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Correction:
The automotive market segment article in the September/October issue of Composites Manufacturing incorrectly listed the name of the CEO of Local Motors as Jay Peters. He is John B. “Jay” Rogers.
Collaboration at CAMX... And Beyond

Thanks to all of you who participated in CAMX in October. I hope that you felt it was worth your time and effort to attend. I know it was for me! I’d like to share some of my perceptions of the first CAMX.

First, it was the culmination of a lot of hard work and planning from a whole lot of people, including volunteers and staff from ACMA and SAMPE. I have mentioned in the past that the team was strong, and I think the show proved that.

Second, the show brought together the composites industry’s best and brightest, ensuring there will be growing collaboration between all parts of the industry. To me, this is significant because in the past, we may have lost sight of our real opportunity to grow the entire market. Now I believe we will be better aligned to offer more solutions in place of traditional materials, with all segments of the composites industry moving forward in sync. This kind of collaboration results from getting to know each other better at the show and maintaining those relationships afterward, too.

This edition of Composites Manufacturing highlights the importance of collaboration. A feature story on page 14 covers space applications. Getting these high-performance composites off the ground requires teamwork among government agencies, materials suppliers, engineers, designers and manufacturers. The issue also includes a story on biobased fibers on page 18. Advances in biocomposites would not be possible without university researchers and industry companies joining forces.

We join forces as an association, too. ACMA is made up of member companies working together to further the industry. I am certain there are folks who went to CAMX that each of us as members can follow up with about joining. If you know of any potential new members, please pass the information on to the ACMA’s membership staff by emailing membership@acmanet.org.

A strong membership is key the future of our association – and it’s a bright one! We are working diligently on many things that will benefit our members, including programs established by ACMA’s Composites Growth Initiative (CGI) and its committees. As you know, the CGI committees are formal sub-sets of our membership, based on markets, processes or materials. The work of our CGIs will be emphasized in ACMA’s latest strategic plan. Another big effort will be to increase efforts to build relationships with governmental groups to push for more specifications of composites and develop more composites standards. And, of course, association leaders will work on making CAMX 2015 even bigger and better than the first one!

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Avoid a Competitive ‘Bake-Off’ at All Costs

Too often in the composites industry, proposals end in a competitive “bake-off,” in which any number of manufacturers line up to work with a large customer, proposals in hand, ready to battle it out in a spec war, a features war or, in the worst case scenario, a price war.

In essence, most of the players – and maybe you, too – look almost identical, which is why these scenarios often end up hinging on price. You will likely feel pressure to lower your bid, and you may lose the business to competitors who are offering less value than you. These bake-offs create a tough position for both your company and your bottom line.

While many companies accept this as reality, it doesn’t have to be your reality, even if you work with large manufacturers who operate in a highly bid-driven RFP/RFQ environment. Instead, it’s important to realize that, if you are competing in a bake-off, it’s usually because you’re coming in to your customer’s buying cycle too late. A buying cycle is the decision process your customers go through when hiring a vendor to solve a problem. It often looks something like this:

- **Step 1**: See an unrecognized opportunity. (Step 1)
- **Step 2**: Recognize an unrecognized problem. (Step 1)
- **Step 3**: Recognize a new solution to an existing problem. (Step 2)
- **Step 4**: Let’s call in the vendors. (Step 3)
- **Step 5**: We’ll evaluate the proposals. (Step 4)
- **Step 6**: We’ll select the right vendor. (Step 5)

For example, your customer’s problem might be as simple as needing a central inlet cone for a jet engine (Step 2). They have decided they need to contract with a composites manufacturer to create it and that it should cost $1,180 per unit (Step 3).

If you were the manufacturer of this part, you would probably come in at Step 4, most likely by answering an RFQ/RFP, and you would be tasked with creating that part for $1,180 or less.

Even if you could supply that part for $1,180, the business isn’t secured by any means. What if your competition comes in at $1,150? You’re out of the running. Additionally, even if you do win the bid, what’s going to stop another competitor from coming in lower than you next year, causing you to lose the contract?

In other words, when you compete in a competitive bake-off and enter the customer’s decision cycle at Step 4, you have no choice but to compete on price. It’s not a sustainable position for any company. It squeezes your margins, and it builds absolutely zero long-term loyalty between you and your customers.

In order to stop competing on price and build relationships that last renewal after renewal, you need to create a competitive advantage, one that doesn’t hinge on price. The best way to do this is to enter the process earlier, ideally at Step 1 and definitely before Step 4.

When you can enter the buying cycle during Steps 1-3, you can offer your customers a unique point of view and show them a different path toward better results. Often, this happens by helping them:

- **Step 2**: Recognize an unrecognized problem. (Step 1)
- **Step 2**: Recognize a new solution to an existing problem. (Step 2)

Ultimately, in each of these scenarios, you’re bringing tremendous value to your customers by helping them better understand their businesses. In fact, if you can understand your customers’ businesses better than they can, they will come back to you again and again for solutions, and they’ll pay a price premium for them.

To understand how this works within the RFP/RFQ environment above, take the real-world example of a composites manufacturer who noticed that its clients were experiencing increased costs, schedule delays and missed delivery dates, which resulted in huge penalties. This particular manufacturer had a unique capacity for design for manufacturability, allowing them to look at a design before it goes into production and determine how to most efficiently manufacture it.

As a result, the manufacturer offered clients like Boeing, McDonnell Douglas and Rolls Royce Jet Engines a different path toward better results. Often, this happens by helping them:

- See an unrecognized opportunity. (Step 1)

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As a result, the manufacturer offered clients like Boeing, McDonnell Douglas and Rolls Royce Jet Engines a different path toward better results. Often, this happens by helping them:

- See an unrecognized opportunity. (Step 1)
Approaching your customers earlier in the buying cycle is as much a mindset shift as anything else. Jumping into the process in Steps 1-3 means shifting the focus of your business development away from answering exclusively RFP/RFQ requests and moving toward creating relationships in earlier stages of the buying cycle.

It may involve more up-front work for your team and a more creative strategy for identifying potential new customers. However, the rewards – protecting your margins and securing more long-term customers by avoiding competing in a bake-off – will make it more than worth your while.

Kevin McArdle is the founder of McArdle Business Advisors. For more Best Practices resources and articles on moving your business forward, visit McArdleBusinessAdvisors.com.

Did you miss one of Kevin McArdle’s business management columns this year? You can read them all at CompositesManufacturingMagazine.com. Click on the “columns” tab, then select “business.”
While it was closed for repairs, citizens of Brisbane, Australia, missed the Brisbane Riverwalk. During the original bridge’s short tenure of seven years, about 3,000 pedestrians and cyclists travelled across the bridge each day. After a flood decimated parts of the Riverwalk in 2011, the Brisbane City Council looked for ways to repair the bridge and make it stronger. The council chose an FRP solution to give the new and improved bridge a better foundation.

The Brisbane Riverwalk, a half-mile bridge along the banks of the Brisbane River, connects a park on one side to wharves on the other. The damaged bridge closed following the flood, and renovations commenced in April 2013. The city shifted priorities for the repair project: Brisbane’s Lord Mayor Graham Quirk told The Brisbane Times in May that construction of the original Riverwalk prioritized sticking to a deadline, while this time the focus was on building a resilient structure.

One step in the renovation project consisted of restoring 18 bridge piles. The piles were renovated last May using QuakeWrap’s PileMedic™ repair system, which uses FRP jackets to repair and strengthen bridge piles. The system impressed the Brisbane council so much so that Mo Ehsani, QuakeWrap’s president, says the city had another repair process in the works, but changed plans after hearing about PileMedic.

Mo Ehsani, president of QuakeWrap, says that workers remarked how simple PileMedic’s installation process was as they completed the repairs.

Tony White, business development manager at Building Solutions Brisbane, which is the official PileMedic agent of Queensland, says that the city council selected PileMedic for several reasons. First, it provides an impervious barrier preventing moisture and air from entering, which eliminates corrosion. Second, the FRP jackets are an economical solution: Contractors can work in water without divers, the PileMedic jacket can be fitted quickly and the pre-manufactured FRP jackets are cut on-site, reducing waste and manufacturing and shipping costs. The latter is particularly important when considering the expense of shipping materials from the United States to Australia. Ehsani also notes that applying FRP jackets to a concrete pile makes it 50 percent stronger.

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carbon fabric sheets laminated with a vinyl resin layer on each side of the fabric. The pre-manufactured sheets are cut to size for the project on-site, then wrapped around the bridge pile twice and sealed with QuakeWrap’s own epoxy at the end. The jacket is temporarily secured with ratchet straps or shrink wrap while the annular space between the jacket and the pile is filled with grout or resin.

In the case of the Riverwalk bridge repairs, the 16 x 16-inch square columns were wrapped with a 24-inch diameter cylinder of glass biaxial FRP materials. The FRP rolls were cut to length to 160 inches horizontally and four feet vertically to allow the shell to be wrapped twice around the column and leave another eight inches at the end to apply an underwater epoxy resin. Prior to wrapping the jacket around the column, a 1.5-inch PVC pipe was placed on each of the four faces of the pile to help the jacket maintain a uniform shape. The columns were wrapped from the bottom up, after removing rocks by hand to expose the bottom of the pile. As the rest of the pile was covered, the next four feet of the FRP jacket would overlap the first by about four inches; the team used plastic sheets to keep the top of the lip of the first jacket clean so the second one could be mated to a clean surface.

Ehsani says that three or four columns can be repaired per day with the PileMedic system and that the entire Brisbane pile repair project – including training demonstrations and installation – took about a week. “The ability to work during any tide meant the time on-site was productive,” White says. “The fact that there’s no need for heavy lifting equipment meant we could keep the rest of the Riverwalk clear [for other construction].” The FRP jackets strengthened the bridge and increased its longevity for 70 years or more, Ehsani says. The bridge, now fully repaired with new lighting, shaded rest areas and separate pedestrian and bike paths along its route, reopened earlier this fall.

Ehsani says the project’s success generated a lot of buzz in Australia, and he is excited about gaining global attention for repair and retrofit projects. “When we started introducing these products into the construction industry 25 to 30 years ago, people were reluctant to use them,” he says. “Now the conversation has really switched; it’s no longer whether we should use FRP or not, it’s now whether we should use this type of FRP solution or another type. That’s a much better conversation for our industry to have because that’s what drives innovation.”

Mary Beck is the communications coordinator at ACMA. Email comments to mbeck@acmanet.org.

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PCCR USA continues a 60-year history of producing high-quality composites for the industry. As your supplier PCCR is

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When Boston Whaler wanted to build a bigger boat, the Edgewater, Fla.-based company faced a problem. The boat’s weight would be too great for its manufacturing facility to handle. Boston Whaler overcame that challenge thanks to advanced composites engineering, and its biggest boat ever – the 42-foot-long 420 Outrage – hit the waves in September. The company teamed with long-time partner Marine Concepts, a composites manufacturer, on the project. Two other industry companies contributed: Composites supplier Gurit and infusion specialist Composites Consulting Group.

Boston Whaler builds six models of fishing and pleasure boats using vacuum infusion to fabricate fiberglass liners and hulls. These are bonded together with a high-density foam sandwiched in between, making the resulting boats almost indestructible, says Chris Wachowski, director of product development at Boston Whaler.

However, going bigger than a 40-foot hull for its new 420 Outrage boat presented difficulties. To fit within existing Boston Whaler manufacturing capabilities, the hull and liner molds had to weigh less than 60,000 pounds. “That is the weight of our 370 Outrage, which was our previously largest Whaler,” Wachowski says. “If we built our tools with our traditional design practices, the new hull and liner molds for the 420 Outrage were predicted to weigh over 90,000 pounds.”

This slimming down in weight, though, could not take place at the expense of strength. During production, the liner is maneuvered into the hull and bonded to it, with a hollow space between the two. Into this space, a robot gun injects a two-part structural foam core that expands, creating an unsinkable foam-fiberglass construct, according to the company. During expansion, the foam creates tremendous pressure on the liner and hull, so material strength is critical.

Previously, Boston Whaler used a steel frame and steel bulkhead/grid construction. This frame system was attached to the hull and liner molds, providing the rigidity needed to prevent them from swelling and perhaps exploding due to the pressure of the expanding foam, says Todd Biddison, project manager at Marine Concepts in Cape Coral, Fla. However, the company’s traditional method would not work for boat lengths beyond about 37 feet. “We had to find an alternative construction method,” Wachowski says.

In searching for a solution, the closest comparable designs Boston Whaler could find were wind turbine blades. As much as 300 feet long, these blades are typically formed by two-part closed molds that accommodate 20 passengers seeking a day on the water sport fishing or pleasure boating.

“What we have learned on this project can be easily transferred to other tools where weight is a critical parameter.”
must be strong and lightweight. So, the company turned to Gurit USA, which had experience in this area.

Gurit USA, a Bristol, R.I.-based subsidiary of the global composites supplier Gurit, engineered new tools for the larger Boston Whaler boat. The two companies performed extensive finite element analysis on the molds to make sure they would satisfy performance requirements and fit within space constraints. In particular, the frame height had to be such that it avoided ceiling clearance issues when the liner mold was hoisted up and then set into place.

With the design done, Boston Whaler approached Marine Concepts to build the specified molds. Biddison notes that the molds were large and subject to intense pressure during the boat building process, requiring certain steps be taken.

“After the body of the mold was infused, we stiffened the molds with infused cored flat panels that were 5-axis machined to match the contour of the geometry and then affixed a steel exoskeleton with structural adhesives,” he says. “Similar processes have been employed on some of our aerospace parts manufacturing with great success.”

While being lifted up from each end, rotated 180 degrees and then lowered into the hull, the liner could not deflect more than a quarter of an inch. The materials used in the liner mold are confidential, as are some of the other details such as the curing temperatures. “The latest high-temp infusion resins were used, along with glass- and infusion-related materials, to ensure a steady and even flow for complete wet out,” Biddison says.

Due to the complexity of the project, Marine Concepts contracted with Composites Consulting Group. The company supplied computer flow modeling expertise, infusion engineering, flow modeling, onsite training and oversight of the material installation and infusion process, says Dean Callander, process specialist at the De Soto, Texas, company.

After plug construction, which included a very robust substructure, Marine Concepts scheduled the process in minute detail and began building and machining the composite panels. Steel was cut as called for in detailed plans, fabrics were carefully situated, and manifolds and flow medium were put in place. The infusion went smoothly, according to Marine Concepts’ Biddison. Then the pre-cut composite panels were bonded where needed and steel glued on.

When it comes to results, Boston Whaler’s Wachowski says the mold strength matched the analysis and the weight was right on target. As for the future, this project will help Boston Whaler build even bigger boats. “What we have learned on this project can be easily transferred to other tools where weight is a critical parameter,” Wachowski says. Biddison adds that the expertise gained also will likely transfer to other lightweight mold requirements customers in other market segments may encounter.

Hank Hogan is a freelance writer based in Albuquerque, N.M. Email comments to hank@hankhogan.com.

For more stories like this, visit CompositesManufacturingMagazine.com and check out the Marine articles under the “Market Segment” tab.
Aquarium Fish Tanks Feature GFRP

A renovated port near downtown Rio de Janeiro will do more than offer a place for ships to load and unload goods: It’s designed as a waterfront destination for residents and visitors alike. A highlight of the revitalized port area will be a 27,000-square-meter aquarium near Guanabara Bay named AquaRio. The aquarium will be home to 12,000 fish from 400 different freshwater and saltwater species, including sharks and rays. Many of them will swim around to visitors’ “oohs” and “ahhs” in tanks constructed from GFRP sandwich panels.

Barracuda Advanced Composites in Rio de Janeiro designed 27 GFRP tanks made with fiberglass fabric, vinylester resins and polyethylene terephthalate (PET) foam cores. Tank shapes and sizes will vary, with the average tank holding 60 cubic meters of water. The capacity of the shark tank, made of concrete with a GFRP/vinylester liner, is 3,000 cubic meters.

Barracuda was commissioned to design the AquaRio tanks in March. The company has provided composite engineering for two other Brazilian aquariums, though nowhere near as large or complex. AquaRio will be located in an old four-story customs warehouse. “They will keep the original 1920s’ façade,” says Jorge Nasseh, CEO of Barracuda Advanced Composites and chief engineer on the aquarium project. “The contractors are rebuilding the interior floors to add the tanks and other areas for biology research, classes and movies.”

Locating the aquarium in a century-old building created challenges for contractors – and opened up an opportunity for lightweight composites. The aquarium architect, a Brazilian company with expertise in marine biology, originally suggested the tanks be made from steel and concrete, but soon realized those materials would not work. “The weight of the tanks was very important because they needed to move the tanks to the third and fourth floors,” says Nasseh. Composites were a great solution. In addition, the GFRP panels, which are finished with an impervious gel coat, are an ideal material for water applications.

Barracuda relied on finite element analysis to ensure its tank designs could withstand fluid flow, water pressure, temperatures inside and outside the tank and other physical factors. The results helped Barracuda and M-Mold, the company building the tanks, decide on details such as fabric selection. The inner and outer skins of the panels are made from 24-ounce quadraxial fabric. The multiaxial reinforcement is well-suited for the project because it allows multiple plies to be positioned correctly, quickly and easily. It’s also a good match for vacuum infusion, the fabrication method used to produce the tanks.

Production begins with temporary female molds made from medium fiber density wood panels. After sealing the mold, the fabricator applies the mold release, then lays down the inner skin fabrics and PET core material with grooves to allow for resin flow. M-Mold uses contact glue to hold the core in the right position. The core materials vary in thickness and feature extra reinforcements around the tank windows. Next, the outer skin fabrics are applied and more reinforcements are placed around the windows and flange. Finally, the vacuum bag is built and sealed over the mold. “When you open the resin lines, the tanks will be infused in a few minutes,” says Nasseh.

Barracuda estimates that production of all 27 tanks, including drains and filters, will take 90 days to complete. The windows, constructed separately and made from acrylic, will be provided by Reynolds Polymer Technology, a company that specializes in manufacturing aquarium windows. The tanks are scheduled for installation in November. M-Mold will ship the tanks in pieces approximately 125 miles to the aquarium, where a forklift will hoist them to the third and fourth floors for assembly.

Rio de Janeiro’s aquarium is scheduled to open in June 2015. City officials estimate that AquaRio will attract 1.5 million visitors per year – and even more in 2016 when the city hosts the Summer Olympics.

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

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Composites: The Final Frontier

Composites are taking off as a key material for outer space applications.

By Mary Beck
From the first heavier-than-air human flight in 1903, to the first manned lunar landing just 66 years after, and today’s new Orion spacecraft, the aerospace industry has a history of rapid growth. Composite materials have been integral to this growth, playing an increasingly greater role in pushing the boundaries of space travel. Some of the latest applications that show the breadth of composites usage are cryogenic tanks, deep-space observatories and launch vehicles.

**Cryogenic Tanks Fuel Exploration**

Composite cryogenic tanks – or “cryotanks” – are so important to new deep space missions that Northrop Grumman, Lockheed Martin and Boeing are all developing them. Cryotanks are often used in outer space as rocket fuel tanks to contain liquid hydrogen or liquid oxygen fuels at cryogenic temperatures (below -238 F). The tanks, previously made from metals, provide high-energy propellant solutions required for extended human exploration missions beyond low-Earth orbit.

Recently, NASA and Boeing successfully tested a 5.5-meter diameter all-composite cryotank as part of the Composite Cryogenic Technology Demonstration Project, funded by the NASA Space Technology Mission Directorate within the Game Changing Program Office. The tank, one of the largest and lightest cryogenic liquid hydrogen fuel tanks ever manufactured, is the latest step toward the planned 8.4-meter tank that could reduce the weight of rocket tanks by 30 percent and cut launch costs by at least 25 percent.

Weight and cost savings are critical because the cryogenic tank is intended to eventually help bring humans to Mars on NASA’s Space Launch System, America’s new rocket for deep space exploration. “We’re looking at an application that’s for the upper stage [of the rocket engine], so any pound you save can be directly transferrable to an additional pound of payload capability,” says Dan Rivera, Boeing program manager for the cryotank project.

NASA and Boeing designed the cryotank for out-of-autoclave (OOA) manufacturing. The team chose OOA primarily because there is not an autoclave large enough to mold a one-piece 8.4-meter cryotank, says Jim Sutter, a senior research chemical engineer at NASA. The cryotank uses Hexcel’s HexTow® IM7 carbon fiber and Cytec’s CYCOM® 5320-1 epoxy prepreg resin.

John Vickers, the cryotank project manager at NASA, says the team’s goal to make the tank as efficient and lightweight as possible did not come without challenges. Finding materials that can withstand the harsh conditions of space alone is no easy feat, and having no past references for an OOA composite tank complicated the task. “A lot goes into the design of the materials and the manufacturing to make sure that [the tank] is durable enough to withstand the cryogenic environments,” Vickers says.

Rivera notes that manufacturing an all-composite cryotank is a relatively new concept; before, engineers only understood how to contain liquid hydrogen using a metal or metal-lined tank. Vickers adds that the effectiveness of OOA composites has yet to be proven in many applications, including cryotanks. But moving into the uncharted territory of OOA composites had distinct light weighting benefits. One of those is cost savings, no small feat for large outer space missions.

“We’re always trying to get the most value for the funding that we have,” Vickers says. In 2014, NASA’s budget accounted for 0.45 percent of the federal budget, the lowest percentage since NASA’s second year of existence in 1959. That makes cutting costs a top priority. “It would cost upwards of $10,000 [to put a pound of payload in Earth orbit],” says Sutter. “Whenever you can save a pound of weight, you are way better off.” Saving on weight and cost without sacrificing performance is a familiar refrain to composites manufacturers.

**Telescope Aids Celestial Observation**

Frank Bernas, vice president and general manager of ATK Structures (part of ATK Aerospace Group’s Space Components Division), is well attuned to NASA’s projects and interest in

![Image of a cryotank](https://example.com/cryotank.jpg)

Photo Credits: NASA
Composites. ATK manufactures composite products for outer space applications, including the backplane of the James Webb Space Telescope (JWST). The backplane holds the mirrors on the telescope, which will serve as a space observatory for viewing the birth and evolution of galaxies and the formation of stars and planets in infrared light. Another ATK project is the heat shield for the Low-Density Supersonic Decelerator (LDSD), a space vehicle designed to create drag to decelerate a spacecraft during entry through a planet’s atmosphere.

Bernas says composites are uniquely qualified for thermal stability requirements. The JWST backplane features three sections made from Toray M55J carbon fiber and cyanate ester resin that connect to form the support structure for the beryllium mirrors on the JWST. Many materials contract in cold temperatures, but ATK built the backplane so it would not distort more than 38 nanometers. This is key in the extremely low temperatures of outer space. By comparison, the LDSD’s GFRP structure must tolerate high temperatures as it decelerates through the planet’s atmosphere.

“The unique characteristics that composites bring to space products is the marriage of three characteristics: Stability, strength and mass,” Bernas says. “You can create a highly optimized structure to enable space missions to be successful. The things we’re doing on James Webb probably couldn’t be done even using high-end materials like beryllium.”

NASA’s commitment to composites is evident in its support of the Advanced Composites Project, a research partnership with six aerospace companies to advance composite materials research and certification to reduce the time for development, verification and regulatory acceptance of new composite materials and structures. “We’re trying to mature composite technology and give our designers the confidence to use these materials,” Vickers says.

Launch Vehicles Send Satellites into Space

NASA doesn’t have a monopoly on space exploration and its subsequent opportunities for composites. One burgeoning market for private companies is the small satellite industry, which grew a whopping 269 percent from 2012 to 2013 and continues to grow, according to SpaceWorks Enterprise’s “2014 Nano/ Microsatellite Market Assessment.” Small satellites are well-suited for real-time earth observation, weather observation and communications applications.

Capitalizing on this growing market, Peter Beck, CEO of Rocket Lab, developed a product to put small satellite platforms in orbit regularly and cost effectively. Rocket Lab’s Electron, the world’s first fully CFRP launch vehicle, is designed to simplify
Potential for All Companies to Reach for the Sky

With the rapid expansion of the aerospace market comes even greater opportunities for small businesses to become involved. Bob Skillen, CEO and chief engineer at VX Aerospace, says that advances in computing and the maturation of the composites industry have opened up the market for smaller companies. “Capabilities that used to be considered only in the realm of large OEMs and prime vendors are now in the hands of small businesses,” says Skillen, who gave a presentation entitled “Small Business in the Aerospace Composites Market” at CAMX in October.

Skillen noted in his presentation that, compared to the first microprocessor introduced in 1971, modern CPUs are 4,000 times faster, use 5,000 time less energy and cost 50,000 times less. In addition, affordable CAD software allows companies such as VX Aerospace to conduct surface modeling to a millionth of an inch. “Ten or 20 years ago, that kind of capability was only in the primes,” says Skillen.

Small businesses also can invest in more powerful and less expensive manufacturing machines than before. “I can go to an $80,000 CNC machine and create shapes with accuracies that used to be unheard of and would cost hundreds of thousands of dollars. [These machines are] now in the thousands of dollars range,” Skillen remarks.

In addition, out-of-autoclave manufacturing has also led to more opportunities. Traditionally, the only way to make large enough aerospace-grade composites was to use an autoclave – a cost-prohibitive proposition for most small companies. Today VX Aerospace uses a 12 x 9 x 40-foot oven that cost $80,000. A similarly sized autoclave would cost about $3.5 million, says Skillen.

Small businesses still face challenges breaking into the aerospace market, however. “Getting jobs is hard,” admits Skillen. “You have to persevere.” Fortunately, Skillen notes that the U.S. Navy Naval Air Systems Command (NAVAIR) is trying to change the status quo. NAVAIR hosts forums for contractors on how to engage small businesses and take advantage of the capabilities of small businesses.

Ultimately, Skillen believes small businesses offer one great advantage – flexibility and nimbleness. “It’s not that we’re different than the people who work at big companies,” he says. “We’re just not encumbered by their size and process and the inefficiencies that can come with that.”

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Future Development

While aerospace remains one of the top industries for composites, those in the trenches say there’s more work to be done. “We are in the ‘final third’ of the development and manufacturing curve, where we’re really focusing on affordability,” Bernas says. The research and development needed for continued growth is off to a strong start through the Advanced Composites Project, private companies like Rocket Lab and universities.

As research and applications flourish, so does confidence that composites will help us travel deeper into space than ever before. “If you’re a company or a government agency that’s trying to accomplish big space missions, and you’re not using composites today, you will be in the next decade,” Vickers says. “I think that’s true for other sectors as well: transportation, automotive, commercial aviation – we’re going to see an explosion of composites usage.”
A century ago, the Ford Motor Co. built a concept car made of soy resin and hemp fiber. Today, automotive manufacturers are more likely to use flax and polyester to create lighter components. While the base materials may have changed, the focus on natural fiber composites has kicked into overdrive.

The replacement of glass and carbon fiber with biobased fiber for the production of composite materials is gaining traction for a number of reasons—weight savings and sustainability key among them. Market research firm Lucintel expects the natural fiber composites market to grow 11.2 percent from 2014 to 2019. The Lucintel study points to increasing penetration in automotive, building and construction and electrical/electronic end markets.

The U.S. Department of Agriculture is keeping an eye on applications through its BioPreferred program, a mandatory federal procurement program that requires federal agencies to buy and use biobased products, and maintains a voluntary “USDA Certified Biobased Product” labeling program. BioPreferred program manager Ron Buckhalt believes that biobased fibers offer a win-win for stakeholders in both potential cost savings and reductions in density and weight. “Farmers benefit from new markets, the environment benefits from renewable-source products and the country will be less dependent on imported petroleum [used as a precursor for carbon fiber],” says Buckhalt.

He cites viable applications in sporting goods, ship building, mass transit, furniture and biomedical devices. “There’s a Department of Defense (DOD) application research project underway comparing biobased fiber composites as an alternative to carbon fiber composite material to reduce weight and improve performance for DOD applications including weapons platforms,” says Buckhalt.

North Dakota State University (NDSU) is among the academic institutions with research resources dedicated to the development of natural fiber-based composites to bring added value to the state’s agricultural base. “If we can...”

These bamboo fibers have been dyed to provide a purely aesthetic option for the cosmetic layer of a laminate.

Photo credit: SunStrand LLC.
take byproducts and convert them to a higher value-added product, we diversify our agricultural industry,” says Chad Ulven, Ph.D., associate professor of mechanical engineering at NDSU. “We think of plants as an engineering material rather than just as food.”

According to Lucintel, the automotive industry is among the largest users of all natural fiber composite applications. The need for lightweight vehicles to meet looming Corporate Average Fuel Economy (CAFE) standards makes natural fibers an attractive option. Added to that is a growing bias from consumers toward environmentally-friendly products and manufacturers’ desire to increase the sustainability of their manufacturing processes.

“Many non-primary automotive structures are compatible with natural fiber systems,” says Troy Riddle, Ph.D., CEO of Gradient Engineering, a service provider for the design and analysis of polymer reinforced composites in Bozeman, Mont. Interior systems such as dashboards, door panel backings and trunk components where heat is not an issue are currently in production and benefit from biobased fibers’ contribution to noise and vibration damping.

**Short and Long Fibers**

Access to short fiber biobased byproducts for non-structural or semi-structural components is commercially plentiful, coming from leafy plants such as sisal, abaca, sunflower hull, rice hull, coconut husk and more. A ready, affordable supply of long fiber bioply or “bast” for structural composites is less so. “These materials, which are derived from the stalk or bark of a plant, provide the reinforcing fiber characteristics that are valuable for structural composites,” says Ulven.

Jute, flax and, in Europe, hemp, are the dominant long fiber sources currently in play. Growing hemp has long been banned in the U.S., but the USDA’s 2014 farm bill allows state agriculture departments, colleges and universities to grow hemp for academic or agricultural research purposes in states where industrial hemp farming is legal. “The future may open up for hemp, but right now there is only one U.S. approved vendor,” says Gradient Engineering’s Riddle. For commercial applications, hemp must currently be sourced from Canada or overseas.

RheTech Inc. in Whitmore Lake, Mich., began compounding and distributing its RheVision® line of bio-fiber reinforced polypropylene in 2006. “We quickly branched into a range of natural fibers for a more complete product line, including agave fiber, ground coconut shell, rice hull and husk, flax fiber and wood fiber,” says Jim Preston, vice president of business development. “We’re supplying the Ford Motor Co. with a combination of ground rice hulls and polypropylene. When we’re replacing a glass-filled polypropylene, we are primarily using flax filler, substituting a non-renewable with a renewable resource.”

RheTech is also starting to work with hemp. “In the long term, it will help us be more competitive with glass fiber systems,” says Preston. “Right now, we’re importing hemp from Saskatchewan for research purposes, but transportation costs are an obstacle to commercialization.”

Earlier this year, Gradient Engineering established a spin-off company, SunStrand, to develop and distribute bamboo fiber reinforcing products for polymer composites. When planted in the proper environment, Riddle says, bamboo requires almost no pesticides, fertilizers or additional watering. He adds it can sequester up to 70 percent more carbon per year than hardwood forest and can be harvested without the need to replant. “Bamboo fibers have been underrepresented in this market,” says Riddle. “It has antimicrobial properties which will make it a good fit for medical and sanitary applications. Plus, there is an infrastructure already in place to support it so that there are minimal sourcing issues.”

**Processing Challenges**

NDSU’s research incorporates fiber volumes from 5 to 50 percent, along with a multitude of chemical treatments and a range of processes, including pultrusion, layup, mat production and extrusion. “Bast fibers require drying, fiber milling and either chemical or mechanical processing to remove naturally occurring pectin. Untreated, the fibers tend to bind or clump when combined with resin,” says Ulven. Removing the pectin results in a shorter length/diameter ratio than the fiber has in its bundle form, reducing the load transfer capability. But the shorter fibers allow resin to penetrate more thoroughly so that the fibers wet out more easily. “Overall, we’re trying to balance fiber separation while maintaining high aspect ratios so that we can compete with fiberglass,” Ulven adds.

RheTech’s biggest challenge is determining the correct fiber length. “We want the longest fiber to create the best strength,” Preston says. “But the length of the fiber is restricted by the capacity of the extruding compounder. Fibers that are too long cross each other, forming a bridge that blocks output.” Processing the composite matrix also is limited by a melting point of approximately 400 degrees F. Above that, biobased fibers tend to burn. “The good news is that in running the equipment at lower temperatures, the cooling time is reduced and the total energy expended by the process is lower,” Preston says.

Gradient Engineering found that the length of the natural fiber is a critical parameter. “There are two aspects at play here, bondability and fiber length, and they are somewhat intertwined,” says Riddle. “We’ve had an easier time developing the combination of right surface treatment and fiber length for thermosets than thermoplastics. In an ideal composite failure, you have fiber breakage after the matrix begins to fail. However, if the fiber is not treated properly or is too short, it can pull out of the resin when the bonding fails. The longer the fiber, the more...
Developers of bio-fiber composites also must address water absorption and resin compatibility. Natural fibers are more absorbent, which can deform surfaces by swelling and creating voids, making it particularly challenging where exposure to inclement weather and water is unavoidable. Matching the right resin with the right natural fiber is one way to address the challenge of moisture uptake. “Theoretically, if the fiber is fully encapsulated, moisture uptake will be limited,” says Ulven. But for marine or wind energy applications, when the boat hits a rock or a rock hits a blade, water ingress can become a problem.

Ulven's NDSU team has found that bio-fibers bond well with biobased vinyl ester or epoxy-like resins developed from sources such as vegetable oil. “We see greater interlaminar and tensile strength and better resistance to moisture,” he notes. “We’ve also achieved success in combining natural fibers with polyurethane. The isocyanate in polyurethane reacts with water fairly violently. As a result, the inherent moisture in natural fibers leads to outstanding bonding.” NDSU discovered this when researching sandwich structures, such as flooring for mass transit.

“The range of resin systems – for example, just the different grades of epoxy alone – will require time to optimize the varying chemistries. It will be trial and error, manufacturing and retesting,” says Riddle. But off-the-shelf chemistry for biobased resin systems with material specifications in place are on the way.

**Keys to Gaining Commercial Acceptance**

By their nature, bio-fibers are variable. There is color variation as well as disparities in moisture content, depending on where the fiber is grown, the amount of rainfall and the age of the fiber when harvested. “We have information about the strength and stiffness of most bio-fibers,” says Riddle. “But since interdependence is so critical, we emphasize material qualification on the actual composite system rather than the individual fiber. Now we’re talking about composite tensile, compressive, flexural and impact performance.”

At this stage in the industry’s development, projects frequently move into uncharted territory. “The hardest job I have is creating the market,” RheTech's Preston admits. To help specifiers compare materials, the company created a reference sheet showing typical glass fiber characteristics versus comparable natural fiber characteristics.

Efforts are underway to create a robust grading system for assessing the properties of natural fibers. “We are working with colleagues in Australia and Canada, as well as with ASTM International, to establish that grading criteria so that part designers will be able to specify grades of fiber just as they do resin,” says Ulven.

One approach to gaining commercial acceptance is hybridizing natural fibers with glass or carbon fibers. “We’ve taken a critical look to see if the micromechanics still apply when adding a known, traditional structural fiber,” says Ulven. “A mix as aggressive as 90 percent flax and 10 percent carbon fiber reduces the variability of the composite systems’ performance. Introducing a known fiber to the mix may facilitate acceptance by the design community.”

**Creating a Value Proposition**

“We’d like natural fiber composites to offer a value proposition of reduced costs, but at this stage, it’s a goal. In practice, the verdict isn’t in yet,” says Riddle. E-glass fabrics represent a mature market with off-the-shelf items. Until the market for bio-fiber
composites matures and is as readily available as E-glass, costs will be a limiting factor, he adds.

“The industry has focused on the short fiber fillers as this is more easily sourced and less expensive than traditional mineral fillers,” says Ulven. “Right now, the costs for long biobased fibers as a replacement for glass fiber is challenging. We are seeing it at $5 to $6 per pound after processing as opposed to $1 to $2 per pound for glass fiber.”

Preston agrees that cost is a hurdle to implementation. “For this industry segment to grow, the replacement composite system will have to be cost neutral or provide cost savings, which includes the potential to save weight,” he says. RheTech has its customers evaluate the material as a cost per cubic inch rather than the cost per pound to get at the true part cost.

“I’m not aware of any entity that has fully realized the potential of natural fiber yet. But we’ve made great strides,” says Riddle. Buckholt notes, “Anywhere we can replace finite products with products that are renewable, affordable and work as well or better than their counterparts is a good thing. We are definitely seeing inroads in the applications for biobased fibers and biobased plastics. With so much happening, it’s an exciting time to be involved.”

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“The exhibit size and content at CAMX were mind blowing!” says Gary Beck of Global Composites Inc., one of more than 7,100 attendees of the inaugural CAMX – The Composites and Advanced Materials Expo, held at the Orange County Convention Center in Orlando, Fla., in October. “The bar is set high for Dallas.” That’s where ACMA and the Society for the Advancement of Material and Process Engineering (SAMPE) will host CAMX 2015. And based on the success of this year’s show, CAMX 2015 is sure to draw thousands of professionals from across the composites and advanced materials industry.

As the industry expands to new markets, uses new manufacturing processes and continues to compete with traditional materials, CAMX’s countless opportunities to learn and network have arrived at a crucial time. “Manufacturing is changing, whether you like it or not,” says attendee Robert Thompson, operations leader at the Mississippi Polymer Institute. “It’s great to hear all of these discussions about our industry in one place.”

Here are five overarching themes carried throughout CAMX 2014, followed by a sneak peak at content from six of the most popular educational sessions:

1. Meeting of the Minds
CAMX is the product of a new collaboration between ACMA and SAMPE, which previously hosted separate conferences. The combined annual conference provides a venue for collaboration between ACMA and SAMPE members.

“For many years, we have attended the ACMA and SAMPE shows,” says Dakota Kieffer of Plastics Unlimited Inc. “CAMX did a great job of combining both shows. It was fantastic to meet with everyone at the same show.” Kieffer says he and other employees from Plastics Unlimited networked with suppliers that will help them improve and expand processes using new materials, which may ultimately help the company lower its costs and gain more customers. They also met several potential new customers, including one that visited the company’s Preston, Iowa, facility just five days after CAMX ended. “It’s one of the best shows we have gone to in many years because of the great opportunity to network with everyone,” adds Kieffer.
2. Digging Deep with Tutorials

Before the exhibit hall opened, CAMX kicked off with a day of pre-conference tutorials. Eleven different three-hour seminars were led by industry experts from esteemed colleges, such as the University of Utah and Brigham Young University, as well as leading composites companies. There were tutorials for both industry newcomers and seasoned veterans.

In his “Overview of Composites Manufacturing” session, Brent Strong, Ph.D., professor emeritus at Brigham Young University, shared eight rules for composites manufacturing when working either with FRP or advanced materials. Later in the day, Chad Duty, Ph.D., from Oak Ridge National Laboratory, gave a crash course on one of the industry’s newest technologies – additive manufacturing.

David F. Erb, Jr., senior R&D project manager at the University of Maine’s Advanced Structures and Composites Center, attended the tutorial “Thermoplastics Composites Technology” led by Arnt Offringa of Fokker Aerostructures. “His knowledge of thermoplastics processing was extensive and provided insight that will be valuable to our future research at the University of Maine,” says Erb.

3. Tackling New Technologies

New manufacturing methods and materials are storming the industry, and CAMX provided attendees a thorough look at many of them through technical paper and educational sessions. Several speakers explored the potential of new technologies ranging from additive manufacturing to out-of-autoclave manufacturing.

Paul Kladitis, a senior research scientist at the University of Dayton Research Institute, discussed one of those up-and-coming technologies – nanotechnology – in an educational session. Kladitis, the Carbon Materials Group Leader in the Multi-Scale Composites & Polymers Division at the University of Dayton, highlighted the use of nano-reinforcements in thermoset and thermoplastics.

Such technologies aren’t as far off as some may think. “Useful applications [for nanocomposites] in other industries, such as batteries and electronics, have recently helped nanotechnology mature in scale and price,” says Mike Nemeth, vice president of sales and marketing at OCSIa1. “Manufacturers who previously considered nanocomposites, even just a few years ago, are now reevaluating their role in creating next-generation products with improved conductivity and durability.”

With more than 300 educational sessions at CAMX, there was just one problem: “The selection of educational and technical paper sessions made it difficult to decide which sessions to attend,” says Beck. “Hopefully with the CD provided by CAMX, I can review the sessions I missed.”

4. Training Tomorrow’s Professionals

A recurring topic of discussion, whether you wandered the show floor or chatted with peers at a networking reception, was the importance of training the next generation of composites professionals. CAMX 2014 featured nearly 30 exhibitors focused on education and training, many of them congregating in the University Pavilion on the show floor. In addition, several sessions covered education and workforce development.

In a session entitled “Education Requirements to Support Market Growth,” Darren Greeno revealed how the nearly two-year-old Composites Washington Training Consortium is strengthening the composites training infrastructure across the state. Greeno is the dean of professional technical education at Bellingham Technical College, one of 10 community and technical colleges (CTCs) involved in the consortium. Working hand-in-hand with industry partners, the CTCs offer much-needed training in materials handling, fabrication, trimming, repair, assembly and more.

The poster session at CAMX 2014 served as a shining example of the result of top-notch composites education. More than two dozen poster displays highlighted pioneering research conducted by students on university campuses worldwide. The projects encompass topics ranging from improved epoxy systems to sensors for in-the-field damage monitoring.

5. Going Green

“People are ready now to embrace biocomposites,” says Joe Luttwak, founder of Lingrove. The company supplied the ekoa flax/bioresin prepreg for the Blackbird ukulele that won the Innovation in Green Composites Design ACE Award. (Visit www.thecamx.org/AwardsCompetitions.php to see all the ACE and CAMX Award winners.)

While the ukulele was a high-profile example of biocomposites at CAMX, it was by no means the only green application touted at the show. More than 40 educational sessions were dedicated to green composites. Topics included natural fiber technologies, FRP and carbon fiber recycling, alternative energy markets, biopolymers, life cycle analysis, sustainable design and more.

“Today’s composite designers should consider how they can enable sustainable solutions that will allow their product to shine and generate sustainable actions – lightweighting, durability, corrosion resistance and more,” says Gale Tedhams, director of sustainability for Owens Corning, who led off the session “Designing for Composites Sustainability.”

Session Highlights

Architecture Taking Aim at the Architecture Market

The architecture market is a large and growing market, ripe with opportunities for composites professionals. The non-residential segment – typically buildings of three or more stories – grew 5.8 percent in 2014, with $7.2 trillion spent on projects. And it’s expected to rise another eight percent next year. These market statistics and an optimistic outlook were shared by Jefferson Ellinger and David Riebe during the CAMX pre-conference tutorial “Composites in Architecture.”

“There are a lot of opportunities here,” said Ellinger, an associate professor of architecture at the University of North Carolina at Charlotte and founding partner of E/Ye Design, an architecture firm based in Jackson, Wyo. “Right now, the composites industry makes up a very tiny part. But there’s a huge market in architecture right around the corner.”
Ellinger said there are two primary ways companies can become involved in architecture. The first is to make a product that can be specified, such as bathtubs, counters or decorative items. The second is to provide an integrated system like cladding. The latter strategy provides better opportunities for composites companies to partner with architects, said Ellinger. While specified products can be swapped out, integrated ones are often explicitly linked to the project.

Perhaps the biggest challenge of working on an integrated system is the long project cycle. “A lot of shops – mine included – are used to taking on a project when the money is flowing; You sign a contract and go into production and tooling,” said Riebe, a partner at Windsor Fiberglass Inc., a fabrication shop in Burgaw, N.C. “That’s no longer the case when you get into the architectural market at the systems level.” There may be a significant upfront investment in time, where you are developing ideas and sharing the resources before landing the account and beginning production.

However, in the long run, it’s advantageous to get involved at the beginning; You are less likely to be subject to competitive bidding and become integral to the project. “You want to engage architects early on to get on their radar,” said Ellinger. As you begin to think about how to penetrate the market, ask yourself these three questions:

1. What is your area of expertise?
2. What type of work do you want to pursue?
3. What will architects need to know?

Once you’ve considered what role you would like to play in the market, the next step is connecting with architects. Riebe and Ellinger offered this advice:

- **Find architects in your area.** Visit the American Institute of Architect’s website at aia.org and click on the “Find an Architect” link.

- **Attend industry conferences to become market savvy.** In addition to an annual show, individual chapters of AIA hold local shows. Many revolve around architectural disciplines, such as hospitality, retail or medical. You may decide to focus on one of these niches.

- **Become a resource for architects.** Offer “lunch and learns” to educate architects on your products and services and how they can be used. You may be eligible to offer architects continuing education credits (required in 40 states) for attending your classes. Visit the education page on AIA’s website and click on “Become a Provider” to find out how.

### Automotive

**Automotive Holds Potential, But Needs Fine-Tuning**

Composites have a place in the conversation on lightweighting vehicles and improving fuel standards, but how can the composites industry lead the conversation? Chris Red, principal of Composites Forecasts & Consulting, gave the facts on the future of composites in the automotive market during the educational session, “The Automotive Market: Where It’s Going and What’s Needed?”

Japan and the European Union (EU) hold stringent standards on fuel efficiency. The EU severely penalizes OEMs for exceeding these standards, issuing fines of €95 ($123) per g/km per vehicle, which could exceed €15,000 (approximately $24,000). The Euro 6 Standards also are curbing large diesel commercial vehicle emissions.

China and North America currently lag behind these standards, but hope to match them. Permissible emissions are expected to drop by one-third by 2025 in the United States. Corporate Average Fuel Economy (CAFE) standards are targeting a highway fuel efficiency standard of 61 mpg and would fine OEMs $5.50 for every 0.1 mpg below that standard.

Red said a vehicle’s weight contributes 20 to 25 percent of its fuel economy, and 50 to 70 percent of weight reduction potential lies in the frame, suspension and body. He also said that if companies can save 250 pounds in the chassis, a “spiral effect” can reduce the weight by 750 pounds by then saving weight in the drivetrain, engine, suspension and brakes. This is where composite materials can come into play.

Carbon fiber demand in the automotive industry is expected to skyrocket into 2022, far above aerospace, industrial applications and sports/consumer applications. But there’s still a long way to go: While advanced composites in automotive grew from 13 million pounds in 2012 to 23 million pounds in 2013, raw carbon fiber still only comprises 0.005 percent of raw materials in the automotive industry. Unfortunately, it is also the most expensive material, ranging from $35 to $175 per pound.

The industry also needs to scale up its current manufacturing capabilities; right now it cannot produce mid-volume demand vehicles quickly enough using carbon fibers to meet demand. Though the composites industry still faces challenges in cost and production for the automotive market, not meeting emission standards will be costly for both OEMs and consumers.

### Construction

**Composites Help Lower the Cost of Big Machinery**

When you see huge equipment on construction sites, you probably assume you’re looking at a whole lot of steel on wheels. And you’d be right. But equipment manufacturers such as Caterpillar are transitioning many applications to composites – and saving money. One example is transmission covers. Caterpillar replaced a 9 millimeter thick steel
Infrastructure

Keys to Market Expansion in Infrastructure

Antonio Nanni, professor and chair of the Civil, Architectural and Environmental Engineering Department at the University of Miami, discussed critical issues related to the advancement of composites in infrastructure markets, including testing, material standardization and additional infrastructure needs for market expansion.

The construction industry is driven by sustainability but regulated by building codes, said Nanni. It’s served by a delivery process that excludes sole sourcing, favors low bidding and separates design from construction. On the one hand, it offers opportunity for young talent with creativity and out-of-the-box thinking – characteristics that are the foundation of composites’ success. On the other hand, Nanni sees a market impeded by the inertia of the system and its reliance on building codes and specifications.

If composites manufacturing professionals want to be successful in this market, they need to understand that progress can be made if all stakeholders – owners, engineers, architects and contractors – are motivated to accept the deployment of innovation. At that point, the opportunities are countless.

Nanni’s presentation addressed the development of composites-related building codes, the collection of mandatory provisions that specify minimum acceptable levels of service and safety. Nanni believes that the composites industry has not always fully understood its protocols, for example, the difference between codes (which include mandatory language and establish required practice) and guidelines (which include non-mandatory language and establish recommended practice). “It’s about prescriptive versus performance standards,” said Nanni.

Updated published standards are slowly becoming available for implementation of FRP infrastructure projects through organizations such as the International Code Council, International Existing Building Code and the American Concrete Institute. But since many codes and standards addressing externally bonded FRP construction are outstanding, the alternative approach to FRP infrastructure projects – obtaining “special permission” – is often the only option.

One of the challenges the FRP infrastructure design community must address is the need to champion sustainability through life cycle assessment in all projects, whether new construction or repair, and the development of recycling and reuse options. With a high growth rate, the combined end-of-life and scrap of GFRP in Europe is expected to reach 608 million pounds by 2015. In the U.S., this scrap almost exclusively ends up in landfills. Down-cycling FRP for filler and aggregate materials for civil project construction could be a solution for the overall composites industry. Nanni would like to see technical organizations in the FRP industry reinvent their role. He proposes that these organizations can play a heretofore unexplored role of protagonist in the education arena as well as coordinate research and standardization at a national or global scale. As an example, he referred to the transformative “Vision 2020, a Vision for the Concrete Repair, Protection and Strengthening Industry,” a plan developed by an inter-industry strategic development council to support the concrete industry’s strategic needs.

“Our customers are driving the demand for performance and low cost,” said John F. Unser, CCT, a process control engineer for plastics/composites with Caterpillar. He led the educational session entitled “Plastics/Composites as a Low Cost Alternative for Heavy Duty Equipment.” One of the best ways to reduce costs is to decrease weight, but that may seem like an odd proposition for a company like Caterpillar.

“We make big, heavy-duty machinery,” said Unser. “So why do we care about weight? For one, every pound we reduce is a pound we can carry. The other reason is much of our equipment has to have counterbalances for lifting. If we save a pound on the front, we don’t have to add a pound on the back.” That’s where composites can help.

Unser said Caterpillar relies on a wide range of processing technologies to make composite parts, including hand layup, compression molding, filament winding, resin transfer molding and compression molding. For example, the company uses hand layup for lower volume parts and compression molding for non-cosmetic parts on the inside of machinery, such as fan shrouds. Caterpillar uses SMC compression molding for higher-volume products, including engine hoods and covers.

Unser then shared questions his company asks when deciding which of its products make good candidates for conversion from metal to composite.

- Is it a structure with assemblies?
- Is there an opportunity to consolidate parts?
- Can we leverage similar parts across our product offerings?
- Do we have an engineering team willing to make the conversion?

The last question, admitted Unser, can be the most difficult. “We have a lot of expertise in pockets [of knowledge] like welding,” he said. “We have very few people who know about composites. We need to train our engineers so they are comfortable using composites.” To do so, Caterpillar offers quarterly forums to display supplier capabilities, monthly lunch-and-learn webinars and a “plastics 101” class run by a local university.

Unser summarized that lower costs and other advantages will drive the increase in composite usage at Caterpillar. But, he added, the company can’t do it without partners. “Supplier collaboration is key for Caterpillar,” said Unser. “In the world of composites, we need collaboration. We look for suppliers with strong engineering backgrounds that will work with us to develop the market.”
**Materials**

**Thermoplastic Composites Are on the Rise**

What happens when you hold a flame just a couple inches under a strip of thermoplastic? Attendees at the standing-room only CAMX pre-conference tutorial on thermoplastic composites found out first hand.

Speaker Arnt Offringa, director of research and development at Fokker Aerostructures, handed out the strips and lighters, and people conducted the mini-experiment. After 10 to 15 seconds, you could bend the thermoplastic into a V-shape.

Though rudimentary, the hands-on activity displayed one of the benefits of thermoplastic composites: They can be reheated above their melting temperature for additional processing. Fokker Aerostructures manufactures lightweight structures, modules and landing gear for the aerospace and defense industry. Using thermoplastics for many of the components brings customers two highly sought-after benefits: It lowers the weight of the aircraft and reduces costs. Some other attractive characteristics of thermoplastics include:

- Unlimited storage and layup at ambient conditions in normal factory conditions
- High material toughness
- Recyclability
- Excellent fire, smoke and toxicity properties

Thermoplastics are a relatively young technology, said Offringa. But they’re making headway in the aerospace industry. Offringa cited the Gulfstream G650 as an example. The rudder and two elevators on the twin-engine business jet airplane were originally constructed of aluminum, then later composites. A few years ago, Fokker Aerostructures began making the parts from thermoplastics. The G650 rudder and elevators require high torsional stiffness and little bending stiffness. They are designed to allow buckling at 70 percent limit load, which provides a weight advantage over a honeycomb sandwich design. The transition to thermoplastic composites for these applications yielded a 10 percent reduction in weight and 20 percent cost savings.

Offringa then summarized production technologies for thermoplastic composites, including thermofolding, press forming, welding and co-consolidation. He also discussed how the technologies are moving into the automotive arena as the industry strives to lower carbon dioxide emissions and reduce weight through new materials. Automakers also seek recyclable and affordable options, which thermoplastics can provide. Lower-cost matrices, including polypropylene and polyamide, are well suited to automotive applications.

“Thermoplastic composites have tremendous growth potential,” said Offringa. Their toughness allows for innovative design, which can lower weight. Plus, fast processing techniques create low-cost solutions. Offringa ended by saying successful research and development of thermoplastic composites depends on these nine factors:

- Consistent, long-term management support (funding)
- A focus on unique capabilities that cater to customers’ needs
- A core of excellent engineers in-house
- Cooperation with customers, suppliers and “knowledge institutes”
- Short time-to-market for new technologies
- Product champions within your customers
- For true step-change innovation, start with a small production application and have growth in sight
- Government co-funding
- Blood, sweat, tears and incidental luck

**Manufacturing Processes**

**Taking On the Challenge of a New Process**

Composites manufacturers are embracing the growth of new processing technologies for a wide range of growing end markets. With opportunity comes challenge, said CAMX speaker Phillip Dushkewich, production manager for Fiberglass Fabricators Inc., a manufacturer with hand lay-up, vacuum infusion, light resin transfer molding and pultrusion capabilities. Dushkewich provided attendees with a set of steps for successfully adding a new process or project to a manufacturer’s organization.

1. **Be specific with your targeted outcomes.** Whether your customer has a unique demand or your competition is gaining an edge that you want to neutralize, be specific with your targeted outcomes. Establishing a well-defined, measurable objective is the first step in the development of a new capability. An example might be, “We are developing a product that outperforms the previous generation by 12 percent.”

2. **Understand the customer’s needs.** Learning and evaluating the customer’s needs up front may lead you to decide against the project if their needs are not in sync with your organization. Do they need the product to be lighter, stiffer, tougher, greener or cheaper? Will it operate in a harsh service environment? Is it a long-term development project, or do they need the new part in less than six months?

3. **Assess the opportunities for going green.** Increased awareness of manufacturing sustainability has created the need for new processes. If your neighbors are complaining or your customer demands a more sustainable model, consider that you may have opportunities to market to other customers interested in a greener public image.

4. **Challenge the customer.** In-depth conversations with the customer may require you to challenge their concept for the
part. They came to you for expertise, so don’t hesitate to share it. Learn as much as you can about their expectations in the finished product – higher volumes, part-to-part conformity or better finish. Develop a rough schedule with them and perform a reality check: Can you meet their deadline?

5. Identify other benefits. It’s possible that the project will provide your company with other benefits such as team development or establishing a long-term direction for the company. The knowledge gained in the new process may be used to improve the rest of your production floor.

6. Don’t forget profit. Develop a budget early that can be tracked and reviewed. Provide different versions of the budget – some more comprehensive than others – to meet the needs of each department working on the project. All versions should include common milestone targets that can be measured. Keep track of real-time spending.

7. Identify and evaluate the team. The impact of bringing new processing capabilities online impacts the entire organization. Make sure all departments are represented on the project team to ensure effective implementation, including management, sales, engineering, administration, purchasing and production.

8. Narrow the choices. Take a good look at your company’s strengths and weaknesses. Understand the differences between current processes and the new process to determine what changes will be needed to ensure success. Will your shop personnel need training? Are new equipment, materials or molds required? Perhaps a more stringent quality control process will be necessary. If the process does not fit what your company wants to be going forward, eliminate it.

9. Make the commitment. It is expensive to start a new process and retreat. Spending time upfront makes sure all participants understand what is expected and identifies a clear set of goals. Commitment must come from upper management. Without their unwavering support, the project may fumble.

10. Go to your resources. Hold conversations with distributors and suppliers to learn what they already know. It may help you avoid making mistakes others have already made. Read articles in composites trade publications related to your project, and reach out to sources in the story. Outside consultants also can be an excellent investment and deepen your internal knowledge pool.

More CAMX coverage can be found online at CompositesManufacturingMagazine.com/tag/camx-2014.
CAMX Forward

The composites industry hit another milestone in its development with the overwhelming success of CAMX in October. North America now has a show that covers the breadth of the composites industry. With more than 550 exhibitors, 350 educational and technical sessions and 7,100 attendees, it reflects the dynamism and innovation of composites. Everyone in the industry should be proud.

I heard many compliments during and after the show, so it is not too soon to book your tickets to Dallas for CAMX 2015. Next year's show, scheduled for Oct. 26-29, will be even bigger and better.

And there’s more exciting news! ACMA’s Board discussed a dynamic strategic plan that seeks to aggressively grow the composites market by educating designers about composites, remaining actively engaged in advocacy around styrene and human health, and growing the number and quality of products and services provided by your association. ACMA works hard to ensure that the industry’s needs and concerns are reflected in strategies to grow the composites industry that have been funded by the government with the association’s support. ACMA will host a conference in January to make sure your voice is heard with government entities and academia as the government works to fund up to $200 million in research and development to overcome barriers to growth in composites through its new Advanced Manufacturing Institute for Composites.

This is an exciting time for our industry, and ACMA is working for your company to open markets and increase your profitability.

Tom Dobbins, CAE
ACMA President

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Connect with Us After CAMX!
CAMX – The Composites and Advanced Materials Expo debuted in October to great acclaim. Did you miss the show? Check out a wealth of great content available online at: theCAMX.org. You can also find editorial coverage from Composites Manufacturing by searching for “CAMX14” on our website: CompositesManufacturingMagazine.com.

ACMA Welcomes New Affinity Partner
ACMA’s newest affinity partner, Amerex, operates one of the largest wholesale energy brokerages and houses one of the most knowledgeable retail energy consulting teams in North America. The company offers customized energy solutions that help control costs for composites manufacturers. Amerex is ACMA’s resource to help members make smart energy decisions and drive innovation based on the latest market information. Members can now download Amerex’s monthly Market Intelligence Report and get a free energy analysis. Visit acmanet.org/opportunities/affinity-programs to learn about all of the benefits available to you.

ACA Looks to Enable Adoption of Automotive Composites
At its recent meeting in Novi, Mich., the Automotive Composites Alliance began creating plans to work with the Department of Energy’s Composites Manufacturing Innovation Institute as well as with universities to research ways to overcome current barriers to more widespread adoption of automotive composites. The ACA will initially focus on two significant barriers (composite materials are not included in the material databases of engineering design software and composites are difficult to repair and replace) by partnering with like-minded organizations to research solutions that could help reduce or eliminate those barriers.

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  Rockwood, Tenn.

For more information on becoming a member of ACMA, email membership@acmanet.org or call 703-682-1665.

ACMA Calendar of Events

For more information regarding ACMA's upcoming events and education, visit acmanet.org/meetings.

November 12-13
CCT-Instructor Course
ACMA Headquarters – Arlington, Va.

December 9-11
CompositesWorld Carbon Fiber 2014
La Jolla, Calif.

March 23-27, 2015
The International Plastics Showcase (NPE)
Orlando, Fla.

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Ice skating is a classic winter activity, but falling through thin ice can mean danger for the rescue team as well as the victim. “Current ice and cold water rescue technology is antiquated,” says Roger Bailey, founder and president of WISE Technology in Gilford, N.H. “It is focused on putting the rescuer on the ice or in the water, placing them at high risk of becoming victims themselves.” WISE Technology’s AIR (Amphibious Ice Rescue) Responder could change this: With the AIR Responder, rescuers can safely reach, recover and return a victim to shore before other methods have even deployed, according to the company.

One Cool Rescue Vehicle

The hull is fabricated with knitted fiberglass fabric around a PVC foam core with additional Kevlar® aramid reinforcement layers in key stress areas. The foam core helps the vehicle stay afloat, despite weighing nearly 1,500 pounds. Vinylester resins are used to withstand water absorption.

The bottom of the hull is covered with 3/16-inch high-density polyethylene (HDPE) plastic for additional impact resistance. The plastic also reduces the likelihood of the hull freezing to icy surfaces when the vehicle comes to a stop.

The bow is reinforced with a biaxial-aramid hybrid glass fabric for added strength against impact with ice and to resist abrasion.

The AIR Responder features a snowmobile with a 33.4-square-foot rescue platform that attaches to the front. It moves through water, ice, broken ice or snow at speeds up to 40 mph. The vehicle’s low center of gravity and flat, non-skid platform is designed to keep the work space stable for easier rescuing. An attached railing system functions as both a victim grab rail and responder tether anchor for added security. WISE Technology began production in January 2014 and delivered the first unit to the Poland Fire Rescue Department in Poland, Maine.
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