-cracks initiate and grow and to optimize particle/fiber volume fraction and orientation throughout a part.

- **Certification by simulation.** Work is underway to create composite simulation tool suites that can be used as the platform for the certification of composite structures and materials, says R. Byron Pipes, executive director of the Composites Manufacturing & Simulation Center at Purdue University.

- **Manufacturing-informed performance.** The next step in simulation is understanding the physics behind any given manufacturing process so you can make it better or meet specific performance requirements, says Pipes. Working with a team of software vendors and aerospace manufacturers, Purdue has teamed up with IACMI – The Composites Institute to create manufacturing process simulation models for additive manufacturing, injection overmolding, high-performance resin transfer molding (HP-RTM) and compression molding. They plan to create models for at least 12 more manufacturing processes, which are part of the Composites Virtual Factory HUB.

- **Cloud-based systems throughout the supply chain.** The four manufacturing process simulation models created for the Composites Virtual Factory HUB are currently browser-based apps. But cloud-based computing is almost here, says Pipes. That will lower the barrier to entry into simulation, he adds, because the related software and hardware currently required are expensive.

- **User-friendly simulation solutions.** The vast majority of people who use composites simulation tools are engineers. But that will change as cloud-based, user-friendly solutions work their way down the supply chain. “Engineers won’t need to dig into the code, see how it works and figure out the input variables,” predicts Pipes. “It will be ‘pick material, pick machine and punch go.’”

The simulation world is changing rapidly. At a recent meeting, Pipes and a colleague envisioned a future where you could take a picture of a carbon fiber fabric on a mobile phone, and an app would provide information, such as the level of permeability for HP-RTM. “The power of the device and the ease of use of simulation tools are going to merge in the future,” says Pipes. “You’ll have the ability to get the answers you need, when you need them, without having to know how the simulation works.”

- **Start small, and take it slow.** “I see people go right to the final step, trying to make a really advanced model,” says Bosworth. “Then they get frustrated because nothing is working right and the joints aren’t articulating. They end up troubleshooting so many issues.” Instead, he recommends users start simple, as he did with the thermoplastic bike frame.

- **Don’t expect to do it all with simulation.** “We don’t advocate for 100 percent simulation. There is no such thing. We also don’t advocate for 100 percent experimentation, which is the traditional approach to design,” says Wollschlager. “The trick is that it’s somewhere in the middle, and we’re all struggling to find the perfect percentage. It’s problem-dependent.”
Put the right people in place to use the tools.

“Honestly, I don’t know much about FEA software,” admits Montague. “So it goes back to hiring smart people and letting them do their thing.” Bosworth was the “smart hire” for Guerrilla Gravity. And, as an experienced user, he agrees it takes some know-how to work with simulation tools. “I think it would be hard for someone who doesn’t have basic material knowledge and a fundamental understanding of stress and strain and boundary conditions to utilize the tools no matter how basic the FEA software is,” he says.

For now, simulation is typically handled by engineers, though that may change. (See the sidebar about future developments on page 14.)

Perhaps the largest barrier to implementation is ignorance—not of individuals, but industry-wide, says Pipes. “People don’t know what simulation can do for them—even many top level senior managers in aerospace,” he says. “They still think of simulation in terms of geometry and performance, not manufacturing. And manufacturing is where the big payoff is going to be because that’s where all the economics lie.”

Pipes wants to “stretch people into believing what you can and will be able to do with simulation.” As the technology advances, that includes more and more each day—not just for mega corporations, but for small and mid-sized companies, too.

“As the simulation industry gets democratized, prices are going to come down due to competition, while the amount you can do will go through the roof,” says Wollschlager. “It’s a great time to get involved in simulation.”

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Learn More at CAMX

Discover other companies that provide simulation software and tools at CAMX, Sept. 23-26, 2019, in Anaheim, Calif. Visit www.theCAMX.org, and search for exhibitors under the product category “Computer Hardware/Software.”
After working at an FRP boat-building company for 10 years, Bill Kreysler launched Kreysler & Associates in 1982 under the half-joking motto “Anything but Boats.” And in the beginning the company did, in fact, do virtually everything else, from fixing hot tubs to making letters for Gap clothing store signs to building sets for the San Francisco Opera. As Kreysler says, “We were all over the map.”

It’s tough to imagine the company, today a leader in architectural composites, so disjointed. But establishing a clear value proposition within the composites industry – itself highly fragmented – is a common challenge faced by many startups.

“The composites industry is quite complex due to its fragmented nature,” points out David Schofield, co-founder and managing director of Future Materials Group, a strategic advisory firm in the United Kingdom. That decentralized nature is evident in the industry’s diverse range of technologies, broad supply chain, vastly different-sized companies and varying regional leaders.

“The market needs and the value proposition being offered by companies can sometimes be misaligned due to that complexity,” Schofield finds. He suggests that getting through these challenges demands clarity on how the startup ultimately wants to segment its market, why it’s targeting those market segments and the value it offers to those targets.

Of course, many startups learn these lessons through tough experience and trial and error.

Watch the Pace of Growth

Today, Kreysler & Associates has just under 50 full-time employees at its facility in American Canyon, Calif., and a new shop on nearby Mare Island. But the company’s present success was built on decades of lessons learned.

In the company’s formative days, many of those struggles centered around growing too quickly. When companies grow beyond what their foundation is equipped to handle, the additional sales can soon be outpaced by overhead requirements. Kreysler learned this while manufacturing props for the 1983 film “Return of the Jedi.” The company made sails and rigging
for Jabba the Hutt’s barge and GFRP parts for the two-legged walking tanks used in the war scene on the moon of Endor.

The demands of the movie project required Kreysler to hire several employees, but when that project ended he didn’t have a backlog of other work. “I was so focused on the project I forgot to look ahead,” Kreysler recalls. “After burning all the profits, I finally had to lay most folks off. I hated that. It is so expensive to train new people, and I felt I’d let them down.” From then on, Kreysler says he has let the company grow organically.

But organic growth can present its own challenges. Scott Reeve, president of Composite Advantage, a division of Creative Pultrusions Inc. since October 2018, explains that growing his company only as money was available led to costly inefficiencies over time.

“When we started out, we bought one building. Then as we expanded, we bought a second nearby building and a third,” Reeve recalls. While that allowed the company to sink significant capital into product and market development as the money became available, rather than securing a large loan or turning to an investor, it led to problems. “We were wasting a lot of money in terms of moving between buildings and redundancy,” Reeve says. Today, the company has solved that problem by bringing its 100 employees under one roof in a 300,000-square-foot building in Dayton, Ohio.

While smaller companies can recover from missteps by cutting back on staff (or the owner’s salary), estimating and cost control become much more critical as companies scale up. So do people.

Putting a skilled workforce in place becomes necessary as founders find themselves pulled in different directions. Yet as Kreysler points out, growth at this stage brings with it a responsibility for keeping that workforce employed. Kreysler recalls, “[In the early days] every penny was in the business, and as I slowly added work and needed more help, I became aware of my responsibility to [my employees] to not make a mistake.”

As Kreysler’s operation has become more manufacturing-intensive, his labor needs have only increased. As a case in point, his company’s new facility manufactures exterior building panels and relies heavily on automation and technology. “I don’t subscribe to the theory that robotics will displace blue collar workers,” Kreysler says. “Every time I invest in a new robot, I have to hire more people to keep up with increased productivity. The custom FRP work we do is still very much a craft. The automated tools are just that – tools.”

Put Trusted Partners in Place

Bringing people on board with the right skillsets proved to be an “aha” moment for Reeve, who founded Composite Advantage in 2005 with now-vice president Andrew Loff. “For the first couple of years when there was only a handful of us, we all did a little bit of everything,” says Reeve. As the company grew, Loff focused on the technical side while Reeve took on more of a sales, marketing and project management role. In time, they began to onboard additional management-level employees to support the company’s growth, including a general manager to run the manufacturing operation.

“Our skills were as composite engineers … but at some point, we needed a real manufacturing person to run the operations,” Reeve recalls. Bringing in a general manager opened up the company to lean processes, ISO compliance and other standards of excellence in large-scale manufacturing – standards often missing from the typical startup composite shop.

Still, adding new employees – even when absolutely necessary – is not easy to do. Lowell Miles, CEO of Miles Fiberglass and Composites, an Oregon-based fabricator of fiberglass and composite products, learned this first-hand in 1983 when he acquired another company, Tiara Spas.

“It was nearly impossible to run the operations of two facilities and two separate companies, so I needed to have a general manager at each location running the day-to-day operations so I could focus on the businesses,” he shares. It’s difficult for many startup founders, particularly in the highly-specialized composites industry, to divest any of their responsibilities to capable partners. Yet this step is necessary for growth. At a certain point, founders must begin to shift their role so that they spend more time working on the business rather than in the business.

“Some find that transition more easily than others,” Kreysler says. “I have a harder time with that. Maybe it’s because I love working in the shop and being part of the day-to-day or even minute-to-minute decisions needed to get things done. When you’d rather be in the shop, it’s harder to step back and manage an organization.”

Bringing outside experts onboard has the added advantage of alerting company founders to any potential blind spots. “The founders of the business – especially if they are the ones who invented that technology – have likely convinced themselves as to why it’s good and why it’s going to be successful,” Schofield points out. “But due to the complexity of the composites market, there are often a number of barriers to the adoption of that technology of which they’re not really quite aware.”

While finding trusted associates can be challenging, it’s equally hard for companies when a valued partner leaves. This hit home for Kreysler when his long-term business partner Serge Labesque retired several years ago. “He was a very smart guy but also an excellent craftsman. We complemented each other,” says Kreysler. “He did the fabrication design and technical stuff; I brought the work in and took care of the business details.”

Suddenly, the team didn’t have Labesque to fall back on and make tough decisions nobody else wanted to make. “We’d become spoiled,” Kreysler says. While it was a tough shift, Kreysler says that it ultimately benefitted the company as it pushed all team members to be decision-makers, rather than deferring to a single senior leader. When Labesque left, Kreysler says, “It broadened the decision-making base and forced more dialogue and consensus among the team.”

Explore the Market for Opportunity

Schofield also encourages startup companies to gather marketplace feedback as soon as possible. “Engage the market as quickly as possible to test out your value proposition and modify accordingly,” he advises. “You might think that one market segment is really where it’s at for you, but when you test that you find it’s not so attractive. You need that real-life feedback.”

It’s a challenge, but also a freeing opportunity for composite startups to evolve their products and companies into new directions. Reeve explains that only some of Composite Advantage’s first products are part of today’s offerings. “There were a number of
markets and products that never materialized,” he says.

For example, the company made prototype manhole covers for a few utility customers, but they soon found that other manufacturers had processes in place that could achieve similar products at a lower cost. The company leadership learned the hard way that they could make lots of products, but had to find the mix of materials, design and manufacturing that offered the best value for the customer. “The market will find the best value,” Reeve says.

Being open to unforeseen opportunities can spur growth. As Reeve explains, “There were a lot of times when there was an opportunity in a market that wasn’t something we originally had on our radar, but the opportunity came to us and we shifted to do that. Some of those worked out really well, and those were points in which we were able to grow the business.”

One of those serendipitous opportunities arose for Composite Advantage when a design consultant the company worked with on FRP bridge decks had a client also seeking a lightweight, modular tank system for hydraulic fracturing in the gas and oil industry. Composite Advantage was not supplying any tank products at the time but recognized that the design and manufacturing process for the product would be very similar to what it already had in place to produce its FiberSPAN® bridge decks.

“The product took off with the frack drilling boom. Our revenues almost doubled in one year,” Reeve says. “This enabled the company to buy its second building, add needed people skills and step up to the next level of capabilities.”

This kind of exploration also proved profitable for Miles.

Create a Plan that Includes Funding

While flexibility is important, it is valuable for startups to outline a business vision and plan. Early on, it’s easy to get so wrapped up in keeping the business afloat that it may seem there’s never time to step back and think about direction. Still, it is important to have clarity around the business vision. “If you can imagine how the business might look in two or five years, then you will start to see the capabilities that you’ll need, how those capabilities are achieved and how you can afford it,” says Schofield. “That then drives startups to focus on the funding required at those stages.”

Capital is a big building block for success, and creating strong relationships with potential funding sources is vital for startups. There are many options for obtaining capital, but self-funding or building a relationship with a bank (rather than outside investors) helps startups to retain control in how the company grows. Miles advises entrepreneurs to remain as debt free as possible: “This allows you to weather many storms.”

To support his company’s growth, Reeve forged a relationship with a small bank early on. It was a fortuitous move. “Those types of organizations are more willing to work with, encourage and help small businesses. Some of the large banks get to the point where they’re so risk-averse that they only want safe things,” Reeve says.

Reeve provided Composite Advantage’s business plan to his personal contact at the bank and routinely keeps the financial institution apprised of upcoming projects that require upfront investments. “They constantly know how we are doing,” says Reeve.
That relationship proved particularly valuable in 2008. “When we were having some bad months through the recession, they were confident and comfortable enough that they didn’t constrain the value of our line of credit,” Reeve says.

No matter how comfortable your balance sheet is today, these entrepreneurs’ stories are potent reminders that every organization is at the whim of market cycles. Planning for a future of ups and downs may seem overwhelming for companies in the beginning stages of growth. It can help to know you’re not alone. Not only are you following a path paved by other entrepreneurs, but there are countless resources available to support small business growth.

“Be involved in composite industry associations such as ACMA and numerous other business groups, as well as business education,” advises Miles.

Kreysler offers another simple piece of advice: Don’t be afraid to make mistakes as they can provide learning opportunities. “I’ve bet the business many times, but part of doing that has to be a willingness to fail and to suffer the consequences, even if it means losing everything,” he says. “If you do things well and thoughtfully, the money will come, and the business will grow.”

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Aircraft Manufacturers Looking for Speed

New composites technologies will help meet the growing demand for civil aircraft.

By Mary Lou Jay

Aircraft companies carried a record-setting 4.3 billion passengers globally in 2018 (International Civil Aviation Association), and by 2037 that number could reach 8.2 billion (International Air Transport Association). To serve those passengers, the research firm Deloitte estimates that aircraft manufacturers will have to produce more than 36,700 aircraft in the next 20 years – and that doesn’t even include aircraft orders from regional carriers.

Aircraft companies are already ramping up their manufacturing. Production rates on Spirit AeroSystems-supported platforms like the Boeing 787 and Airbus A350 continue to increase, according to Eric Hein, senior director of research and technology at Spirit AeroSystems. This puts pressure on the composites industry, since aircraft manufacturers have been steadily increasing the percentage of composites used in their planes. The airframe for the Boeing 787, for example, is made from 50 percent advanced composite materials.

“Increased production rate capabilities for composite structures are important to commercial aerospace because the demand for composite aircraft structures continues to grow,” Hein says. “Composites offer many great advantages when compared to metals. These include weight, tailorability, automation opportunities and service performance.”

Composite materials in today’s aircraft are used primarily for nacelles, streamlined housings or tanks that hold engines, fuel or other equipment. “However, future clean-sheet single aisle fuselage structures are likely to contain significant composite content,” Hein adds.

A greater use of composites would help reduce the weight of these new designs, an important consideration for carriers that want to reduce their planes’ carbon footprints. But there are economic factors at play as well.

“Increased speed and volume [in composites manufacturing] result in lower costs due to economies of scale and faster time to market,” says John Geriguis, innovation leader for General Atomics Aeronautical Systems Inc. (GA-ASI). The use of composites also meets customers’ demand for lower cost of ownership, not just the initial cost of the aircraft.

“Fuel usage, maintenance, reliability and availability of aircraft play a big role in the total cost. Designing and building...
producible, lighter weight, unitized composite structures to lower initial cost, maintenance cost and fuel consumption is paramount,” Geriguis adds.

New urban air transportation services that carry people short distances will add to the demand for faster composite manufacturing technologies. Several companies, such as Uber Elevate, Joby Aviation and German-based Volocopter are working on variations of small, electric-powered aircraft that will be able to travel as far as 150 miles on a charge. These aircraft could transport commuters to and from work or take them on short hops between two cities. While some of the aircraft will be operated by pilots at first, the goal is to ultimately have them operate autonomously.

“The vehicles will have to be made from composites because they have to be lightweight,” says John Melilli, president of Composite Automation LLC. Since these services are intended to be ubiquitous, there will be a need for thousands of aircraft. “When they talk about building urban aircraft, they’re not talking about building 30 or 40 a month,” says Melilli. “They’re talking about building 500 to 1,000 units a month.”

Improving on Technology

Manufacturers currently produce many aircraft parts with thermoset composites using hand lay-up and autoclave curing. It’s a labor and capital-intensive process.

Much of today’s manufacturing equipment isn’t designed for higher production rates, either. The specific design details of a part, including its geometry and ply stack-ups, can limit the feed and speed of equipment. “For example, depending on local part curvature, cross-sectional area, ply starts and terminations, and other design details, the equipment will have to slow down to complete a task and avoid creating undesired manufacturing defects,” says Larry Ilcewicz, the Federal Aviation Administration’s chief scientific and technical advisor for composites.

What’s needed to meet the increasing demand are processes that enable scalable and variable rates of manufacturing. Melilli says that manufacturers have to find processes that can move production from manual to automated operations, from resin systems that require going into an autoclave to systems that can get parts production out of the autoclave.

Spirit AeroSystems is currently researching new material...
systems that improve performance, processing and cost. It's also developing new high-rate deposition processes. "Material deposition rates and cure times are key to improving fabrication costs and throughput," notes Hein.

Aerospace composites manufacturers are beginning to research and build processes around fast-cure resin systems. Improvements in cure time will ultimately remove the autoclave or oven as a potential production bottle neck.

Thermoplastic Possibilities

Composite parts makers are experimenting with a variety of out-of-autoclave (OoA) technologies, including compression molding, resin transfer molding (RTM), vacuum-assisted resin transfer molding (VARTM), and bladder and mandrel curing.

Thermoplastic in-situ consolidation is one OoA technology that's attracting interest. Modern laser technology has given manufacturers more control over the temperatures required for working with thermoplastics; they can employ a laser to heat up the thermoplastic resin system and create pressure with a roller, so there's no need for an autoclave cure.

Robotic tape placement is another possibility with in-situ consolidation. GA-ASI, for example, has introduced a tool-less thermoplastic manufacturing process that uses two robots, one to dispense thermoplastic tape and the other to consolidate it. This eliminates the need for massive tools; only perimeter holding and handling fixtures are necessary.

With Cevotec’s fiber patch placement system, a flexible gripper arranges and orients pieces of unidirectional fabric during the automated lay-up of a composite part, which provides the strength required along the part's load paths.

With in-situ consolidation, part makers can form a unified composite structure comprising several different components in real time. This eliminates the need to drill holes to bolt things together. "You don't want to drill holes in a composite part if you can help it, because you're breaking the fibers," Melilli says.

In-situ consolidation also enables the manufacture of strong, lightweight parts in less time. "Thermoplastics can be put down substantially faster, and there's not as much waste," says John Tyson, president of Trilion Quality Systems. The graphite epoxies used for thermosets have a limited shelf life, and they can become outdated before manufacturers can use them. With thermoplastics, there are no shelf life limitations.

Thermoplastics offer another advantage. "Thermoplastic parts are effectively just as strong as if not stronger than thermosets, because they don't have as many knockdowns," Tyson adds. "You don't have to put additional material on the part, which makes it lighter." He notes that thermoplastics are already being used in aircraft like the Airbus A380, which has a thermoplastic leading edge. In addition, Tyson predicts that the use of thermoplastics could reduce costs substantially, perhaps as much as 50 percent.

While the work being done in thermoplastics holds promise, Melilli cautions that it's not yet ready for large-scale production. "Where and how thermoplastics will have a role in increasing the production throughput of aircraft is still developing," he says.

"There's a lot of interest and work by major companies in this area. The materials manufacturers, the Tier 1s and the OEMS
are working together to explore how and where these kinds of technologies will fit well with certain classes of their parts.”

**In-Situ Inspection and Repair**

One of the challenges in moving to OoA parts production is maintaining the quality. “When you put the thermoplastic in a tool and then you put the tool in an autoclave, the annealing or curing process under a vacuum bag and against a hard tool solves a lot of problems. A lot of errors in manufacturing are fixed in the curing process,” Tyson says.

GA-ASI, for example, has begun incorporating in-situ inspections along with in-situ rework and repair into its tool-less manufacturing process. This makes the process more reliable and efficient and yields more predictable results.

ARAMIS Thermography, developed by Trilion Quality Systems, is a full-field optical measurement system that can monitor the quality of composites parts as they’re being produced. It’s an integral part of the Real-time Virtual Assembly Tooling (RVAT) system being used by GA-ASI.

“This technology uses a high-speed, thermographic camera. We can heat up a cured part, and as the part cools, using that camera, we can actually detect any voids or any foreign objects that are in the part,” Melilli says. “That allows us to know whether or not the part is acceptable from a quality standpoint. It’s faster than using ultrasonic technologies, which are the current accepted standards for examining parts after they’ve been made.”

One camera can do a lot of different things, Tyson explains. “While we’re laying tape down with a robot head, we can track that head in six degrees of freedom so we can make sure that it’s laying down material where it’s supposed to be,” he says. “We can check the bond quality of the material that’s getting laid down and we can check the shape of the material – or the whole part – while it’s being built to make sure it matches CAD in real time.”

Tyson says the number of production steps for in-situ monitoring with thermoplastics is half the number required for thermoset parts production. This makes manufacturing up
IPD Teams Are Key to Identifying Best Technologies

With all of the new possibilities for design and production of composite aircraft parts, how can manufacturers determine the best approach? “It is my belief that experienced integrated project development (IPD) teams – including suppliers and partners – that have a strong basis in product development and certification are essential in selecting and implementing composite processes,” says Larry Ilcewicz, the Federal Aviation Administration’s chief scientific and technical advisor for composites.

“The specific design detail defined for composite parts and assemblies affects product value through nonrecurring development costs, manufacturing costs, structural weight, maintenance costs and many other factors,” he continues. “Without the input of an IPD team, product value will likely be reduced because there are so many interactions that depend on design, manufacturing and maintenance decisions.”

Consider a hypothetical material form and its raw material cost, which is very high but facilitates very fast production rates with an advanced process. Assume the design is constrained to avoid other problems (e.g., manufacturing defects and part rejections). The first decision by the IPD is whether or not reduced manufacturing costs for faster production rates offset higher raw material costs. But that can’t be accurately assessed without considering specific design detail, Ilcewicz says.

“You can start to see how the specific structural design needs to be developed with an understanding on how it can potentially affect total manufacturing costs. This design development needs to start before committing to the raw material that has higher costs because, particularly with composites, the devil is in the detail,” he continues.

It’s also important to remember that each composite component of an aircraft design is likely to have interface issues with other materials and other processes in the design. “A process that looks good to a development team may not have the maturity for real applications until the team addresses sufficient size scaling issues and all known technical issues for structures, manufacturing, maintenance and systems interface,” Ilcewicz adds.

Companies must do a complete business case assessment to ensure that the nonrecurring product development and recurring manufacturing costs are justified by customer interest in the final product.

to 10 times faster and may cut costs in half. But utilizing data from thermographic cameras could be helpful in thermoset parts production as well. The cameras could immediately detect any foreign materials caught between the layers of fabric during the lay-up process.

To take advantage of the cameras’ capabilities, Trilion has begun adding patterns on critical composite parts during manufacturing to enhance visual inspection. Using data from thermographic cameras, aircraft companies will be able to look for changes in the pattern to check for strains on those parts. They can monitor a plane’s structural health during its lifetime without adding any weight or power (such as multiple strain gauges or acoustic sensors) to the aircraft. It is equivalent to using millions of strain gauges, according to Trilion.

Faster Lay-up

The use of sophisticated software is another way that manufacturers can speed parts production while improving the parts’ quality. Fiber patch placement, for example, could cut lay-up time for tools and reduce the amount of fiber required for a composite part without impacting its strength.

Developed by Cevotec, the fiber patch placement process uses pieces of unidirectional material, ranging from credit-card to letter-sized, in conjunction with a flexible gripper and a CAD model. After the gripper picks a patch up, a camera in the system exams the material for defects. The gripper then places each patch on a tool, arranging and orienting the pieces to optimize the strength of the part along its load path.

“We have the potential of arranging the patches so that they are precisely where they need to be in the part to provide the strength that the part needs as defined in its CAD model,” Melilli explains. “The software does all of the analysis, including a finite element analysis of the part.”

With this system, companies could produce thermoset or dry fiber preforms that can either go into an autoclave or into a clamshell mold for resin infusion. Plus, fiber patch placement is a faster process than hand lay-up, eliminating many steps in the manufacturing process.

Composite Automation has done some prototype programs with the fiber patch placement, and European aerospace companies Safran and Premium Aerotec are doing some development work with it as well.

Sharing Information

Industry-wide cooperative efforts, including the sharing of data about new manufacturing technologies, will help speed development of the next generation of composite aircraft components. “In general, these improvements must be developed aggressively, which requires commitment and engagement from industry and partners,” Hein says.

In the United Kingdom, Spirit AeroSystems is partnering with the University of Strathclyde and other organizations on this
research. “U.K. Catapult centers allow industry partners, like Spirit AeroSystems, to experiment on next-generation equipment much sooner than would typically be possible through internal funding,” he adds. Established by UK Innovate, the United Kingdom’s innovation agency, Catapult centers are a network of not-for-profit centers designed to spur innovation in a variety of industries.

Another example of the cooperative approach is the Thermoplastic Composites Research Center (TPRC) in the Netherlands. The members of this consortium believe that thermoplastic composites are the best choice of material for lightweight manufacturing in large volumes, and they work together to eliminate technological barriers to its adoption.

Melilli says NASA is proposing a similar thermoplastic consolidation institute in the U.S. But whether or not this becomes a reality, there’s little doubt that manufacturers in this country will soon be trying some new approaches to aircraft parts production. Geriguis predicts that in the next three to five years, aerospace leaders like NASA, Airbus, Boeing and General Atomics and manufacturers like Fokker GKN and Spirit will adopt the new concepts of thermoplastic consolidation and that within a decade it will become one of the methods routinely employed for composites manufacturing.

Hein sees some challenges, however. While many of the new composites technologies will be ready for incorporation into manufacturing in the next five years, the nature of the aircraft industry could delay their implementation. “Some of the technologies will require capitalization, material qualification or even changes to engineering, which are costs that are hard to justify on an existing program,” he explains. “In those cases, the implementation will need to be coordinated with new product launches, which aren’t as frequent in aerospace as in some other industries. At the same time, this drives a need to have the technologies ready earlier for when an implementation opportunity presents itself.”

Improved technologies will speed the adoption of composites by the aircraft industry. “There has already been a major increase in composite utilization in aerospace that has coincided with the productivity increases that have been incorporated over the last 20-plus years,” Hein continues. As the cost and cycle times improve even further, composite material will likely assume an even larger role in future aircraft products.

Mary Lou Jay is a freelance writer based in Timonium, Md. Email comments to mljay@comcast.net.
By MJ Carrabba

While Election Day 2020 is more than a year-and-a-half-away, it already feels like it’s right around the corner. Throughout the country, politics are more polarized – and polarizing – than at any point in recent memory. However, the halls of Congress are operating much as they always have.

It’s easy to overlook the significant amount of legislation moving out of Congress every day that keeps the country going because there is so much public disagreement on the big ticket issues. But those issues are the ones that keep the politically inclined up at night, so let’s take a moment to look at them a little closer through the lens of the composites industry.

International trade is always an important issue, but it is much more visible in the mainstream now than usual. It is also something that doesn’t fit neatly in the two-party duopoly: There is as much disagreement within parties as between parties. For the composites industry, the current dialogue on international trade is a mixed bag. On one hand, the global steel and aluminum tariffs are causing an increase in the cost of raw materials used by composites companies for machinery, molds and tooling. For composite products that are a component of a broader system – like farm equipment, for example – the increased costs of metal components can drive up the consumer cost of the final product and have an overall negative impact on sales.

But there’s more to the story. If a composite product can fully replace a steel or aluminum product that’s gone up in price, like some construction products, the composite alternative may be even more attractive financially than before. However, the cost of some composite raw materials have been impacted as well. Some fibers and specialty chemicals used by the industry have been included on last year’s tariffs on Chinese products. It is important to note, though, that despite some negative ramifications of the trade war, the administration’s actions against China are due largely to a trade imbalance that has led to American manufacturers facing considerably higher tariffs to do business in China than Chinese manufacturers have faced in the United States. There are also concerns with intellectual property theft and currency manipulation that provide additional rationale.

The climate debate is another issue with sweeping implications on our industry. Generally speaking, composites are an environmentally-preferred solution. They require less energy to produce and are long-lasting and durable. And should they end up in a landfill, they are chemically inert and will not harm the surrounding area. ACMA and the industry overall have made a huge commitment to and investment in composite recycling, which moves us even farther up the sustainability curve.

But take an idea like the Green New Deal, watershed environmental reform legislation being championed by Congressional progressives. At the time of this writing, its legislative prospects do not look strong in Congress this year. But we can be assured that the concept will be a consistent thread into 2020. Some Democrats love it, while others are less sure. Most Republicans are dismissive, some vehemently so.

The Deal doubles down on renewable energy, prioritizing investments in wind and solar energy. Those sectors are major markets for composites, using some of the largest composite components made.

There’s another side to this coin. Oil and gas extraction and distribution is also a huge market for composites. And let’s not forget our feedstocks. Bio-based resins are becoming more cost- and performance-competitive, but the vast majority of the resin chemistry used in our industry – the very thing that makes composites work – is a byproduct of petroleum refining. That is not to say that those chemicals would never be available again through other means of production, but the commercial scenario would be uncertain at best. This is all in addition to the Deal’s stringent regulatory requirements which, among other things, would virtually eliminate American competitiveness in the automotive and aerospace sectors.

Immigration is another hot-button issue that needs to be solved. There are legitimate law and order concerns related to immigration, but our industry also desperately needs workers. Manufacturing might be experiencing a renaissance, but it cannot be sustained without a robust workforce. There appears to be agreement that there needs to be changes to immigration policy, but unfortunately the debate remains so polarized that Republicans and Democrats have been unable to broker a compromise.

It’s important to look at all three of these issues – international trade, environmental reform and immigration – from all angles. And there are a number of other topics we could touch on; perhaps I’ll do so in another column as the steady roll toward Election Day continues. There are currently more than a dozen candidates seeking the Democratic nomination, with several major players still undeclared but widely expected. They all look at these issues a little differently, and the next year should be an illuminating exercise. President Trump may be the most divisive incumbent presidential candidate of the last century – maybe in American history – but he has proven to be a formidable candidate.

No matter where we end up, the road will certainly be an adventure. In the meantime, let’s borrow a phrase from our British friends and “Keep Calm and Carry On.”

MJ Carrabba leads government affairs and political advocacy for ACMA. He can be reached for comment at m carrabba@acmanet.org.

Disclaimer: Opinions and statements within the Legislative & Regulatory column are that of the author and do not represent any official stances of the American Composites Manufacturers Association.
CAMX 2019 is returning to Anaheim, Calif., and bringing a fresh, new energy. With updated branding and a focus that includes a broader range of markets and key technologies, CAMX’s exhibit hall and educational programming promise to make it one of the best yet. CAMX Steering Committee member, Steven Mead of Toray Advanced Composites in Morgan Hill, Calif., discusses some of the event’s most exciting changes and features.

Q: CAMX 2019 has recently launched a rebranding. How does this shift the focus of the event?

Mead: The re-branding initiative in 2019 is really about having a broader reach to the global materials industry across all market segments and across a much more diverse attendee base. We have historically been considered quite ‘niche’ in terms of our areas of focus, the type of person/position that attended our event and the areas of application, which were fairly limited. Today, we look at our industry, and we see it touching a much broader range of people and markets: Composites have gone from niche to mainstream and are a key enabling technology for existing and emerging industries.

Other technologies have also evolved to a point where they create much larger scale demand for lightweight materials in new markets. Consider the electric vehicle market or the urban air mobility market, for example. These industries have developed around a key technology – battery power – but need affordable, lightweight materials available in volume to enable them. These sorts of emerging markets are creating enormous opportunities for our industry and have taken us from niche to mainstream.

Q: Are you seeing any trends with the types of exhibitors that are registering so far?

Mead: We are seeing more companies with a focus on high rate production, such as rapid cure thermosets, as well as thermoplastics – not just materials and parts, but enabling technologies such as processing equipment and design/simulation technologies. We are also seeing more exhibitors focused on recycling technologies and on automation and industrial processes to enable large-scale production volumes. In addition, we are seeing more parts fabricators in general; with the overall increase in demand across many segments, the parts and structures fabricators are experiencing more growth opportunities and are using CAMX as a key event to help grow their businesses.

Q: What’s new with the educational programming at CAMX 2019?

Mead: The conference programming is much more diverse than in prior years. We are focused on providing information for attendees along the entire ‘experience spectrum’ and from a range of market segments. So, you can expect to see
content that is tailored to beginners and experts, as well as content that is relevant to all market segments, such as marine, infrastructure, aerospace, automotive, electronics, medical and sporting goods. Additionally, CAMX is offering more content on the business and strategy side of the composites industry, including key trends and emerging technologies, as well as more fundamental “composites 101” type sessions for the newer, younger attendees just now entering the workforce. And this year we’ll be emphasizing our technical and expert level sessions. We will provide sufficient information well ahead of time so that attendees will know the expected knowledge level needed to actively learn in each session. We hope this will help attendees select the right courses and will help the course instructors to hit the ground running in the sessions.

Q: What message would you give people who have never attended CAMX, but are considering it this year?

Mead: CAMX 2019 is really going to be an incredible event. We have transitioned from a niche focus on a limited number of markets to broader coverage across massive global industries, and you will see this in play at CAMX. You will see a significant emergence of new technologies and new content that are helping drive this shift for our industry. Additionally, you will notice that the attendee profile is changing to be younger and more diverse, with fresh ideas and perspective that our industry needs to continue to thrive.

Be a part of forming the future – register for CAMX today: www.thecamx.org/

Organic Peroxides Task Group Readies New Fire Code

A task group of organic peroxides suppliers and fire code experts, including ACMA and National Fire Protection Association (NFPA) members, is preparing a comprehensive revision of the fire code requirements for storage and use of organic peroxides. The revision will be submitted to NFPA for review this summer. For more information, contact John Schweitzer at jschweitzer@acmanet.org.

ACMA Members Advocate Against Undue Regulatory Burdens

More than 30 meetings were held over two days in March with California legislatures, the governor’s office and the California EPA (OEEHA) to educate them on how complying with Proposition 65 regulations has placed an undue burden on companies and is causing many of them to move their plants out of state. The meetings were successful and met receptively regarding issues that the composites industry faces. ACMA will continue to build and grow relationships with lawmakers in California.

New ACMA Members

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