



IACMI – THE COMPOSITES INSTITUTE

INSTITUTE ACCOMPLISHMENTS

January 2019

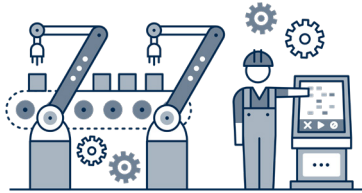


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IACMI creates a collaborative path for global competitiveness by establishing supply-based frameworks for decision making at production-relevant environments for innovation and with the workforce needed to meet the critical need skills gap.

160+ MEMBERS



Driven by industry needs



**University research
for collaboration &
validation**



**Public/private partnership
with federal, state, &
industry support**

CHARTER

Dassault Systèmes
Ford
Lockheed Martin
State of Colorado
State of Indiana
State of Michigan
State of Ohio
State of Tennessee
DowAksa

PREMIUM

Airbus Americas, Inc.
American Chemistry Council
Arkema Americas
BASF Corporation
Cytec Engineered Materials, Inc.-
Solvay Group
DuPont
Evonik Corp.
Huntsman
Local Motors
State of Kentucky
Volkswagen

CONSORTIUM

3M
Advanced Composites
Advanced Carbon Products
Aligned Vision
Alpha USA
American Composites Manuf.
Assoc.
AnalySwift
AOC
Ashland
ATK Space Systems, Inc.
Automotive Insight
Berndorf
Bossard North America
Century Tool & Gage
CHZ Technologies
Colorado School of Mines
Colorado State University
Composites One
Continental Structural Plastics
Convergent Manuf. Technologies

US Inc.
Cynet USA
Dallara
Danobat
Deakin University
Dralon
Dixie Chemical
Diversified Machine Systems
Dow Chemical Company
East Tennessee Economic Council
Eaton
EELCEE Ltd.
Electric Glass Fiber America, LLC
LG Carbon Fibre Ltd.
Fiat Chrysler Auto
Fibrtec
Firestone Fibers and Textiles LLC
Gates Corp.
General Electric
Globe Machine Manufacturing Co.
Gurit

Hanwha Azdel
Harper
Highland Industries
Hot Stamp Tooling Group, Inc.
IDI Composites International
Impossible Objects
Infiana USA
Ingersoll Rand
Innegra Technologies
International Automotive Components Group
Izumi International, Inc.
Janicki Industries
JEC Group
John Deere
Johns Manville
Kruss Scientific Instruments, Inc.
L & J Omnico AG
LeMond Composites, LLC
Luna Innovations
McCoy Machinery

CONSORTIUM continued

McCoy Machinery
Mafic USA
Magnum Venus Products
Mar-Bal
Materia, Inc.
Michelman
Michigan State University
MiniFIBERS
Mitsui Chemicals America
Mitsui Plastics
Moldex3D
Montefibre Hispania
N12 Technologies
NCAM-LSU
National Research Council Canada
Neenah Technical Materials
Nissan North America, Inc.
Norplex-Micarta
Oklahoma State University
Olin Corporatio
ORNL/UT-Battelle, LLC
Oshkosh Corp.
Owens Corning
Plasan Carbon Composites
Polynt Composites USA
PPG
Pratt & Miller Engineering & Fabrication
Prescott Composites
Prisma Renewable Composites
Purdue University
Rassini International Inc.
Resource Fiber

Romeo Rim
RMX Technologies (d/b/a 4X Technologies)
Sabic
SAERTEX USA
Saint-Gobain HyComp, LLC
SAMPE
A. Schulman, Inc.
Shape Corp.
Siemens Gamesa Renewable Energy
Steelhead
Techmer PM
Technical Fibre Products
TenCate Performance Com
Teijin Carbon America, Inc.
TPI Composites
University of Dayton Research Institute
University of Kentucky
University of Massachusetts – Lowell
University of Tennessee
Universal Asset Management, Inc.
UTRC
Valley Enterprises Inc.
Vanderbilt University
Vartega Carbon Fiber Recycling LLC
Wabash National
Wright Industries, LLC (d/b/a J.R. Automation)
Zoltek America

RESOURCE

C.A. Litzler
Chomarat N.A.
Cincinnati, Inc.
Dynamic Robotic Solutions, Corp.
ESI North America
E-Xstream Engineering, MSC Software
Hennecke, Inc. USA
Milacron
Plasmatrete USA
RocTool
Schuler
Strongwell

ASSOCIATE

Hogan Consulting, LLC
Next Generation Technology Matters
Rypkema Composites Automation
Ruhl Strategic Partners

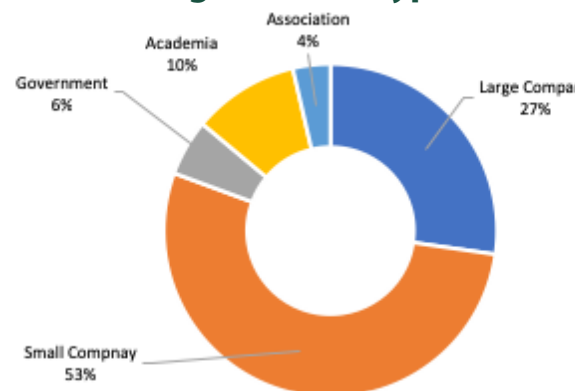
COMMUNITY COLLEGE/ TRAINING

Abaris Training Resources
Pellissippi State Community College
Roane State Community College

IACMI Members Represent:

- Automotive
- Wind Energy
- Compressed Gas Storage
- Aerospace
- Marine
- Oil & Gas
- Infrastructure
- Consumer Products
- Composites Recycling

Organization Types

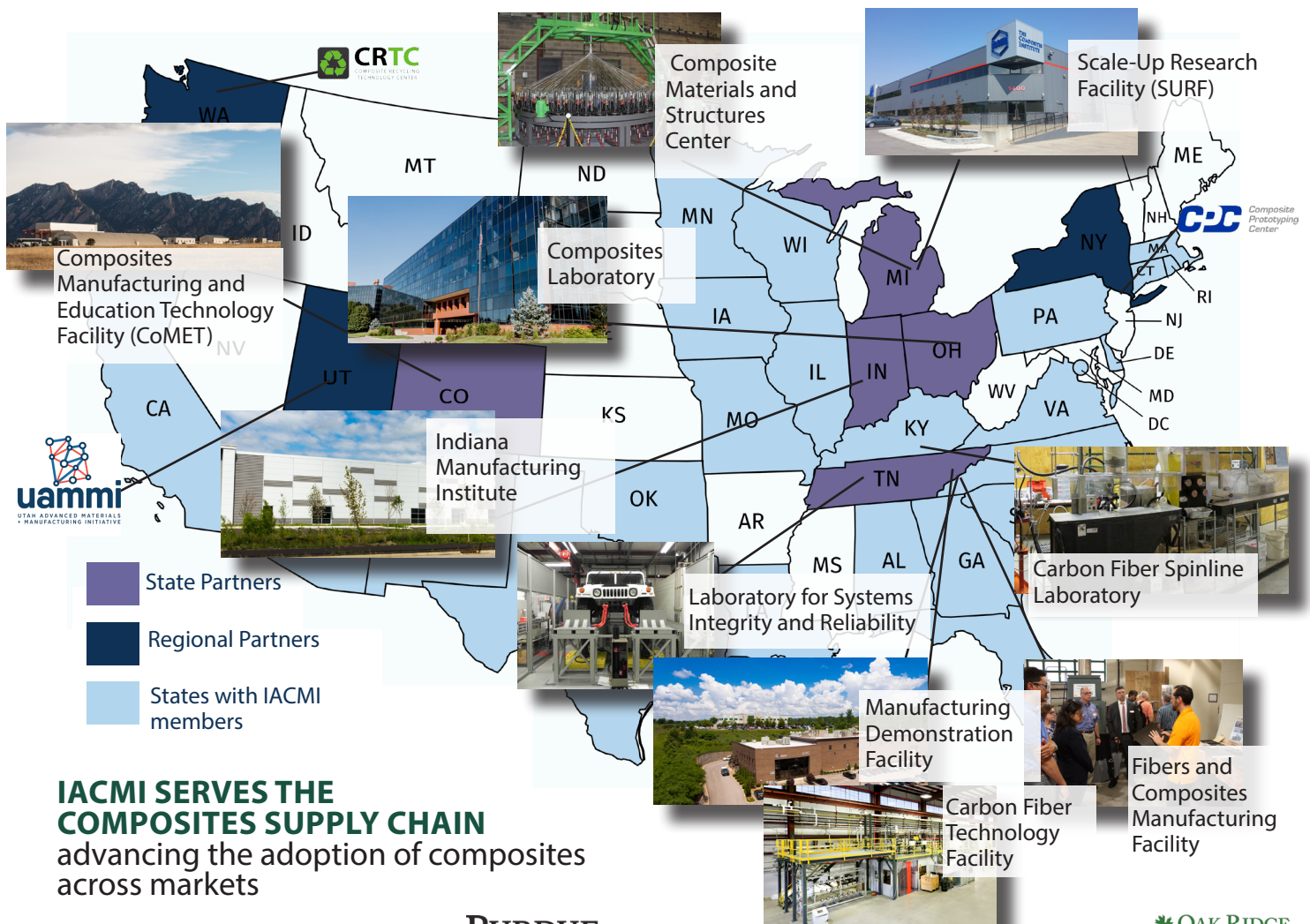


Membership Organizations

Large companies (>500 employees): 41 organizations
Small companies (<500 employees): 87 organizations
Government organizations: 8 organizations
Academic organizations: 15 organizations
Associations: 5 organizations

as of Jan. 2019


IACMI FOOTPRINT





IACMI SERVES THE COMPOSITES SUPPLY CHAIN


advancing the adoption of composites across markets


modeling & simulation

IN: Indiana Manufacturing Institute 
Developing comprehensive set of simulation tools to model composites structures from manufacturing to end-of-life product cycle

TN: Laboratory for Systems Integrity and Reliability at Vanderbilt University 
Combines modeling and simulation tools, sensing and control techniques, and risk and reliability analytics to improve performance and dependability of manufacturing systems

MI: Composite Materials and Structures Center at Michigan State University 
Leading facility in polymer composite research with latest equipment and instrumentation for studying composite manufacturing, performance, and durability


KY: Carbon Fiber Spinline Laboratory 
Largest spinline in an academic setting which produces research quantities of precursor tow


OH: Composites Laboratory at UDRI 
Features full-scale manufacturing work cells and small business incubation

testing business viability


prototyping & testing


TN: Carbon Fiber Technology Facility at ORNL 
Offers flexible, instrumented carbon fiber line for demonstrating advanced technology scalability

CO: Composites Manufacturing and Education Technology Facility (CoMET) at NREL 
Enables design, prototyping, testing, and manufacturing of composite wind turbine blades

TN: Fibers and Composites Manufacturing Facility at the University of Tennessee, Knoxville 
Allows students and researchers to work through complete composite manufacturing process, collaborating with industry for problem solving, testing, and product development

full-scale production implementation

TN: Manufacturing Demonstration Facility 
Collaborates with industry to reduce risk and accelerate development and deployment of energy-efficient manufacturing processes and materials

MI: Scale-Up Research Facility (SURF) 
Production-scale composites manufacturing equipment, with a focus on lightweighting

IACMI PARTNERS

STATE PARTNERS



IACMI's state partners contribute both financial and advocacy support for IACMI. IACMI offers opportunities for economic development through research and development projects leading to commercialization as well as through workforce initiatives that lead to job growth in the key states. IACMI's state partner supports are central to IACMI's growth and success.



Former Michigan Governor Rick Snyder, Detroit Mayor Mike Duggan, U.S. Senator Debbie Stabenow, Congresswoman Brenda Lawrence, former Michigan State University President Lou Anna K. Simon celebrated the ribbon cutting of the IACMI Scale-Up Research Facility (SURF), a joint facility with LIFT.

REGIONAL PARTNERS



IACMI and several regional partners have memorandums of understanding (MOUs) because of mutual recognition of the impact and opportunities of collaborations to reach organization goals. Through these MOUs, IACMI has developed workforce development initiatives leveraging resources in additional states and growing the impact for hands-on training.



Regional partnerships lead to composites training workshops in Utah, internship and technical projects in Washington, and workforce development initiatives in New York.

CORE PARTNERS



The University of Tennessee Research Foundation (UTRF) and Oak Ridge National Laboratory (ORNL) are the founding support for IACMI – The Composites Institute. UTRF established Collaborative Composites Solution, a not-for-profit organization that houses IACMI as a project in the organization.

UNIVERSITY PARTNERS



IACMI's university partners are home to many of the technical research experts who are key resources to IACMI members throughout their project processes. These researchers offer invaluable guidance and expertise to IACMI members. Additionally, many of these university partners house world-class facilities that are open to IACMI members engaging in projects.



University of Tennessee, Knoxville Interim Chancellor Wayne Davis welcomed attendees to the 2018 Summer Members Meeting, pictured with Knoxville Mayor Madeline Rogero, former Knox County Mayor Tim Burchett, and University of Tennessee Vice President for Research, Outreach, and Economic Development Stacey Patterson.



DRIVING REGIONAL ECOSYSTEMS OF INDUSTRY ADVANCEMENTS

Case study: East Tenn. advanced manufacturing growth

2016



3D printing: East Tenn.'s next manufacturing boon
"East Tenn.'s emergence is payoff for generations of government investment in research and development."

– Dec. 8, 2016 *Curbed*

2017



Leisure Pools announced Knoxville location and creation of **1,000 jobs**.

2018



Oshkosh announces plans to open a new manufacturing facility by renovating a **50,000 sq.-ft. facility** in East Tennessee, creating **300 new jobs**.

2019



Volkswagen announces Chattanooga as location for first electric vehicle plant in North America – an **\$800M project** expected to generate **1,000 additional jobs**.

Indiana Advanced Manufacturing Sector

- > 1/3 of the 8,500 manufacturers in Indiana are advanced manufacturers
- > 25% of Indiana economic output based in manufacturing
- > **1 in 5 Hoosiers are supported by manufacturing**
- > \$36.6B in manufactured good exports (2017)
- > 108,100 manufacturing jobs since 2009
- > #2 in the nation for manufacturing jobs added since 2009

Source: Indiana Economic Development Corporation

Michigan Advanced Manufacturing Sector

- > Michigan has the highest concentration of electrical & mechanical engineers in the U.S.
- > Michigan is home to 91 global suppliers' N.A. headquarters or tech centers
- > **Michigan employs more industrial designers than any other state**
- > Michigan is the national leader in automotive R&D spending

Source: Michigan Economic Development Corporation

Ohio Manufacturing & Aerospace Industries

- > 14,000+ Ohio manufacturing businesses
- > 600,000+ manufacturing industry workers in Ohio
- > **Ohio has the 3rd largest manufacturing workforce in the U.S.**
- > Ohio is the #1 supplier state to Airbus and Boeing

Glenn Richardson, Managing Director Aerospace & Manufacturing at JobsOhio

Colorado Advanced Manufacturing Sector

- > 6,000 manufacturers in electronics, energy, aerospace, and biomedical sectors
- > Colorado advanced manufacturing workforce annual wage is 43% higher than the average annual wage for all industries
- > **150,000+ annual employment in advanced manufacturing sector**

Source: Colorado Office of Economic Development & International Trade

Tennessee Advanced Manufacturing Sector

- > 3rd in the nation for employment in the advanced materials industry
- > **Manufacturers employ 16,800+ Tennesseans**
- > 170+ advanced materials establishments
- > TN is the 2nd largest manufacturing region in the U.S.
- > TN is home to 90,000 automotive industry jobs

Source: TN Department of Economic & Community Development

\$25.2 BILLION:
Composites' annual contribution to the U.S. economy



Source: ACMA 2019 Industry Report

"Manufacturing is vital to a strong Colorado economy, and has significant growth potential. Colorado manufacturers are highly innovative and use advanced processes to support the state's diverse sectors."

– Colorado Office of Economic Development & International Trade

IACMI fosters innovation to drive productivity, growth, and value.

FACILITATING INDUSTRY COLLABORATION

90 PROJECT PARTNERS ON **50+** IACMI PROJECTS **\$70Million** IACMI R&D VALUE

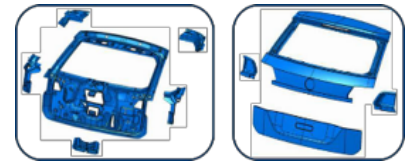
Project team leads include:



SAVING MANUFACTURING ENERGY & COST

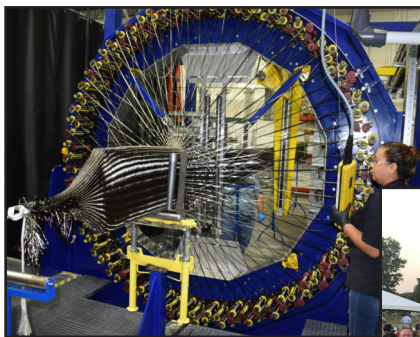


Advanced manufacturing including **additive manufacturing** is being implemented for efficient manufacturing.



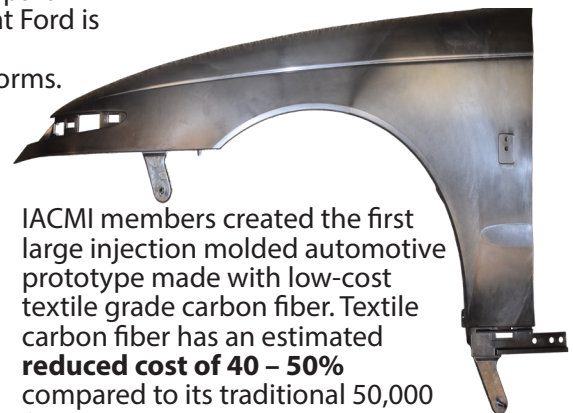
Automotive OEMs research materials and processes to integrate composites into current and near-future vehicle models for energy and cost savings for both the company and for drivers.

ADOPTION-READY TECHNOLOGIES

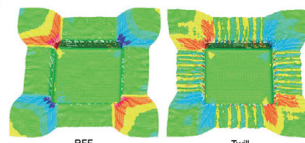


Carbon fiber braiding was utilized to create **17 free-floating, 33-foot long arched composite beams** creating a pavilion at an Oak Ridge, Tenn. community park.

The Dow composite material, developed through an IACMI project, achieved part level material performance such that Ford is willing to declare it acceptable for specification on future vehicle platforms.



IACMI members created the first large injection molded automotive prototype made with low-cost textile grade carbon fiber. Textile carbon fiber has an estimated **reduced cost of 40 – 50%** compared to its traditional 50,000 filament tow commercial counterpart.



"We can use simulation to look at different cases, do sensitivity studies and parametric analysis, and see where we can get the most bang for our buck out of the physical experimental work."
– Michael Bogdanor, director of the Composites Design Studio, on how simulation reduces cost

COMPOSITES VIRTUAL FACTORY HUB

Through its IACMI partnership, Purdue University makes it's Composites Virtual Factory Hub (cvfHUB) available to IACMI project partners to provide world-class access to modeling and simulation of composites manufacturing processes.

REDUCING EMBODIED ENERGY & LANDFILL WASTE

29 MILLION POUNDS OF CARBON FIBER END UP IN LANDFILLS EVERY YEAR

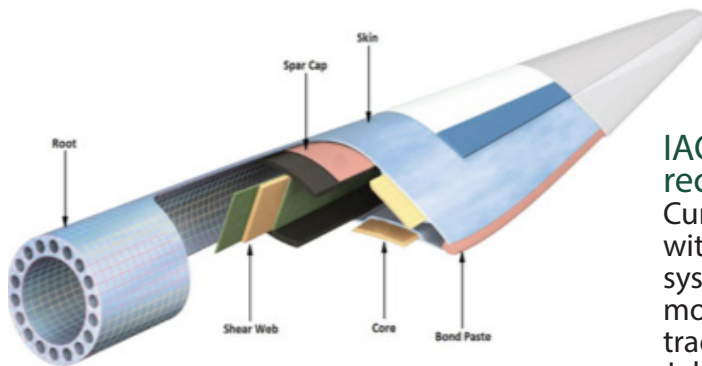
IACMI recycling projects aim to reduce carbon fiber in landfills by leading projects:

- 1) developing new recycling technologies to utilize scrap carbon fiber
- 2) creating new production technologies to reduce scrap

IACMI recycling technologies produce real-world application items, such as **park benches and automotive seatbacks**, through innovative composites recycling methods, thereby making composites integration feasible for more industries.



CHZ Technologies was awarded the bronze medal from R&D Magazine's 2018 Special Recognition Award for Green Technology. CHZ Technologies implemented this technology on an IACMI recycling project.



IACMI projects work to increase the recyclability of wind turbine blades

Currently, all wind turbine blades are fabricated with a non-recyclable epoxy based thermoset resin system. The IACMI project used a 1.3-meter spar cap mold to experiment and test different variables against traditional methods. IACMI members, Arkema and Johns Manville, provided material for the research. The team used Arkema's new Elium® resin and Johns Manville unidirectional fiberglass to create the thermoplastic sample, which is capable to be recycled, increasing efficiency in the life cycle of wind energy.



INDUSTRY'S RESEARCH AND DEVELOPMENT PARTNER

Accelerating the adoption of composites through new process and material development and validation from concept to full-scale demonstration.

SHAPING THE MANUFACTURING NARRATIVE

Inc. America Can Win Manufacturing in the 21st Century: Here's How

"You have to create an **environment in which people can feel confident in sharing information and insights**, while at the same time protecting interests of all sides, especially with regard to intellectual property. Once you build that community, we have found that **unanticipated synergies can be unlocked.**"

– IACMI CEO, John A. Hopkins in *Inc.com* article March 10, 2018



Forbes Michigan's New Governor Can Accelerate the Auto Industry's Transformation

"The industry is on the cusp of a light-weighting and multi-material revolution. Detroit hosts two public-private partnerships under the Manufacturing USA initiative that could, with the right direction, be **the epicenter of many industry lightweight innovations.**"

– Forbes, Nov. 13, 2018

America's Infrastructure Scores a **D+**

American Society for Civil Engineers 2017 Report Card for America's Infrastructure

Composite products produced in the U.S. offer **durable, sustainable, and cost-effective solutions** in infrastructure applications



"One provision of the [IMAGINE Act] would call on the Transportation

Secretary to form innovative material hubs throughout the country to continue to drive research into and development of innovative materials for use in infrastructure projects. The provision was inspired by the success of communities of materials manufacturers – like advanced composites makers in Rhode Island and the **Institute for Advanced Composites Manufacturing Innovation in Knoxville, Tennessee – that have leveraged their innovations and expertise to grow their industry.**" – American Coatings Association discussing support for the Innovative Materials for America's Growth and Infrastructure Newly Expanded (IMAGINE) Act

PARTNERS WITH TOP INDUSTRY ASSOCIATIONS



IACMI has established itself as a trusted leader in the composites industry by partnering with top industry associations such as ACMA, JEC Group, CompositesWorld, SAMPE, ACC, and SPE.

PARTNERS WITH TOP INDUSTRY ASSOCIATIONS cont'd



"IACMI brings a **unique input on technology research and development** by shaping the future of the composites industry." – *Ryan Delahanty, CompositesWorld's publisher*



Through their IACMI partnerships, **JEC, ACMA, and CompositesWorld** contributed to the JEC Composites Pavilion at the 2019 North American International Auto Show (NAIAS) to provide additional composites-related media and visitors to the pavilion, garnering a broad reach and impactful presence at **NAIAS' first composites pavilion.**



BUILDING A COLLABORATIVE COMPOSITES NETWORK

IACMI hosts bi-annual members meetings in its partner states of **Michigan, Colorado, Ohio, Tennessee, and Indiana** to showcase technical advancements in IACMI projects, facility tours and updates, workforce initiatives, and member successes. On average, each meeting brings in over **320 attendees** from IACMI member organizations representing on average more than 30 states.



"I've attended all of the IACMI member meetings thus far and I find them invaluable not only for the project updates, but also for the **networking**. It is incredible to be able to meet with **all of these industry experts** in one place to collaborate and pioneer new ideas for the next project."

– *Dana Swan, Arkema*



NATIONAL ACADEMY OF SCIENCES

"The IACMI consortium has been an effective way for industry, universities, and federal laboratories to **collaborate on industrially-relevant technology.**"

– *Joe Fox, Ashland Composites* | **2018 Innovation Policy Forum at the National Academy of Sciences**

96%

of surveyed attendees from the Winter 2018 Members Meeting reported the meeting resulted in a new business opportunity

IACMI WORKFORCE IMPACT

IACMI has leveraged institute partnerships, members, and IACMI facilities to create programs that grow the composites workforce by providing composites-related training opportunities.

ENGAGED 9,000+ K- 12 STUDENTS IN STEM



- **Manufacturing Day** activities with 7+ schools in Knoxville, TN and Detroit, MI
- STEM partnership activities with Society of Plastics Engineers' **PlastiVan** and **Society of Women Engineers (SWE)**

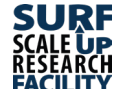
- Growing **mentorship cycle** with IACMI interns leading STEM events
- Offering new STEM opportunities in underserved communities



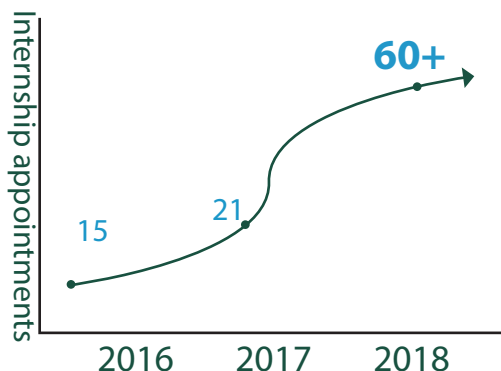
IACMI interns grow mentorship cycle by leading students in STEM activities.

HOSTED 100 INTERNSHIP PLACEMENTS

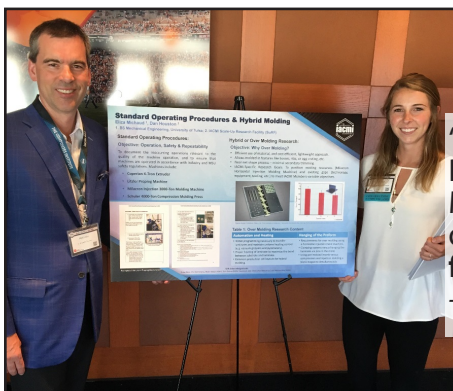
Intern hosts include:



IACMI Internship Placements



IACMI interns gain hands-on experience and build professional networks through participating on IACMI research and development projects.



"...One of my projects was to create Standard Operating Procedures (SOP's) for a Litzler Prepreg Line... at the Summer Members Meeting I got to meet Matt Litzler, the man who designed IACMI SURF's Litzler Prepreg Line. **Thank you, IACMI, for providing me with such tremendous opportunities!**"
– Eliza Michaud, 2018 IACMI Intern at SURF

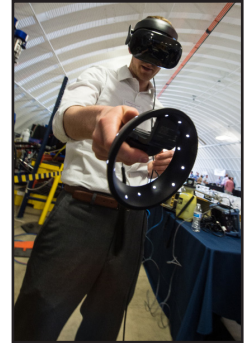
WORKFORCE DEVELOPMENT

TRAINED 2,000 PARTICIPANTS

Immersive training workshops offer opportunities for hands-on training utilizing advanced technologies at IACMI facilities and through partnerships throughout the U.S.

Composites Training Workshops

ClosedMold
Alliance



Quarterly workshops at IACMI facilities across the U.S. including the IACMI Scale-Up Research Facility (SURF), Composite Prototyping Center (CPC), Composites Manufacturing and Education Technology Facility (CoMET) at NREL, and Purdue University.

Train-the-Trainer Courses



Increasing certifications and learning opportunities through courses throughout the year, with presentations from IACMI Chief Technology Officer, Uday Vaidya.



The Abaris Training course in partnership with IACMI at the CoMET at NREL offers attendees an opportunity to gain a better understanding of advanced composites.

Emerging Topics:

- SMC Compounding
- SMC Compression Molding
- Composite Repair
- Composite Recycling
- Composites in Infrastructure



Hands-on training workshops to prepare participants for an introduction to composites certifications.

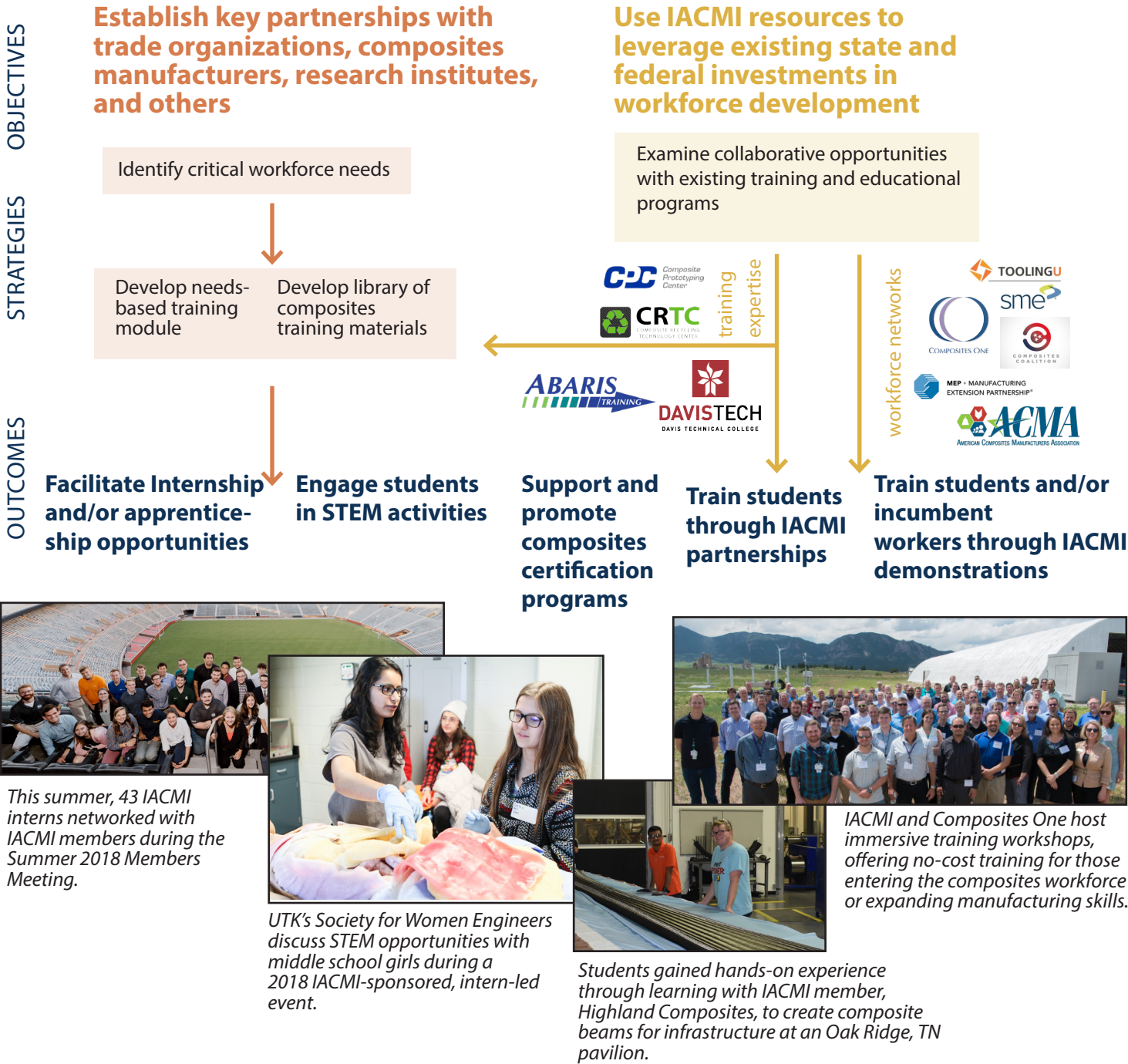


EXPANDING KNOWLEDGE SHARING & TRAINING

through industry teaching sessions at affordable costs, across the United States

IACMI WORKFORCE ROADMAP

IACMI's goals and strategy support the development of a supply of trained talent that meets the specific needs of the composites manufacturing industry and drives future growth.



FUTURE PLANS

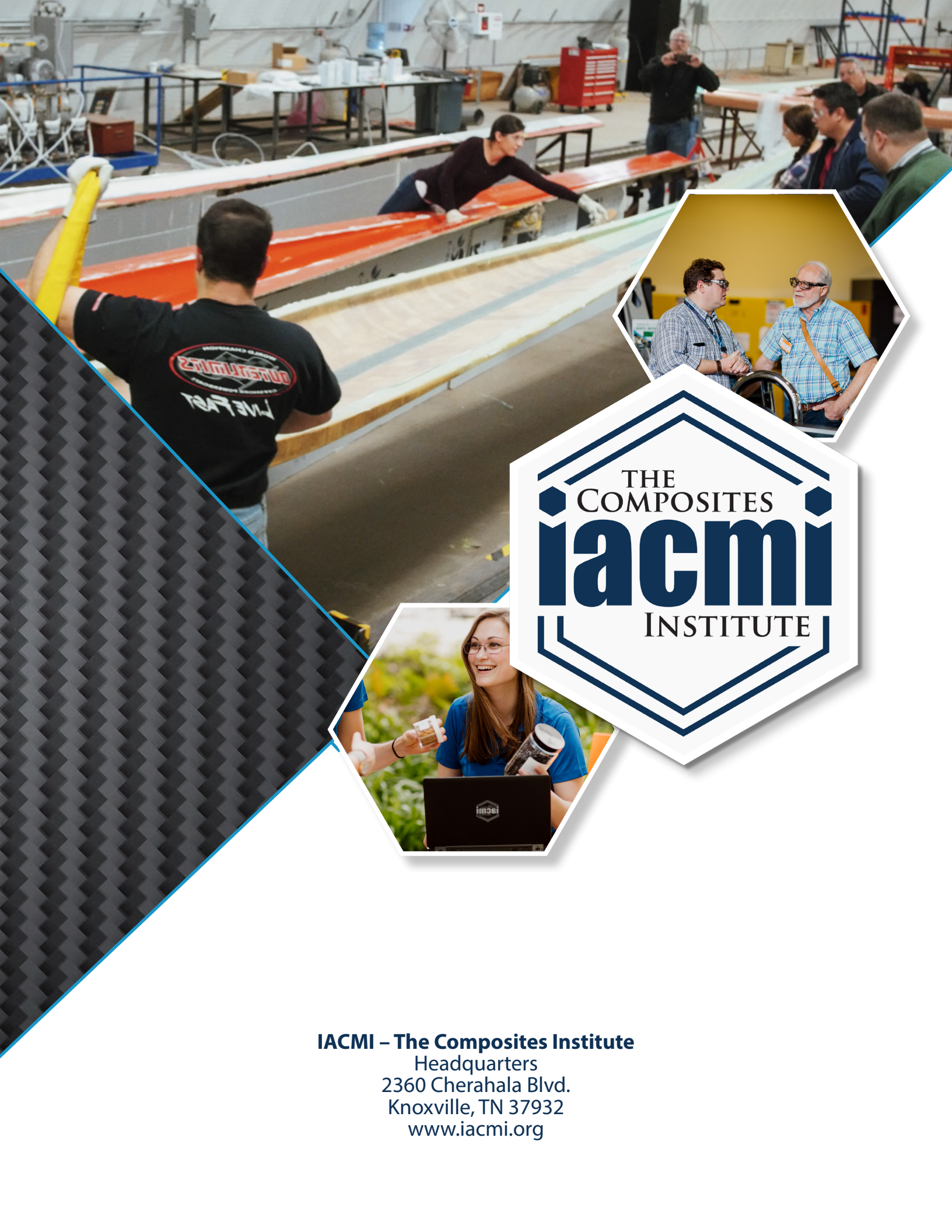
IACMI is working to meet current and future industry needs via technical innovations and workforce development. As IACMI continues to work with its consortium members and stake holders to meet their needs, IACMI is:

- > expanding into new markets to best reach the composites industry
- > growing the IACMI footprint through membership, state, and university support
- > continuing to develop new materials and processes for composites manufacturing innovation
- > partnering with new industry training organizations to reach a larger technician audience for workforce training
- > growing soft skills training in the internship program
- > working with more experts and organizations to shape meaningful STEM K-12 initiatives



Learn more at iacmi.org





THE
COMPOSITES
iacmi
INSTITUTE

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