Jennifer Ridgeway

Minnesota's Composites Cluster

Minnesota is only a mid-sized player in the composites industry, but an unusual cluster of composites companies in the Winona area specializes in everything from violin bows to canoes.

Composite materials date back more than 100 years, and today they can be found in a variety of applications. Polymer composites, which are resins (plastics) reinforced with items like glass fibers, offer many advantages such as light weight and high strength. Those characteristics make them popular in applications from autos and airplanes to roofing and golf clubs.

Growth in the composites industry will likely come from technological advances that improve the material's properties and from new uses, but there is also potential for growth in green composites or biocomposites.

Composites contribute to the production of violin bows.

Minnesota is a mid-sized player in the U.S. composites industry, but growth in the state industry has been outpacing the nation lately. Almost all of the employment in the sector is in the Twin Cities and the Winona area. In fact, composites employment in Winona is more than 30 times what would be normally expected in a community of that size. And much of that employment can be traced back to a few local entrepreneurs.

Building on Strengths

The plastic products industry is the third-largest manufacturing segment in the United States, employing 1.1 million workers and creating $379 billion in annual shipments, according to the Society of Plastics Industry Inc.[1] Plastics production is concentrated primarily in California, Texas and parts of the upper Midwest (including Ohio, Michigan, Illinois and Indiana), but every state has some activity in this industry.

Minnesota's combined plastics and resins-related industries accounted for nearly 15,000 jobs in 2008—more than 90 percent of them in plastics product manufacturing, which includes everything from plastic bottles and packaging to building materials. Many plastics manufacturers have a diverse

product line or do work for a variety of customers.

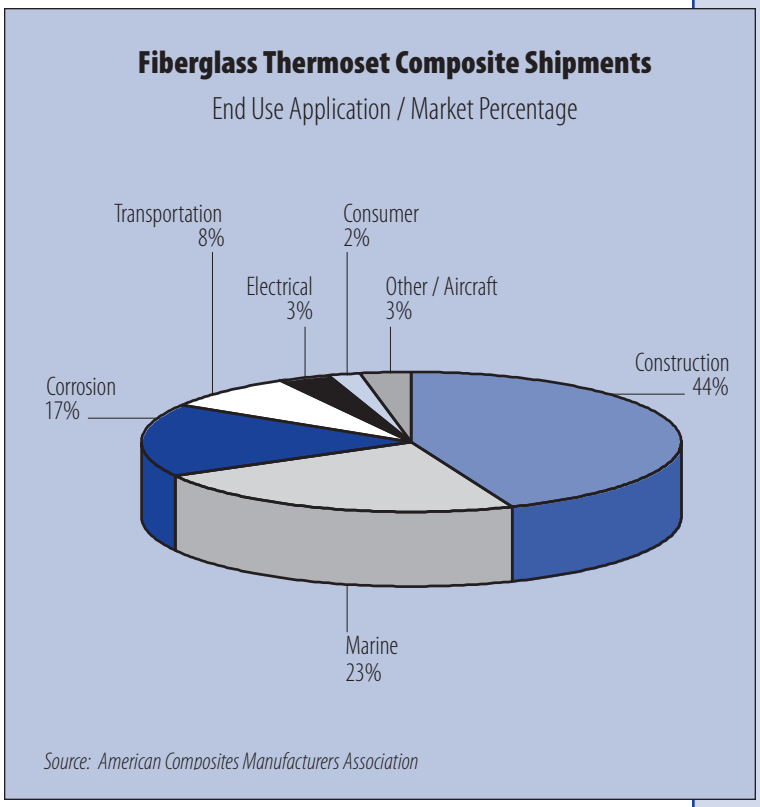
Several factors have driven growth in plastics, including lower costs, lighter weights and more flexibility than other materials. Those characteristics have helped plastics penetrate into markets that traditionally have relied on metal, glass and wood. Some of the most innovative plastics and resin companies work with composites—a material composed of a matrix (binder) of one material that is reinforced with the fibers or particles of another material.

There are different types of composites, with Minnesota wood composites being one example. Another type of composite is the polymer (plastic) matrix composite. These composites are often touted as being good replacements for some metals because they are lighter (think greater fuel efficiency for lighter automobiles), but they can also be high-strength, corrosion-resistant and non-magnetic.

Another example of a composite is fiberglass, a plastic resin reinforced with glass fibers. Fiberglass dates back to the 1940s, with applications in the aerospace and naval industries and eventually in the auto industry in the 1970s.

Today construction is the largest market segment for fiberglass composites, followed by marine, corrosion (chemical-resistant products like pumps and ducts for services like oil, gas and wastewater treatment) and transportation.[2] Consumer applications include household appliances and sporting goods (see Figure 1).

FIGURE 1



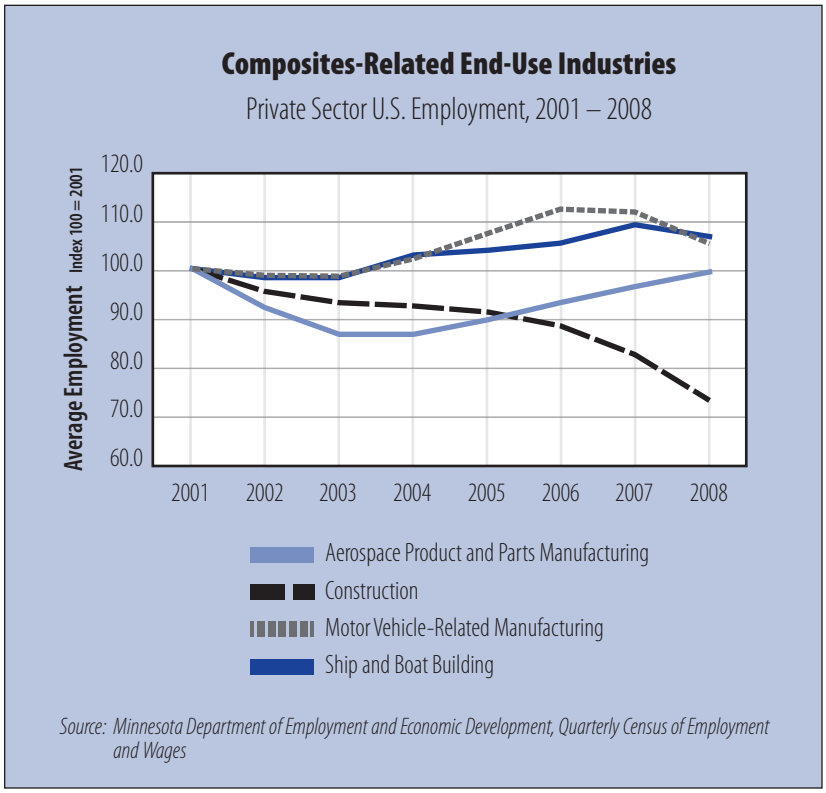
Composite materials are also used in defense, wind energy and agriculture, as well as biotechnology industries like medical devices and equipment.

The U.S. Census Bureau's County Business Patterns identified roughly 1,145 Minnesota jobs in two industries closely related to composites manufacturing. One is plastics material and resin manufacturing and the other is custom compounding of purchased resins. Minnesota employment accounts for slightly more than 1 percent of U.S. jobs in those two industries.

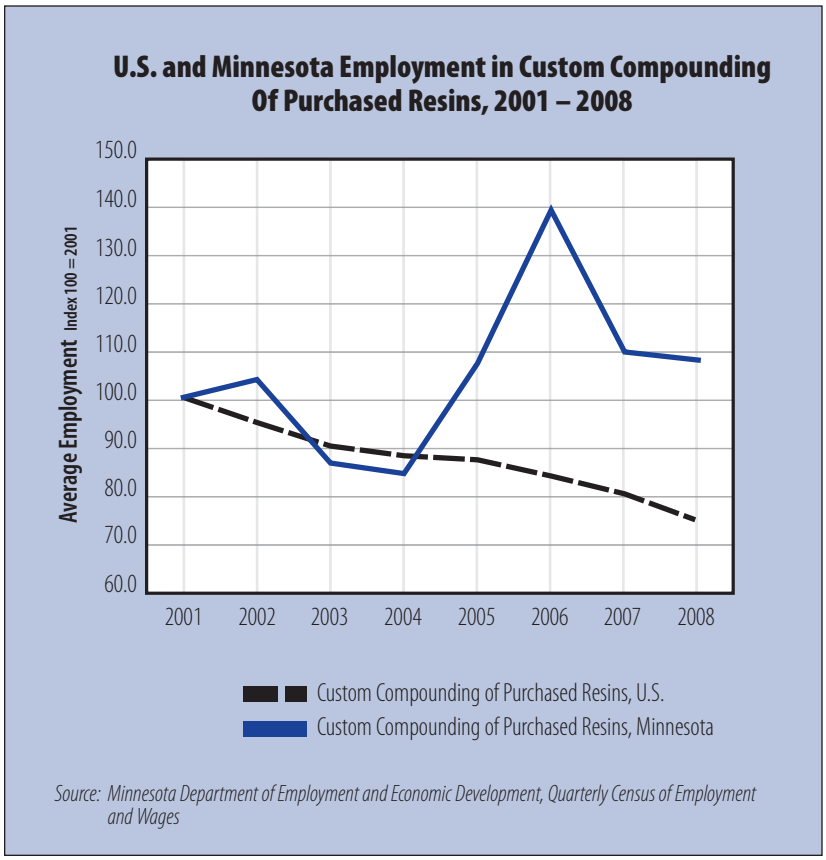
Texas accounts for one-third of material and resin manufacturing shipments in the U.S., with Louisiana, Illinois and Indiana together making up another 20 percent of shipments. The custom compounding of the purchased resins industry is spread out across more states, but one-third of shipments are concentrated in the top four states (Ohio, Indiana, New York and Texas). These states have strong industrial bases in sectors like energy and oil/gas production, construction and auto manufacturing.

Like overall employment in the plastics product manufacturing

FIGURE 2



Source: Minnesota Department of Employment and Economic Development, Quarterly Census of Employment and Wages



Source: Minnesota Department of Employment and Economic Development, Quarterly Census of Employment and Wages

FIGURE 3

industry—down more than 15 percent in the state and nation between 2001 and 2008—U.S. employment in plastics material and resin manufacturing and in custom compounding of purchased resins has also declined. Some of that employment change can be traced to employment declines in national end-use industries for composites, like aerospace and auto manufacturing (see Figure 2).

Unlike the national industry, though, Minnesota employment in the custom compounding of purchased resins industry—firms engaged in custom blending, mixing and reformulating resins made elsewhere—started to rebound in 2004 and continues to outpace employment in 2001 (see Figure 3).[3]

Employment in plastics product manufacturing started to fall earlier in the recession, although job losses have been milder in Minnesota than nationally (see Figure 4). Custom compounding of purchased resins maintained employment growth in the state until early 2009, even as U.S. industry employment was falling at rates of 5 to 9 percent each quarter of 2008.

While statewide industry employment data are available only through the first quarter of 2009, tough economic conditions will likely persist throughout the

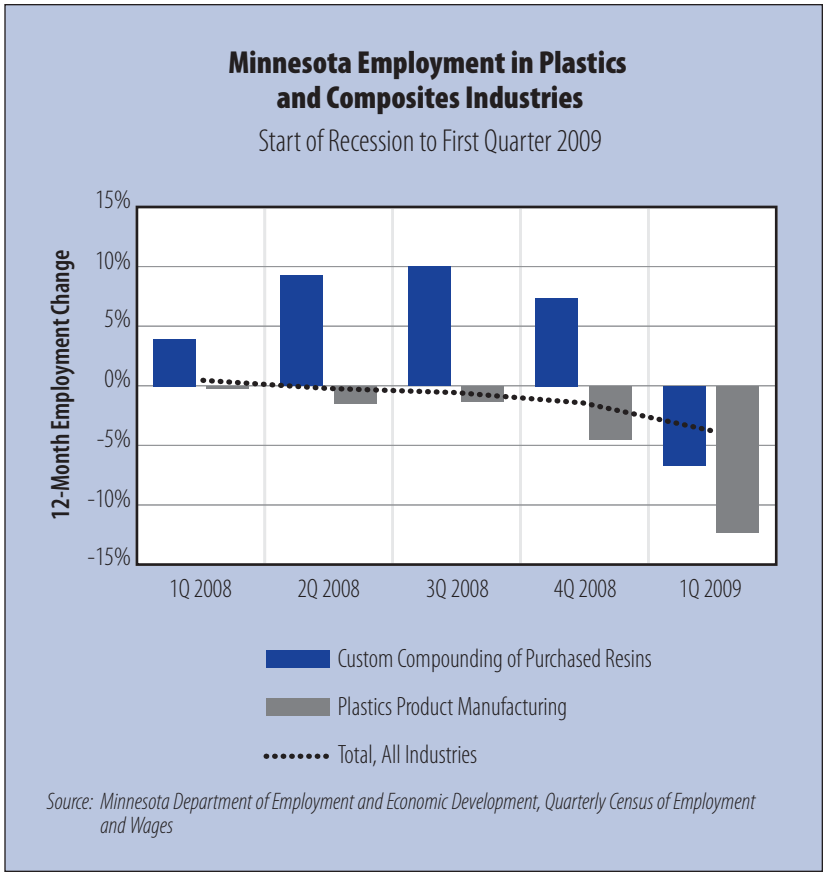
year. The American Composites Manufacturers Association (ACMA) reports falling sales in marine, recreational vehicle, auto and truck segments—meaning market conditions for composites will likely remain challenging through much of 2009.[4]

But the ACMA points out some areas of growth, for example power, sewage and waste disposal, water supply, highway and street, and transportation construction. June 2009 figures from the U.S. Census Bureau show 13 percent over-the-year increases in power-related construction spending and 8 percent in sewage and waste disposal spending.

Despite growth in the industry – for example, Minnesota's worldwide plastics exports grew 156 percent between 2003 and 2008 to $920 million[5]—increasing worker productivity is limiting job growth.

U.S. plastic products manufacturing output is projected to grow 50 percent between 2006 and 2016, but productivity growth from automation and technological innovations will push projected employment down to 2 percent growth. In Minnesota, employment growth in plastic products manufacturing is projected to reach only 0.8 percent over the 10-year period, while employment in the related chemical manufacturing industries is projected to decline.

FIGURE 4



Source: Minnesota Department of Employment and Economic Development, Quarterly Census of Employment and Wages

Composites of the Future

The value of composites is their ability to make materials lighter, more durable and flexible. For applications in industries like aviation, that can translate into considerable fuel-cost savings. Continued investments in research and development have advanced the industry's growth in new markets and helped make its products competitively priced. Together, the plastic, resins and rubber industries spent $3.9 billion on research and development in 2004, and some segments of the industry rank lower than only computer and pharmaceutical manufacturing in their ratio of full-time equivalent R&D scientists and engineers per 1,000 employees.[6]

Current research in composites continues to focus on how to make stronger, lighter and more flexible materials, as well as advancing production technologies.

Companies also hope to compete

DOUGLAS ROOT
Agricultural Utilization Research Institute scientist

TIM WELLE
BioBusiness Alliance

MARC HILLMYER
U of M polymer chemist

MIKE CICHANOWSKI
Founder of We-no-nah Canoes

on cost. For example, molded composites in manufacturing can reduce the number of parts, thereby reducing complexity, labor and costs required for assembly.

"When it comes to high-volume manufacturing, synthetic composite materials can be made ready to go out of a mold without the need to do assembly," said Darin Grinsteinner, engineering manager at Composite Products Inc. (CPI) in Winona.

CPI manufactures composites products for a variety of industries, including automobiles and agricultural equipment. Not only does the company's molded Ford F-150 running board eliminate the need for attachments and metal brackets, its use of custom-compounded composites eliminates the need to paint.

Another focus of industry research is green composites, including using a variety of recycled plastic materials. For example, an application at CPI combines recycled water bottles and fiberglass to create a tray used in painting applications. Other applications combine reclaimed diaper trimmings with fiberglass to create a variety of products.

Biocomposites

Another strategy is the use of bio-based materials to create new and unique biocomposites. Biocomposites utilize resins that are derived from crops like corn or potatoes, with reinforcement from fiberous plants such as kenaf or hemp. The end result is a strong, lightweight and cost-effective product that creates a smaller carbon footprint than traditional materials.

While bioplastics have found a home in consumer products and packaging, some types of biocomposites have been slower to gain momentum in large-scale production. One of the reasons biocomposites have been slow to replace traditional petrochemical composites is cost. Specifically, while petrochemicals may suffer from price volatility, they benefit from established processing, transportation and distribution systems.

Composites manufacturers also point out that durability or corrosion resistance are often more important that biodegradability.

Douglas Root, senior scientist of biomass and renewable products technologies at the Crookston-based Agricultural Utilization Research Institute (AURI), said biocomposites are being used at some companies, such as Environ Biocomposites Manufacturing

LLC in Mankato, but there is still significant work to be done in chemistry and material sciences before biocomposites make up a larger share of production.

Despite the fact that science is still making inroads in biocomposites, many stakeholders look at Minnesota's manufacturing, bioscience and agricultural strengths and see an industry ripe for growth.

The Destination 2025 project, a collaborative effort between the BioBusiness Alliance of Minnesota and Deloitte Consulting LLP, is optimistic about long-term prospects for biocomposites.

Tim Welle, research analyst at the BioBusiness Alliance, said increases in oil prices will cause renewable material resins to become more cost-competitive with petrochemical resins in the longer term.

PHOTO COURTESY WE-NO-NAH CANOE. PHOTOGRAPHER: VERN C. MATTHEWS

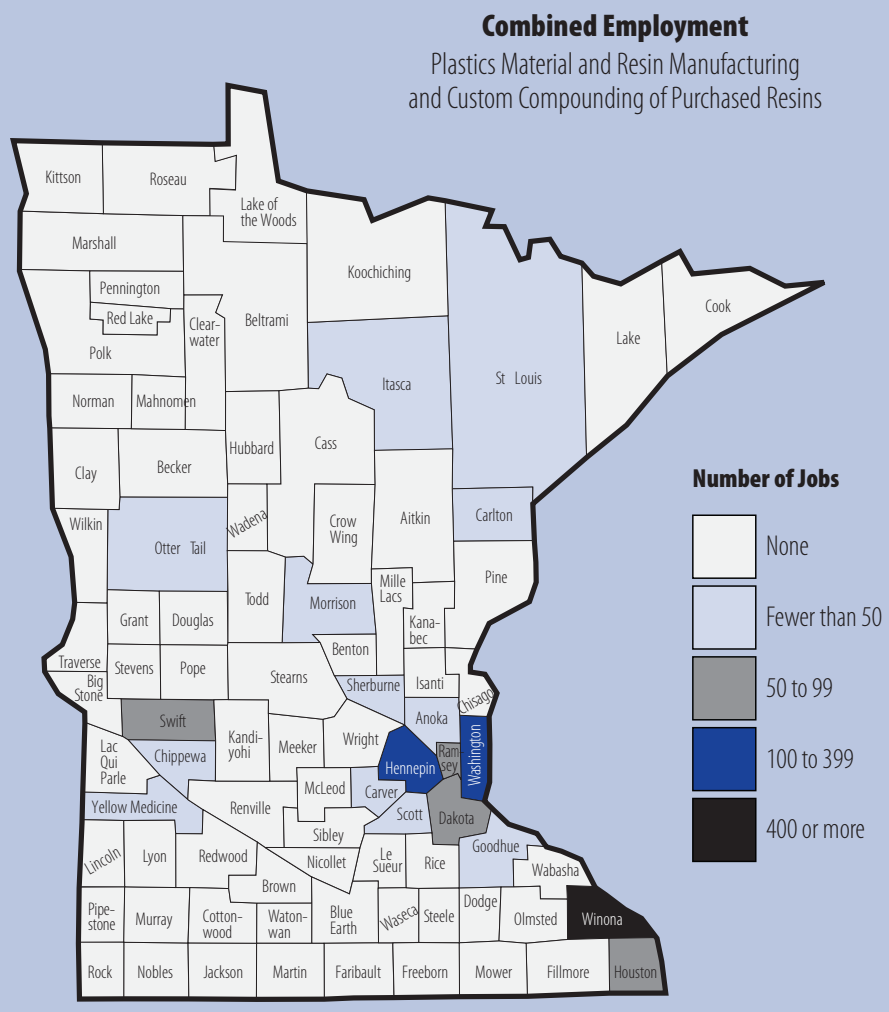
We-no-nah's Adirondack canoe.

Professor Marc Hillmyer, a polymer chemist and the director of the Center for Sustainable Polymers at the University of Minnesota, said that while the petrochemical industry has a huge head start on economies of scale, renewable resource polymers have several things going for them, including reduced costs due to the environmental sustainability of the production process, volatile oil prices and growing consumer demand for green products.

The growth of green materials in the construction industry shows the power of consumer demand, he said. While not all composites companies will switch to an all-biocomposites product line, Hillmyer sees a competitive advantage, if not a business necessity, in offering a bio-based alternative as well.

Welle also points to technological advances that are making biocomposities as strong and light weight, in many cases,

FIGURE 5



Source: D&B Million Dollar Directory. Accessed online Sept. 22, 2009.

as synthetic composites.

Minnesota could become a strong player in biocomposites, thanks to companies that are doing innovative work in that area and the state's strength in agriculture.

"The state has resources available for biomass harvesting and transport innovation that will be important to moving raw materials in a biocomposite industry," Welle said. "And most importantly, the significant agriculture base is capable of providing a stable source of feedstock to a company seeking biomass for composite production. Minnesota's strong skill set of materials science and chemical engineering also bodes well for industry development and continued manufacturing strength."

Some of that strength comes from Minnesota's universities, including chemistry and materials science departments at the University of Minnesota. Universities have the flexibility to explore long-term research and development strategies, according to Hillmyer.

Root added that universities and groups like AURI are needed to provide technical support and testing capabilities for smaller, innovative firms that often lack access to Ph.D. chemists.

Composites Cluster in the River Valley

Minnesota has average employment in plastics product manufacturing, but it has double the expected number of jobs in custom compounding of purchased resins, a much smaller sector. It helps that Minnesota is home to many companies that use composite materials in their products, such as construction firms and manufacturers of boats, cars, computers, medical devices and wind turbines.

Plastics product manufacturing firms are scattered around the

state—two-thirds of Minnesota counties have some employment in this industry—and the vast majority of these are small businesses with fewer than 50 workers.

Plastics material and resin manufacturing and custom compounding of purchased resins firms are much more geographically concentrated. In fact, in terms of employment at these firms, almost all of it is concentrated in the Twin Cities and the far southeastern part of the state (see Figure 5). In the southeastern corner, employment in these industries is more than 30 times what one would expect in an economy of fewer than 25,000 private-sector jobs.

Major Composites Companies in the Winona Area

Coda Bow	*www.codabow.com*
Composite Products Inc.	*www.compositeproducts.com*
Cytec Engineered Materials	*www.cytec.com*
Geotek	*www.geotekinc.com*
Miken Composites	*www.mikensports.com*
Natural Process Design	*www.naturalprocessdesign.com*
Plasticert Inc.	*www.plasticert.com*
Plasticomp	*www.plasticomp.com*
RTP Company	*www.rtpcompany.com*
Strongwell	*www.strongwell.com*
Ticona Celstran	*www.ticona.com*
We-no-nah Canoe	*www.wenonah.com*

Source: Compiled by the author using various sources. May not include all companies.

So why is southeastern Minnesota such a hot bed of composites activity? The answer lies largely in the history of the Winona manufacturing sector. A timeline of composites development compiled by the Winona Area Composites Consortium reads like a complex family tree, the roots of which reach back to the Miller brothers.

In 1947, Ben and Rudy Miller, who owned a textile waste-processing business called Miller Waste Mills, founded Fiberite Corp. and started their work with cotton fabric reinforced phenolic compounds.

Since that time, the Millers, various business partners, their employees and others with some connection to important figures in the Winona area composites industry—names like Stan Prosen, Ron Hawley, Mike Cichanowski and Steve Bowen, to name a few—have developed and spun off more than a dozen composites companies that specialize in everything from violin bows and canoes to applications in vehicle, energy and aerospace sectors.

Cichanowski, who has been building canoes in the area since his days as an Eagle Scout, founded We-no-nah Canoe, the world's largest manufacturer of Kevlar canoes and the second largest manufacturer of Royalex canoes. Along with making canoes from composite materials, the company is a leader in developing materials and manufacturing processes.

In fact, many area companies were launched when someone at an existing company developed a new process or technology, hoping to gain a competitive advantage. So it surprises some people that Winona area composites manufacturers (along with companies from surrounding Minnesota and Wisconsin communities) are members of an industry consortium. What started

PHOTO COURTESY OF WINONA STATE UNIVERSITY

MATTHEW BENSON, shown with former student Karen Bratsch, heads Winona State University's Composite Materials Technology Center, which tests and analyzes composite materials.

loosely as a luncheon group in the late 1990s has evolved into a semi-formal group with regular meetings and bylaws today. The official purpose of the Winona Area Composites Consortium is to promote continuing development of the composites industry in Winona.

Although the group structure is more formal now, Dave Sterling, a local composites engineer and current head of the consortium, admits that the group is still finding its way. Some would like to focus on business development, while others lean toward an emphasis on community development or education.

As in many industry clusters, there can be a fine line between cooperation and competition, and trade secrets can serve as a barrier to business development efforts. But Sterling said there is a high level of cooperation among a variety of composites companies in the area, many with their own niches.

He points to a common concern: the availability of talent. Winona composites manufacturers, like companies in many comparable mid-sized communities across the upper Midwest, grapple with how to attract and retain talented workers, especially in highly-competitive fields like engineering. One strategy of the companies is to develop their own local talent.

Over the years, the higher education system in the Winona area has developed expertise in composites training to support the industry, including a Bachelor of Science degree in composite materials engineering at Winona State University (WSU).

When demand exists, Minnesota State College—Southeast Technical has also ramped up a technical program in composites, and it currently offers nanotechnology training in partnership with Dakota County Technical College. The WSU program now graduates more engineers than can be absorbed into the Winona area, and many graduates work at firms across the U.S.

The WSU program has done more than just prepare graduates, though. The Composite Materials Technology Center (COMTEC) was launched in 1987 to work with the industry.

COMTEC Director Matthew Benson said the center plays a key role in testing and analysis. Local companies may have more resources to invest in manufacturing equipment and research and development, but COMTEC's expertise in testing and analysis makes it an excellent industry partner. Companies

using the center not only benefit from reasonably priced services, but they also get a "first look at students," Benson said. Many of the center's customers are former WSU students, reinforcing the web of relationships in the Winona composites cluster.

Talent is also a primary focus of a new tri-state collaborative. Partners in southeastern Minnesota, western Wisconsin and northeastern Iowa are engaged in 7 Rivers BioWorks, a group that recently received a $15,000 grant from the state of Wisconsin to help advance the region as a center for bioplastics and biocomposites manufacturing, and to identify training needs and align training resources to meet them.[7]

The initiative grew out of what 7 Rivers Executive Director Terry Whipple describes as building on the region's assets, including manufacturing, agriculture and the burgeoning organic sector.

Entrepreneur Ron Hagemann of New Composite Partners in Edgerton, Wis., echoes Whipple's optimism. Hagemann said now is the time to be educating not only the workforce and consumers, but the industry. He believes commercially available and cost-effective second-generation reinforced materials are just around the corner.

But for now, many manufacturers are focused on the economic recovery. Benson said the economy is the most pressing thing right now for Winona area composites manufacturers, and it may force some businesses to get leaner. But the industry could come out of the recession more aggressive and profitable.

"The industry has seen an uptick in demand," Sterling said. "For the consortium, it has forced all of us to look at how we manufacture things, looking at efficiencies and value-added services, taking our core competencies and getting better at what we do." T

Industries Served by Winona Area Composites Firms

- Aerospace
- Agriculture
- Appliances
- Automotive
- Building materials and construction
- Electrical and electronics
- Energy distribution and transmission
- Fluid handling
- Furniture
- Industrial machinery
- Marine
- Medical
- Sports and recreation

ENDNOTES:

[1] Society of Plastics Industry Inc., "Fast Facts." Accessed at www.plasticsindustry.org on Sept. 1, 2009.

[2] American Composites Manufacturers Association, "The 2008 Composites Industry Report." The fiberglass used in the listed materials is fiberglass thermoset composites.

[3] Statewide employment data for the plastics material and resin manufacturing industry — companies that manufacture resins or plastics and sometimes mix or blend custom resins — is not available from annual payroll employment records, although estimates from the U.S. Census Bureau, only available for 2007, show statewide industry employment at 536 jobs. Annual data available for the U.S. show national industry employment was down 10 percent between 2001 and 2008.

[4] American Composites Manufacturers Association, "The 2008 Composites Industry Report."

[5] Harmonized Tariff System Data from the World Trade Atlas U.S. State Export Edition, Global Trade Information Services.

[6] National Science Foundation, Division of Science Resources Statistics, 2008. "Research and Development in Industry: 2004." Detailed Statistical Tables NSF 09-301. Arlington, Va. Available at www.nsf.gov/statistics/nsf09301/ .

[7] La Crosse Tribune, "Wisconsin awards grant to help with regional 'bio' effort," June 19, 2009. Accessed online at www.lacrossetribune.com.