

» GEORGIA TECH MANUFACTURING INSTITUTE

INDUSTRY 4.0
AS A SYSTEM

**Georgia
Tech** 

CREATING THE NEXT®



CREATING THE NEXT: ADVANCED MANUFACTURING AS A SYSTEM

GTMI brings stakeholders together to solve manufacturing challenges with a different model for university-based innovation. The model uses analysis of the business case, technology readiness level (TRL) and manufacturing readiness level (MRL) all along the innovation chain from lab to marketplace. This calls on systematic collaboration across the campus and across research disciplines. From precision machining and robotics, complex factory information systems, and leading research on composites joining and repair, to biomanufacturing and automated production of cell-based therapies, to Industry 4.0 strategies that connect production with information and data systems to create intelligent and flexible factory models, GTMI is the hub for manufacturing research and innovation at Georgia Tech.

GTMI'S CORE RESEARCH AREAS

- Additive Manufacturing
- Biomanufacturing
- Clean Energy
- Composites/Nano-Composites Manufacturing
- Enterprise Innovation
- Flexible Automation
- Internet of Things for Manufacturing and Factory Information Systems
- Model-Based Systems Engineering and Cyber Physical Systems
- Precision Machining
- Public Policy: Manufacturing Innovation
- Supply Chain and Logistics
- Sustainable Design and Manufacturing

Georgia Tech Manufacturing Institute (GTMI)

GTMI is Georgia Tech's (GT) interdisciplinary research institute (IRI) tackling the challenges facing today's manufacturers. The IRIs bring together a mix of talented researchers from different disciplines and organizations around a core research area. GTMI focuses on the complete innovation value chain for manufacturing — from raw and recycled resources to prototypes and finished products. GTMI is a global thought leader in rapidly moving innovation from the lab to market. Its comprehensive expertise ranges from manufacturing processes and factory automation to supply chain management and enterprise transformation. GTMI also offers a hands-on educational experience that produces scientists and engineers who are innovative, collaborative, adaptive and well-suited for the rapidly evolving world of manufacturing.

GTMI is Mission Driven

» Engage

Build relationships with internal and external stakeholders to foster and sustain manufacturing capabilities aligned with opportunities to address high-impact manufacturing challenges

» Leverage

Champion Georgia Tech's tradition of excellence in across-campus manufacturing- related knowledge, basic research and interdisciplinary applied research

» Accelerate

Apply and deploy manufacturing innovation by collaboratively, concurrently, and aggressively maturing technology, manufacturing, business case and eco-system readiness

#1

Undergraduate Industrial/
Manufacturing
Engineering Program*

#4

Most Innovative
School *

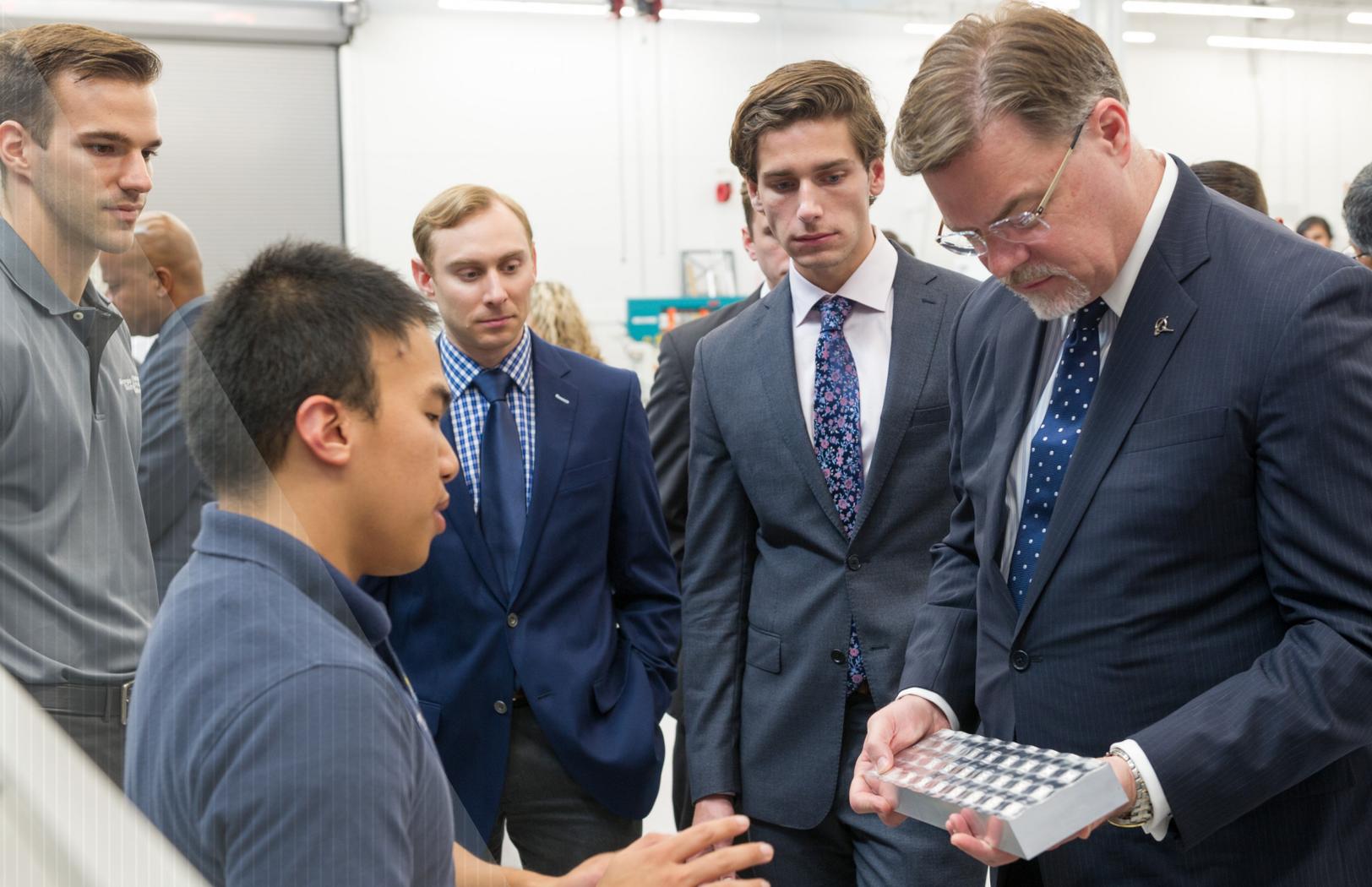
#5

Top Public
University *

* Georgia Tech's rankings as of September 2019. According to U.S. News and World Report.

Below: GTMI is located on the Georgia Institute of Technology campus at 813 Ferst Drive, Atlanta, GA.





WORKFORCE DEVELOPMENT IS A STRATEGIC IMPERATIVE

GTMI is committed to cultivating the next generation U.S. manufacturing workforce and its leaders. Our education programs enhance the hands-on manufacturing and research knowledge of engineering graduate and undergraduate students. We offer a manufacturing certificate for graduate students, scholarships, a program to assist veterans and minorities boost their STEM experience and graduate assistantships. We also work with community and technical colleges to grow a skilled workforce.

Helping Vets and Minorities Transition to Stem Fields

The Research Experience for Student Veterans in Advanced Manufacturing and Entrepreneurship (REVAMP) program is a National Science Foundation (NSF) Research Experience for Undergraduates (REU) summer site. The program helps veterans transition the skills they learned during their military service into skills they can use in STEM fields. It also seeks to give women and minorities an opportunity to explore STEM-related manufacturing disciplines.



THOUGHT LEADERSHIP IS A STRATEGIC IMPERATIVE

GTMI believes it is important to provide students, staff and other stakeholders opportunities to hear from innovative leaders in the manufacturing sector. By the same token, our researchers are thought leaders themselves who serve on national boards, and present at state, national and international conferences. GTMI is harnessing the thought leadership required to respond to a highly dynamic environment in which the very definitions and perceptions of manufacturing are rapidly changing.

GTMI hosts numerous meetings and workshops that bring together thought leaders from government, industry and academia to work on solutions to challenges facing today's manufacturers and build business cases for emerging technologies.

FY21 Speaker: Carmelo Lo Faro, Solvay



GTMI'S Distinguished Lecture

GTMI hosts an annual Distinguished Lecture devoted to addressing manufacturing challenges. Pictured in the top photo is 2020 Distinguished Lecturer, Dr. Carmelo Lo Faro, President, Solvay Composite Materials. Dr. Lo Faro's lecture will focus on "The growing pains of a young technology destined for a very bright future." Lecturers from previous years also appear to the right.

Manufacturing Luncheon Seminars

Each fall and spring semester, GTMI hosts weekly "lunch and learn" seminars on a variety of issues affecting manufacturers. A number of companies that present also conduct student recruitment sessions while they are on campus. The seminars are free and beginning in 2020, were also offered as online webinars. FY 20 speakers included: **W. Hong Yeo**, GT ME and BME; **Edward Wang**, Texas A&M University; **Rohan Shirwaiker**, NC State University, ISyE, BME and Comparative Medicine Institute; **Mark Styczynski**, GT ChBE; **Brad Driver and Mark Munson**, Microsoft Partner, ACE Microtechnology; **Joseph Lewis**, Flentek Solutions; **Samantha Kasraie**, Novatech/Markforged; **Jason Roth**, Autodesk; **Richard Shefer**, GT IEN; **Michael Filler**, GT ChBE; and **Thomas Beck**, Novelis Global Research Technology Center.



LEFT: FY19 Speaker, Tom Caulfield, Global Foundries



RIGHT: FY17 Speaker: Dean Kaymen, Segway Inventor



LEFT: FY16 Speaker: Jeff Wilcox, Lockheed Martin



RIGHT: FY15 Speaker: Michelle Gloeckler, Walmart



LEFT: FY14 Speaker: Reinhold Achatz, Thyssenkrupp



RIGHT: FY13 Speaker: Alan Mulally, Ford Motor

SIGNIFICANT COLLABORATIONS AND ACHIEVEMENTS

Cell Manufacturing Technologies

GTMI continues to partner with the Georgia Tech Marcus Center for Therapeutic Cell Characterization and Manufacturing and the NSF-funded Engineering Research Center for Cell Manufacturing Technologies (CMaT). GTMI is engaged in a CMaT simulation-based project that aims to reduce total cost and risks associated with cell manufacturing and logistics, improve patient benefits (safety, mortality rate, and access), and incorporate patient and regulatory perspectives. Ultimately the project will result in an analytic tool to: 1) test supply chain design strategies for cell therapy manufacturing, 2) simulate unexpected events and 3) test strategies for risk mitigation, cost reduction and increased patient benefit.



Composites Joining and Repair

GTMI is a thought leader in composites joining and repair (CJAR), a critical challenge for industries that rely on products made from composites such as airplanes, cars, wind blades and more. GTMI led the Consortium for Accelerated Innovation and Insertion of Advanced Composites (CAIIAC), a group of over 50 companies, government organizations and trade associations to create a technology roadmap for moving research toward a standard repeatable methodology.

In 2019, GTMI was awarded a National Science Foundation (NSF) planning grant for the IUCRC Center for Digital Composite Joining and Repair (D-CJAR). This public-private partnership will involve interdisciplinary teams of faculty, students and industry scientists/engineers working to transform currently labor-intensive, experience-based CJAR practice into science-based, automated digital processes. GTMI will submit its full proposal to NSF in summer 2020, and if successful the D-CJAR will open in early 2021.

Advanced Manufacturing Pilot Facility

The Delta Airlines Advanced Manufacturing Pilot Facility (AMPF) that opened in June 2017, has attracted substantial attention due to its unique value to GTMI's industry and government partners. The AMPF is a collaborative workspace for translational research and development at TRL/MRL 4-7, as well as a teaching factory. Phase I included digital manufacturing and robotic manufacturing. Now beginning Phase II, GTMI is offering additive manufacturing and composites joining and repair capabilities and preparing to expand operations to serve more partners.

In 2017, Boeing inaugurated the Boeing Manufacturing Development Center (BMDC) located at the Delta Air Lines Advanced Manufacturing Pilot Facility at Georgia Tech to further expand the relationship with Georgia Tech to include translational research in advanced manufacturing.



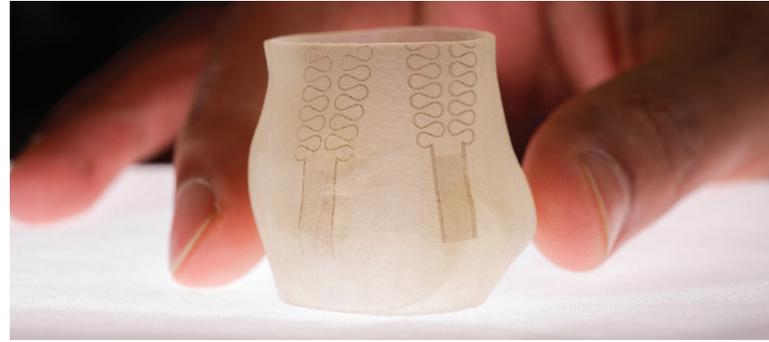
GT-Boeing Strategic University Partnership

The Georgia Tech-Boeing Strategic University Partnership is sponsored by Boeing Research & Technology. Since its inception in 2007, this program has supported research into a broad range of topics driven by manufacturing challenges such as advanced manufacturing processes, automated material handling, data analytics, model-based systems engineering for aerospace design and manufacturing, robotics and sensing.

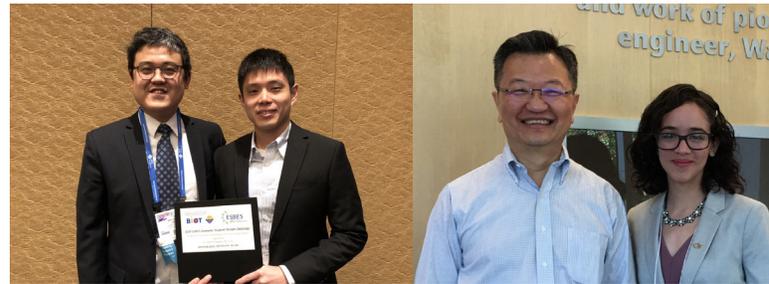
SIGNIFICANT COLLABORATIONS AND ACHIEVEMENTS

Valve Phantom Wins Top Innovation Honors

In 2018, a team of researchers from GTMI and the Piedmont Heart Institute was named a winner in the annual R&D 100 Awards Competition, an international competition that recognizes the 100 most exceptional innovations in science and technology. The team's winning project, "3D Printed Patient-Specific Tissue-Mimicking Phantoms for Surgery Planning" involved creating 3D printed tissue-mimicking heart valves, also called phantoms, from an individual's heart scans. These phantoms emulate disease and conditions present in a patient's aorta and allow surgeons to explore personalized treatment options pre-surgery. The R&D 100 Awards have long been considered the most prestigious global recognition of invention and innovation. The same project also won a 2018 TechConnect Innovation Award. At its annual conference, TechConnect selects the top early-stage innovations submitted from around the world based on which have the greatest potential for positively impacting a specific industry sector.



3D Printed Patient-Specific Tissue-Mimicking Heart Valve, award winning project, 2018 R&D 100 Awards Competition and 2018 TechConnect Innovation Award.



LEFT: Yi (Brian) Liu, left; Howard Chin-Yuan Tseng, right; and Yeng-Hong Lin, not pictured, won second place in a graduate student design competition at the American Chemical Society National Meeting in Orlando, FL in March 2019. RIGHT: Ben Wang and Carolina Colon at the CMAAT Annual Meeting where Colon won first place in the Industry Choice Poster contest.

Students Win Top Awards

During summer 2018, Carolina Colon, a self-described multilingual undergraduate research engineer who worked as a CMAAT research assistant through the GT Research Experiences for Undergraduates program (REU), won first place for the Industry Choice Poster. Carolina was mentored by GTMI Executive Director, Ben Wang, Ph.D. and Kevin Wang, Ph.D.

In a different competition, Ph.D. students Yi (Brian) Liu (project team leader, GT, chemical and biomolecular engineering), Howard Chin-Yuan Tseng (GT, industrial engineering) and Yeng-Hong Lin (China Medical University in Taiwan, medical engineering) won second place at the 2019 American Chemical Society National Meeting for their project: "Production of Clinical Grade Cartilage: A Quality Design Approach". The team created the designs for a commercial manufacturing facility to produce allogeneic human mesenchymal stem cell derived chondrocyte cartilage grafts for the treatment of joint cartilage disease and the related supply chain.

Thank You to GTMI's Industry Partners

GTMI's industry partners enjoy access to the university's research infrastructure, faculty and student talent while also sponsoring valuable GTMI workshops and fellowships.

Airforce Sustainment Center

Boeing

Clean Hands Safe Hands

Coca Cola Freestyle

Cytec Engineering Materials

Delta Airlines

Ford Motor Company

GA Department of Economic Development

Georgia Automotive Manufacturers Association (GAMA)

General Dynamics

Generation Orbit

IronCAD

Omron Corporation

Solvay

The Association for Manufacturing Technology (AMT)

Thyssenkrupp

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