

Georgia Tech Manufacturing Institute

2018-2021

STRATEGIC PLAN

CREATING THE NEXT





*GTMI Vision: GTMI will be  
the world's premier institution  
anticipating needs and providing solu-  
tions on the frontiers of  
manufacturing research,  
application, and deployment.*

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The logo features a stylized chevron shape on the left, composed of two parallel lines that point to the right. The top line is black and the bottom line is yellow. To the right of this graphic, the text "2018-2021" is written in a large, bold, blue sans-serif font. Below "2018-2021", the words "STRATEGIC PLAN" are written in a smaller, blue, all-caps sans-serif font.

# 2018-2021 STRATEGIC PLAN

In acknowledgment of the 2017 GTMI Strategic Planning Committee:

- » **Karen Fite**, GTMI Internal Advisory Board, Director, GaMEP, Enterprise Innovation Institute
- » **Tina Guldborg**, GTMI Associate Director and Director of Strategic Partnerships
- » **Diana Hicks**, GTMI Internal Advisory Board, Professor, Georgia Tech School of Public Policy
- » **Rob Maskell**, GTMI External Advisory Board, Chief Scientist, Cytec Engineered Materials/Solvay
- » **Michael McGrath**, GTMI External Advisory Board, Consultant and Technical Advisor, McGrath Analytics, LLC
- » **Shreyes Melkote**, Morris M. Bryan, Jr. Professorship in Mechanical Engineering, Georgia Tech School of Mechanical Engineering
- » **Jud Ready**, Deputy Director, Innovation Initiatives for the Georgia Tech Institute for Materials
- » **John Russell**, GTMI External Advisory Board, Technical Director, Manufacturing & Industrial Technologies Division, AFRL/RXM
- » **Ben Wang**, Chair of the Strategic Planning Committee, GTMI Executive Director, Gwaltney Chair in Manufacturing Systems, Professor in Materials Science & Engineering, and Georgia Tech Chief Manufacturing Officer
- » **Chip White**, GTMI Internal Advisory Board, Schneider National Chair in Transportation and Logistic, Georgia Tech School of Industrial and Systems Engineering

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*Committee members represent a diverse group of stakeholders that includes faculty, staff, government partners and industry leaders.*

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In November 2013, the Georgia Tech Manufacturing Institute (GTMI) 2014-2017 strategic plan was endorsed by the office of the Georgia Tech (GT) Executive Vice President for Research (EVPR), the GTMI External Advisory Board (EAB) and Internal Advisory Board (IAB). The strategic framework focuses on the concurrent maturation of xRLs – TRL (technology readiness level), MRL (manufacturing readiness level), and BcRL (business case readiness level) and how GTMI can advance knowledge and processes to solve the manufacturing grand challenges of our time.

GTMI continues to make significant progress as the leader of the Georgia Tech manufacturing innovation neighborhood, consisting of academic and interdisciplinary labs for basic research, and a pilot facility for translational development. These basic research labs are led by faculty, powered by bold ideas, focusing on Technology Readiness Level (TRL)/Manufacturing Readiness Level (MRL) 1-3 challenges, and supported by professional staff. The Advanced Manufacturing Pilot Facility (AMPF) is the anchor facility of the GT manufacturing innovation neighborhood where faculty, students, and GT industry partners are co-located and developing and testing solutions to TRL/MRL 4-7 challenges.

The 2014-2017 strategic plan is at the core of GTMI's success. The Strategic Imperatives set forth in the 2014 plan remain viable and GTMI continues to work toward them. However, a number of internal and external drivers have changed. Internally, GTMI successfully completed a thorough 5-year review by

the office of the EVPR. After the review of GTMI and other Interdisciplinary Research Institutes (IRIs), the performance metrics for IRIs were consolidated from 16 to 10 objectives to assist in guiding their development. In the last two years, GT is emerging as the leader in (biological and stem) cell manufacturing and characterization, where GTMI plays a critical role. Externally, we have seen accelerated adoption and convergence of emerging technologies, such as data analytics, AI/ML, robotics and flexible automation, additive manufacturing and advanced lightweight materials. We are also witnessing new business models as a result of these new technologies. These internal and external drivers necessitated a substantial update to the GTMI strategic plan for 2018-2012.

In February 2017, a strategic planning committee was named. Committee members represent a diverse group of stakeholders that includes faculty, staff, government partners and industry leaders. The committee's first discussion focused on looking at new external drivers such as the new National Network for Manufacturing Innovation (NNMI), emerging technologies, and macro-economic trends that will impact manufacturing in the next five to ten years. The second was to look at internal changes such as the Advanced Manufacturing Pilot Facility (AMPF), manufacturing of biological and stem cells, and to incorporate the revised GT IRI objectives. Moving through the process, the committee also analyzed GTMI through a deep Strengths, Weaknesses, Opportunities and Threats (SWOT) exercise.

Through the SWOT analysis, the committee synthesized the information to derive a set of signature initiatives that can assist GTMI in meeting its goals and its mission.

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## Strategic Goals (See the IRI Objectives on page 4)

### Goal #1:

Establish and sustain GT as a premier technology university for manufacturing related research, education, and thought leadership (Correlates to IRI Objectives 1,2,5,6,7)

### Goal #2:

Champion and support GT excellence in multi-disciplinary manufacturing research & innovation (Correlates to IRI Objectives 1,2,4,8,9,10)

### Goal #3:

Create and deploy transformative capabilities across GT to identify and collaboratively solve systems-level, high impact manufacturing challenges (Correlates to IRI Objectives 1,2,3,8,9)



## WHY MANUFACTURING MATTERS

*“Where manufacturing goes, innovation inevitably follows.”*

*- Dow Chemical CEO Andy Liveris*



## GTMI Strategic Plan

(Past Achievements and Future Plans are discussed later in this document.)

### Vision

GTMI will be the world’s premier institution anticipating needs and providing solutions on the frontiers of manufacturing research, application, and deployment.

### Mission

To pursue knowledge and skills that accelerate the translation of manufacturing-related research into high impact products and manufacturing systems.

There is abundant evidence that manufacturing is a critical sector of a nation’s economy for providing jobs, building wealth and as an impetus for innovation. A number of studies from governments, corporations, policy institutes and academic institutions support this assertion and indicate that “making things” is an important way to improve a society’s standard of living. Without a healthy manufacturing segment, nations spend their wealth obtaining goods versus receiving wealth for producing and exporting goods. The good news is that manufacturing in the U.S. is a vibrant component of the nation’s economy.



According to a report by the Economic Policy Institute, “The Manufacturing Footprint and the Importance of U.S. Manufacturing Jobs” by Robert E. Scott, manufacturing is responsible for roughly two-thirds of all U.S. business research and development spending. With the link between research and development and manufacturing, a vital manufacturing sector is important to maintaining an innovative economy. The report also states that a vibrant manufacturing sector will be needed to supply the new materials needed to rebuild America’s decaying infrastructure and to create a low-carbon economy.

According to the National Manufacturers Association (Source: Bureau of Economic Analysis):

“In the most recent data, manufacturers contributed \$2.18 trillion to the U.S. economy in 2016. This figure has risen since the second quarter of 2009, when manufacturers contributed \$1.70 trillion. Over that same time frame, value-added output from durable goods manufacturing grew from \$0.87 trillion to \$1.20 trillion, with nondurable goods output up from \$0.85 trillion to \$1.00 trillion. In 2016, manufacturing accounted for 11.7 percent of GDP in the economy.

“There are 12.3 million manufacturing workers in the United States, accounting for 9 percent of the workforce. Since the end of the Great Recession, manufacturers have hired more than 800,000 workers. There are 7.7 million and 4.6 million workers in durable and nondurable goods manufacturing, respectively.”

Additional benefits that manufacturing contributes to the U.S. economy include:

- » 70 percent of U.S. exports consist of manufactured goods;
- » One manufacturing job produces up to six additional jobs in the general economy;
- » For every \$1 invested in manufacturing, there is an additional \$2.48 in economic activity; and
- » 90 percent of patents are credited to the manufacturing sector.

Georgia Tech’s vision states that it, “will define the technological research university of the 21st century.”

The three goals for research at GT are to concurrently:

- » Facilitate transformational research,
- » Strengthen collaborative partnerships, and
- » Accelerate use for economic and societal benefit.

Georgia Tech is home to 12 Interdisciplinary Research Institutes (IRIs) responsible for bringing together a mix of researchers – spanning colleges, departments, and individual labs – around a single core research area. IRIs also connect a large portfolio of basic and applied research programs, support world-class research facilities and laboratories, engage Georgia Tech students, and collaborate with government and industry research partners. The 12 IRIs are:

- » Parker H. Petit Institute for Bioengineering and Bioscience
- » Institute for Data Engineering and Science
- » Institute for Electronics and Nanotechnology
- » Strategic Energy Institute
- » Institute for Information Security and Privacy
- » Georgia Tech Manufacturing Institute
- » Institute for Materials
- » Institute for People and Technology
- » Renewable Bioproducts Institute
- » Georgia Tech Research Institute
- » Institute for Robotics and Intelligent Machines
- » Brook Byers Institute for Sustainable Systems

## OBJECTIVES FOR GT IRIs

The Interdisciplinary Research Institute model is integral to Georgia Tech's research strategy (Figure 1). The IRIs are evaluated on 10 objectives, or performance metrics. These objectives are reflected in GTMI's strategic plan. They are:

1. Develop, maintain and communicate a vision and strategic plan.
2. Communicate the broad research vision to all members.
3. Work closely with colleges, schools, centers, and GTRI to coordinate research efforts in the IRI subject area.
4. Catalyze new research directions, maintain a dynamic research portfolio, and facilitate formation of interdisciplinary teams.
5. Act as an effective focal point for interactions with external partners in the IRI focus area.
6. Organize and articulate national and international thought leadership in the IRI focus area.
7. Enable creation of funding opportunities through policy participation and leadership in the development of national, state and local S&T priorities.
8. Coordinate with GTRC, EI2, and Government Relations on: 1) R&D, 2) technology commercialization, and 3) economic development and entrepreneurship
9. Provide leadership and resources to facilitate the development of large-scale multi-investigator extramural grant proposals.
10. Manage and support research space, including core resources and facilities, as appropriate to the research field.



Figure 1. Georgia Tech's Research Strategy.

# GTMI STRATEGIC FRAMEWORK

GTMI's strategic framework is mission driven and focused on three imperatives:

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

**Leverage** and champion Georgia Tech's tradition of excellence in cross-campus manufacturing-relat-

ed knowledge, basic research and interdisciplinary applied research

**Accelerate** application and deployment of manufacturing innovation by collaboratively, concurrently, and aggressively maturing technology, manufacturing and business case readiness

This approach is a different model for university-based innovation and industry engagement. Most importantly, it is a different model for faculty engagement across the campus.

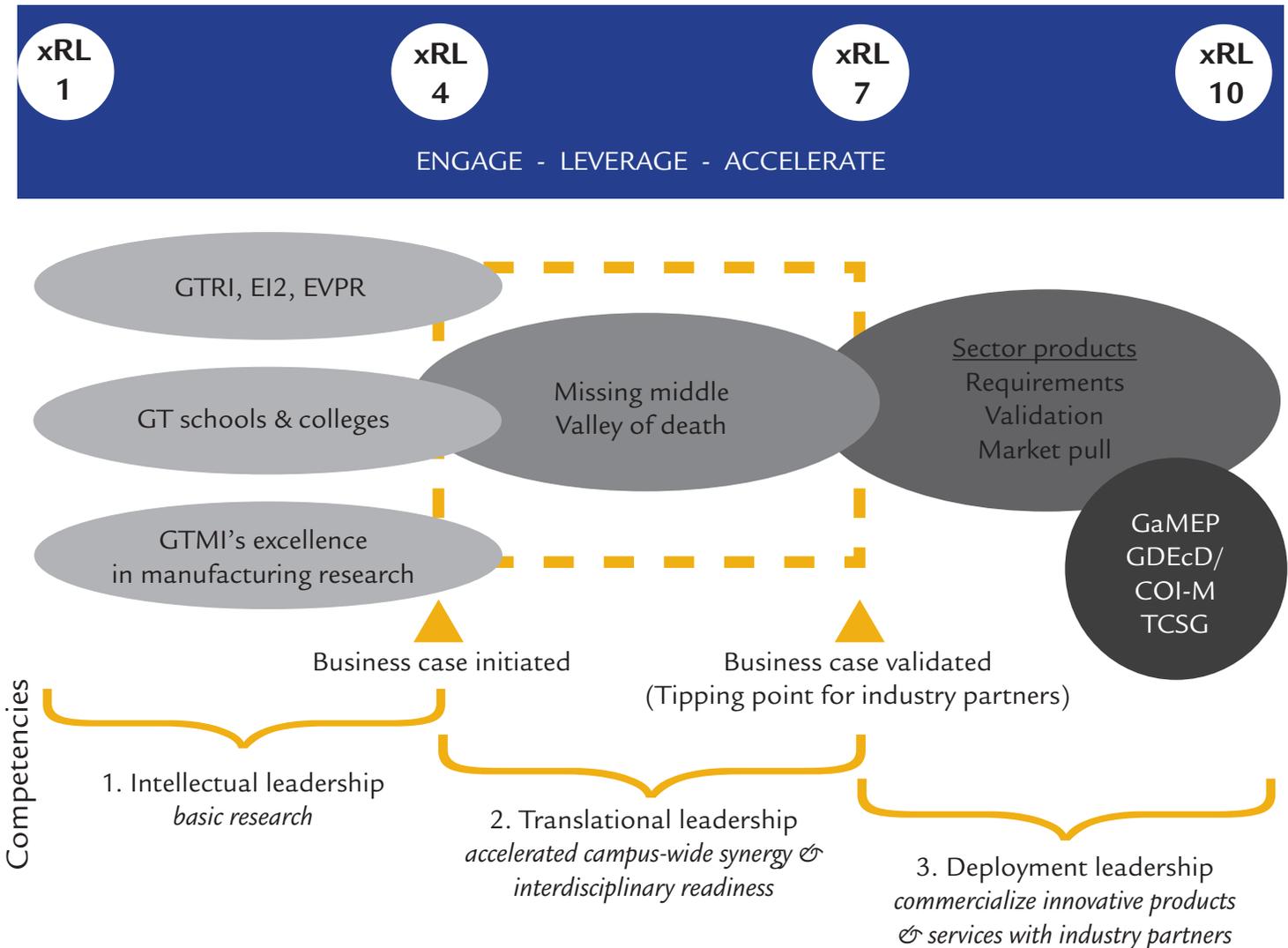


Figure 2. GTMI's model for university-based innovation and industry engagement.

The GTMI Concept of Operations (Figure 3) brings together the framework provided by its strategic plan and the interdisciplinary approach to research to solve challenges.

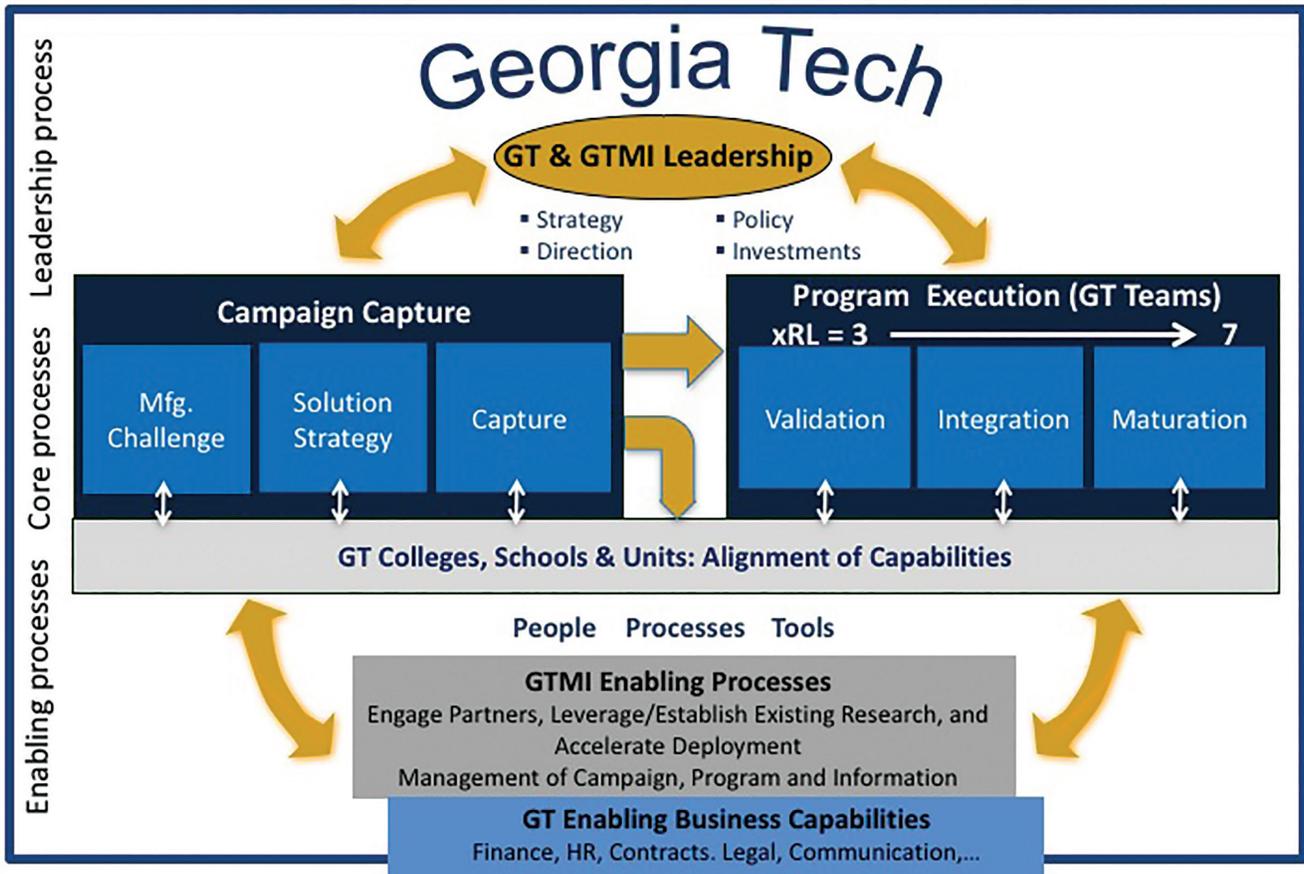


Figure 3. GTMI's Concept of Operations.

The GTMI Concept of Operations is to take a challenge or idea into a winning proposal whereby it is turned into a contract or grant. Next, the goal is to take the research from a low Technical Readiness Level (TRL) of 1-3 to a TRL of 6-7. The stages involved in this approach include: 1) defining the challenge and forming a strategy to create a compelling case to capture an award or contract; 2) engaging interdisciplinary GT faculty, faculty from other institutions, and appropriate business and/or government partners in the process to get feedback and participation; and 3) gather the support and resources available from GT such as finance, legal, human resources and communications.

Another critical component is to proactively develop faculty leaders in cutting edge research areas such as robotics, biomanufacturing, additive manufacturing and more. The GTMI strategic plan includes processes to include a wide spectrum of GT faculty and researchers, as well as undergraduate and graduate students in the pursuit of turning challenges and ideas into winning proposals.

At the national level, there remains two overarching grand challenges facing U.S. manufacturing. The first is how we accelerate innovation by rapidly turning research results into innovative products. Today's research translation takes too long, costs too much, and the results are too random. The second challenge is for the U.S. to invest in and build a productive manufacturing ecosystem. A manufacturing ecosystem is built on a skilled workforce, a robust infrastructure, a friendly business climate, a good investment community, and a hot bed for innovation. Creating these is a key to our nation's ability to innovate. Conquering these grand challenges will catalyze advanced manufacturing, and it will act as a vital component for developing a national innovation policy.

A framework is necessary to give structure to work towards having an impact on grand challenges. GTMI has built a portfolio of manufacturing challenges that it focuses on in concert with other GT colleges, schools and IRIs; and with government, industry and trade associations. Our current portfolio includes:

#### High Impact National Manufacturing Initiatives

- » Cellular Bio-Manufacturing Technologies and Standards (AMTech, Marcus Foundation)
- » Accelerated Innovation and Insertion of Advanced Composites (AMTech)
- » Manufacturing USA (NNMI) opportunities & topics

#### Frontiers of Systems-Level Impact on Manufacturing

- » Nation-wide Workforce Development (GDEcD, TCSG, COI-Mfg, SME, NNMI)
- » Policies and Economic Development (GTMI, GaMEP)
- » Innovation in Pilot Production Facility and beyond for Accelerating Maturation
- » Next Generation Logistics and Supply Networks

#### Manufacturing that Innovates and Enables "Grand Challenges"

- » Hypersonic Capabilities (DARPA)
- » Regulatory: Material and Manufacturing Implications of New CAFE Standards
- » NAE Engineering Grand Challenges ("Manufacturing on Critical Path of Engineering Grand Challenges")

GTMI STRATEGIC GOALS	YEARS 2014-2017	YEARS 2018-2021
<p>GTMI Goal #1: Establish and sustain GT as a premier technology university for manufacturing related research, education, and thought leadership (1,2,5,6,7)</p>	<ul style="list-style-type: none"> <li>» Participated in AMP 1.0 &amp; 2.0</li> <li>» Participated in shaping the Mfg University concept (and potential funding) for collaboratively achieving high impact solutions</li> <li>» Created composites J&amp;R space</li> <li>» Collaborated with IBB/BME in creating cell-mfg space</li> </ul>	<ul style="list-style-type: none"> <li>» Continue to amplify GT mfg innovation thought leadership</li> <li>» Continue to shape policies and participate in large-scale opportunities at state and national levels</li> <li>» IAB process for linking new learning from challenges into GT education</li> </ul>
<p>GTMI Goal #2: Champion and support GT excellence in multi-disciplinary manufacturing research &amp; innovation (1,2,4,8,9,10)</p>	<ul style="list-style-type: none"> <li>» GT-Boeing partnership</li> <li>» Seed funding</li> <li>» Manufacturing challenge portfolio framework</li> <li>» Obtained new funding for multi-disciplinary challenges</li> </ul>	<ul style="list-style-type: none"> <li>» Expand the concept and participation of GT- Boeing model</li> <li>» Expand the internal manufacturing research leadership participation</li> <li>» Prioritize seed and project funding and services</li> <li>» Align with Schools and Colleges to include recruitment of needed skill sets</li> </ul>
<p>GTMI Goal #3: Create and deploy transformative capabilities across GT to identify and collaboratively solve systems-level, high impact manufacturing challenges (1,2,3,8,9)</p>	<ul style="list-style-type: none"> <li>» Created infrastructure – EAB, IAB, SPC, IPP &amp; re-deployed staff</li> <li>» Collaborative design on concept of operation</li> <li>» Expanded innovation portfolio including economic development &amp; workforce. Nurtured solid partnerships with TCSG &amp; GDEcD</li> <li>» Advocacy for pilot facility space &amp; capability</li> </ul>	<ul style="list-style-type: none"> <li>» Develop and expand mfg innovation neighborhoods (AMPF, TEP)</li> <li>» Expand pursuit of government sponsors with existing funds aligned with GT challenges</li> <li>» Expand GT leadership and link pursuit to future industrial base needs and high impact products</li> </ul>

*In addition to the aforementioned progress made on GTMI's strategic goals, a great deal of effort has gone into other innovative programs that have a major impact on manufacturing innovation at Georgia Tech. Examples include:*

## **WORKFORCE DEVELOPMENT**

### *Partnership With Technical College System of Georgia*

GTMI has a robust partnership with the Technical College System of Georgia (TCSG) and the Georgia Department of Economic Development (GDEcE). Programs already in place provide opportunities for two-year TCSG students to work with Georgia Tech undergraduate and graduate students, and post-doctoral fellows. Georgia Tech faculty and staff supervise all student teams as they work on real-world challenges.

### *Manufacturing Scholars Program*

This program is leveraging critical partnerships between GTMI, GT faculty, and sponsoring manufacturing companies to accelerate the development of awareness, interest, skills, and knowledge in manufacturing for GT undergraduates. Plans are to grow the program and actively recruit participants.

## **ADVANCED MANUFACTURING PILOT FACILITY (AMPF)**

AMPF is a place that enables teams of academic, industrial and government expertise to develop, scale and deploy next-generation technologies that promote innovation and allow technical, business and economic strategies to evolve in strengthening and growing the manufacturing ecosystem. It provides opportunities for student engagement via internships and cooperative work positions. As a pilot facility, pre-commercial production systems that employ new production technology can be realized, producing small volumes of new technology-based products, mainly for the purpose of learning about the new technologies. Delta and Boeing were the first to establish research centers at AMPF. Delta provided generous funding to refurbish the facility prior to its opening.

## **CELL MANUFACTURING**

GTMI continues to support the new Georgia Institute of Technology research activities located in the Engineered Biosystems Building and Parker H. Petit Institute for Bioengineering & Bioscience (IBB), that will develop processes and techniques for ensuring the consistent, low-cost, large-scale manufacture of high-quality living cells used in cell-based therapies.

The center was established with a generous grant from the Atlanta based Marcus Foundation, along with funds from the Georgia Research Alliance and Georgia Tech for a total investment of \$23 million. The therapies developed by the center will be used for a variety of disorders such as cancer, lung fibrosis, autism, neuro-degenerative diseases, autoimmune disorders and spinal-cord injury – as well as in regenerative medicine.

Cell therapies, especially immune cell therapies such as T-cell immunotherapies for cancers, are revolutionizing the way we treat devastating, incurable, and chronic diseases and have great potential for transformative impact on health and on how health-care impacts the economy. Cell therapy is the fastest growing segment of regenerative medicine and also the largest. Globally, the stem cell therapy market is expected to be worth US \$180 billion by 2030. The T cell therapy market alone will be worth US \$30 billion by 2030. The emerging cell therapy industry is challenged to enable scalable manufacturing of therapeutic cells as an effective, safe, reproducible, and affordable pharmaceutical product with standardized characterization and quality control. A necessary condition for fast growth and significant impact of this emerging industry is robust end-to-end supply chains. In fact, a key barrier to such growth identified by industry in the National Cell Manufacturing Consortium, an industry-academia consortium funded by the Advanced Manufacturing Technologies program of the National Institute for Standards and Technologies, is the absence of supply chain management and process modeling for cell therapy products.

## **COMPOSITES JOINING AND REPAIR**

Work on a first-of-its-kind roadmap by the Consortium for Accelerated Innovation and Insertion of Advanced Composites (CAIIAC, pronounced “KAYAK”) is complete. CAIIAC’s mission has been to create an innovative domestic manufacturing ecosystem to significantly shorten the time required in manufacturing development cycles, and provide “right-the-first-time material yields” for broad-based composite processes. The consortium’s roadmap focuses on composite joining and repair because it is a highly-underserved market with significant growth

momentum, and has transportation and safety implications. The worldwide maintenance, repair, and overhaul market (MRO) is expected to grow at a compound annual growth rate (CAGR) of 3.8% reaching about \$65 billion by the year 2020.

### **THOUGHT LEADERSHIP**

GTMI is constantly demonstrating its thought leadership position by organizing workshops on topics such as the Internet of Things for Manufac-

turing and holding weekly luncheon seminars as part of the Manufacturing Luncheon Series. GTMI staff are also active in national and international trade associations, with several holding leadership positions within these organizations. The Industry Partners Program provides numerous opportunities to build relationships with manufacturing experts in academia, government and industry. In addition to these activities, GTMI researchers are often sought out as speakers for topical workshops and they also publish papers singularly and in collaboration with others.



A SWOT analysis is an integral part of the strategic planning process because it provides a good all-around view of the current and potential positions of an organization. The strengths (S) and weaknesses (W) sections provide a snapshot of “what is.” The opportunities (O) and threats (T) sections help focus on “what could be” or “the to be” state. The analysis revealed big opportunities to leverage our brand and expertise. The following shows the results of the group’s discussion.

**Step one:** Identify strengths, weaknesses, opportunities and threats

### **STRENGTHS**

1. Strong brand recognition: GT, GTMI, GTRI
2. GT manufacturing faculty are global thought leaders
3. Strong partnerships with industry and government agencies at different levels (including GaMEP, TCSG, GDEcD)
4. GT is the leader in some (emerging) areas – (Cell/Bio Manufacturing; Composites Joining and Repair; Robotic Manufacturing; Additive Manufacturing; and Digital Manufacturing)
5. GT is a leader in other areas, (define grand challenges, narrow down & clearly define unique core competency more tightly focused)
6. GT investment in interdisciplinary research programs
7. Manufacturing at GT is a campus-wide, multi-disciplinary effort encompassing all major topical areas of Big M Manufacturing

### **WEAKNESSES**

1. Usable space is a chokepoint
2. Funds to purchase and maintain high-end equipment are extremely limited
3. State’s support for manufacturing R&D is relatively scarce
4. IRI model is not fully embraced across campus
5. Internal support processes have not kept up with the growth of research activities (contracting, NDAs, patent apps.)
6. Inadequate (collective) faculty leadership: lack of interest, resources, time, champions for focus areas, etc.
7. GT’s IRI structure is not visible enough to industry; structure is confusing

## OPPORTUNITIES

1. Awareness of the importance of manufacturing to national economy and security higher than ever
2. Be the one to define manufacturing future, when new global trends & new technologies are emerging
3. GT offers fertile ground for engagement of GTRI and other IRIs to foster rich and unique interdisciplinary opportunities
4. Engagement with TCSG, GaMEP, and GDEcD to be the national leader in workforce development for future of manufacturing
5. Next generation (NSF) ERCs and IUCRCs
6. AFOSR interest in manufacturing for the first time
7. Greater use of R&D consortium model (DOD, Army)
8. Increase investments by federal and private entities
9. Grow Georgia's interest and potential for state support
10. Identify and satisfy the need for manufacturing expertise from GTMI toward interdisciplinary efforts
11. Expand usable R&D space, equipment and infrastructure
12. Increase strategic partnerships
13. Grow faculty leadership and provide a platform for emerging faculty champions

## THREATS

1. National investments in manufacturing R&D (basic and translational) are behind competing nations
2. Other states invest heavily in manufacturing-related R&D and translational efforts
3. Strong competitions for thought leadership position and funding from these universities: Michigan, MIT, Carnegie-Mellon, UC Berkeley, Ohio State, Penn State, NC State
4. Overall S&T funding for academia may decline

**Step two:** Comparative analysis of strengths vs. opportunities and threats, as well as the weaknesses vs. opportunities and threats.

The following shows the major take aways from the activity. (The detailed charts generated by the groups can be found in Appendix 1.)

- » An in-depth SWOT analysis revealed big opportunities to leverage our brand and expertise
- » GTMI should continue to engage faculty, industry, other IRIs, and GTRI in identifying emerging challenges (in addition to cell mfg and composite joining and repair) and providing solutions and thought leadership
- » GTMI seed funding best used to sponsor workshops and meetings that lead to the development of national roadmap documents and formation of consortia
- » Translational facility (AMPF) is attracting great interest from industry and other academic institutions

**Step three:** Develop actionable, signature initiatives and SMART action plans. SMART action plans are ones that are specific, measurable, achievable, results-focused, and time-bound.

**The following are the Actionable Recommendations stemming from the SWOT analysis. These actionable recommendations will lead to the formation and execution of GT Signature Initiatives:**

1. Garner strong state-level support, particularly in critical/emerging areas where GTMI can make strong national and global impact (Bio-mfg and TEP translational facility, GCAB, NSF CMat ERC, NIIMBL, ARMI, Marcus Center, ...)
2. Implement composite joining & repair roadmap & consortium long-term sustainability strategy
3. Communicate GTMI value propositions & core competencies to and engage GT faculty and administrators by visiting school faculty meetings and workshops
4. Develop and execute a joint GTMI-IRIM industry membership model
5. Identify big topics & grand challenges for major federal funding, e.g. NSF IUCRC, ERC, DOE consortium programs
6. Be the leader in robotics & flexible automation; develop and implement a technology roadmap, workshops, partnerships, strategy, new faculty positions, faculty engagement
7. Develop a digital factory roadmap and an implement strategy
8. Identify and develop joint IRI signature initiatives – robotics/flex automation (IRIM), high-temp additive mfg (IMAT, SEI), biomedical devices (GCMI, IBB), aircraft sustainability (GTRI), cybersecurity, etc.
9. Implement AMPF phase 2 build-out to include high-temp additive mfg and composite joining and repair; faculty engagement & industry engagement
10. Secure critical equipment: consignment, grants, sharing under-utilized equipment
11. Be the leader in adv mfg workforce development: innovative models, partnerships in critical/emerging technology areas, state/federal sponsorships for critical/emerging technology areas
12. Convene high profile workshops/forums to develop and convey GT's vision of the future of manufacturing, national visibility, global leadership
13. Work with schools, colleges and IRIs in recruiting new faculty leaders of today and tomorrow
14. Develop actionable intelligence – competition and collaboration

The GTMI strategic plan covers a four-year period. The following are steps that need to be taken in order to put the plan in action:

- » Review announcement of GTMI seed funding program for roadmap development
- » Test directional policy matrix approach and include it in seed funding program
- » Develop year-to-year S.M.A.R.T. goals and an implementation plan for each of the signature initiatives
- » Final review and approvals

To help ensure that the projects submitted for seed funding are of a caliber to meet the goals of the strategic plan, a directional policy matrix will be used to assess them. The following illustrates the type of matrix that will be used. Items in each list will be given a weight in order to compare different proposals.

### **Potential Assessment Factors**

#### **Opportunity Attractiveness**

- » Clear and compelling drivers for investment in innovation have been identified and are understood
- » Emerging research challenges are driven by clear market drivers and require significant discoveries and key challenges will require sustained R&D efforts over a decade or more
- » Research activity and funding been growing in the fields of opportunity
- » Significant / major sponsors in the sector have a history of university research engagement and collaboration
- » Multiple sources of funding for exploration of innovations are available to universities
- » Major research awards of \$1million per year are available
- » Government funding has been appropriated for research and is accessible to universities
- » GT has direct access to key decision makers in the market sector / government agencies
- » Research engagement provides opportunities for publications in major peer reviewed journals
- » Research opportunities in field align with major focus areas of GT faculty and schools

#### **Competitive Position**

- » GT faculty are recognized and in dialogue with key industry and government decision makers on critical directions for future innovations
- » GT faculty have been actively engaged in road-mapping and / or investigations of innovation requirements in the field
- » GT faculty has conducted research in the key challenges that has been referenced by other major researchers in the field
- » GT has core technical competencies in the critical topics required to address the research and innovation challenges which are at least on par with the current major universities in this arena
- » Depth and breadth of faculty engaged in the key research areas matches that of the most established competitor
- » GT can attract and retain additional faculty and research scientists required competencies
- » Required core technical competencies are supported and renewed by engagements with government programs
- » GT has facilities available for the research that match or exceed other research sources
- » GT currently has research agreements in place with the major funding sources in the sector
- » The State of Georgia will strongly support R&D in this area



# APPENDIX 1: SWOT ANALYSIS CHARTS

Comparative analysis of strengths vs. opportunities and threats, as well as the weaknesses vs. opportunities and threats.

Table 1: Which of the organization’s strengths can be used to maximize the opportunities identified? Shaded boxes are top level ideas.

<p>Opportunities →</p> <p>Strengths ↓</p>	<p>Awareness of the importance of manufacturing to national economy and security higher than ever (Federal)</p>	<p>Be the one to define manufacturing future, when new global trends &amp; new technologies are emerging – <i>this is a vision not opp/</i></p>	<p>GT offers fertile ground for engagement of GTRI and other IRIs to foster rich and unique interdisciplinary opportunities</p>	<p>Engagement with TCSG, GaMEP, and GDEcD to be the national leader in workforce development for future of manufacturing</p>	<p>Next generation (NSF) ERCs and IUCRCs</p>	<p>AFOSR interest in manufacturing for the first time</p>	<p>Greater use of R&amp;D consortium (DOD, Army – these two don’t have a cost share requirement)</p>
<p>Strong brand recognition</p>	<p>Leverage GT’s brand recognition to position GT at the forefront of national manufacturing initiatives.</p>		<p>Identify opportunities for collaboration with other IRIs (e.g. IRIM, iMAT, IDEAS) and GTRI, especially where there are thematic synergies.</p>	<p>Broaden scope of current partnerships w/ TCSG, GDEcD, and GaMEP to focus advocacy efforts at the State and federal levels for funding equipment and/or space to assist in training workforce of the future, especially in emerging technology areas.</p>	<p>Leverage brand recognition to create consortia in emerging technology areas to pursue IUCRCs and ERCs (e.g., Composites Joining &amp; Repair IUCRC).</p>	<p>Identify specific expertise on campus that intersects with AFOSR’s manufacturing R&amp;D and workforce training interests.</p>	<p>Leverage GTs brand recognition to create consortia to pursue DoD funding opportunities.</p>
<p>Global thought leadership of GT manufacturing faculty</p>	<p>Coordinate efforts of GT manufacturing thought leaders to ensure effective articulation and communication of GT’s views on State-level and National needs in manufacturing. Also, work to suitably engage and position more GT faculty in</p>	<p>Lead a coordinated effort to leverage GT thought leaders in articulating the future of manufacturing. For example, GTMI can convene workshops to develop GTs vision of the future of manufacturing.</p>	<p>Employ GT thought leaders to promote the importance of R&amp;D opportunities at the intersection of IRI foci (where it makes sense).</p>	<p>Employ GT thought leaders to advocate (at the State and National levels) for GT’s views on best practice approaches to workforce development in emerging areas.</p>		<p>Leverage GT thought leaders with links to DoD to promote emerging technology areas of relevance to DoD and where GT has unique strengths.</p>	<p>Leverage the relationships and connections of GT thought leaders in establishing consortia to pursue DoD funding opportunities.</p>
	<p>national discussion on manufacturing.</p>						

Appendix 1, continued...

Strong partnerships with industry and government agencies at different levels	Convene industry and relevant government agencies (State and Federal) to develop and shape approaches to enhancing State and U.S. competitiveness in manufacturing of the future.		Strengthen and leverage existing partnerships with industry and government agencies to create new programmatic opportunities at the intersection of relevant IRI/GTRI efforts.	Strengthen and leverage existing partnerships with industry and government to create workforce training programs in emerging technology areas. For example, be proactive in creating the partnerships needed secure funding from DoD's Manufacturing Engineering Education Grant Program ("Manufacturing Universities Act").	Strengthen and leverage existing partnerships with industry and government to pursue ERC and IUCRC opportunities.	Work with partners who can help GT in securing AFOSR funding.	Strengthen and leverage existing partnerships to position GT to respond effectively to potential DoD funding opportunities.
GT is a leader in emerging and other technical areas	Develop effective communication mechanisms (e.g. presentations at Departmental faculty meetings) to broaden faculty participation in the campus-level and national discourse on manufacturing.	Leverage GT leadership in emerging technology areas (e.g. bio manufacturing, composites manufacturing, additive manufacturing, digital manufacturing, etc.) to define the future of manufacturing.	Identify relevant expertise in other IRIs and GTRI to enhance GT leadership in emerging and other technical areas.	Partner with TCSG, GDECD, and GaMEP to create effective workforce training programs in emerging areas.	Pursue ERC and IUCRC opportunities in emerging technology areas.	Same as NSF actions	Let faculty know about changing env & more need to be able to work in large consortium of same
<i>Other ideas not captured under a stated weakness</i>	Create an overall network of IRIs where companies can join and						
	be members of more than one IRI. GTMI can come up with a model that links different IRIs.						

Table 2: How can you use the company's strengths to minimize the threats you identified?

Threats 	National investments in manufacturing R&D (basic and translational) are behind competing nations	Other states invest heavily in manufacturing-related R&D and translational efforts	Strong competitions for thought leadership position and funding from these universities: Michigan, MIT, Carnegie-Mellon, UC Berkeley, Ohio State, Penn State, NC State	Overall federal S&T funding for academia may decline
Strengths 				
Strong brand recognition	Use brand recognition to advocate (at the State and Federal levels) for greater investment in manufacturing R&D. With the launch of the AMPF, GTMI/GT has a strong platform to demonstrate the value created through establishment of a R&D continuum that spans basic and translational R&D.	Get data, use in arguing for more money for equipment to support manufacturing education in emerging areas. Emphasis on education might be more amenable to the State.	Leverage brand recognition to establish mutually beneficial partnerships with competitors to get a "piece of the pie" in areas where we are not sufficiently competitive.	Leverage brand recognition in pursuit of industry and philanthropic funding sources to mitigate impact. Engage GTF in this effort.
Global thought leadership of GT manufacturing faculty	Advocate/inform GA participation in national forums on mfg (e.g. Congressional mfg caucus). Approach Congress in partnership w/ industry.	Leverage EVPR's Office, EI <sup>2</sup> and GT thought leaders in educating the relevant State agencies of the economic value of investing in manufacturing R&D in strategic areas (e.g., bio manufacturing, additive manufacturing, robotic manufacturing, digital manufacturing, etc.).	Coordinate the efforts of GT thought leaders in communicating a clear message that advances GT's competitiveness in federal funding opportunities.	Leverage GT thought leaders to educate local and national agencies on the negative impact caused by decline in S&T funding and to advocate for increased funding. Also, leverage them to pursue industry and philanthropic funding to mitigate impact.
Strong partnerships with industry and government agencies at different levels	Build broader partnerships with overseas companies operating in the US to leverage other funding opportunities.	Build industry partnerships and approach State for matching support. Use education and workforce training as the primary theme of the pitch to the State.	Leverage our industry partners that work with our competitors to get a "seat at the table" in areas where we are not sufficiently competitive on our own.	Offer IRI as an alternative to getting funding through traditional routes. Need to visit with faculty to communicate value.
GT is a leader in emerging and other technical areas	Advocate to EVPRs office of the importance of continued investments (for the long haul) in emerging and other areas where GT has strength. Greater advocacy at the State and Federal levels.	Leverage GT strengths to advocate for strategic State level investments (e.g. in bio manufacturing, aerospace manufacturing). Leverage AMPF in advocacy efforts.	Establish mutually beneficial partnerships with competitors to get a "piece of the pie" in areas where we are not sufficiently competitive.	Pursue industry and philanthropic funding sources to mitigate impact.
<i>Other ideas not captured under a stated weakness</i>	Need to be more visible and active in national discussion on manufacturing Partnering with industry to advocate for funding would be stronger than not.		Develop actionable intelligence – IRI intel gathering; communications with faculty to discover potential competitors or collaborators. Be selective – find the best person to sit on a board, for example, to create a more broad and diverse expertise base	

Appendix 1, continued...

Table 1: What action can you take to minimize the weaknesses by capitalizing on the opportunities? Shaded boxes are top level ideas.

<p>Opportunities →</p> <p>Weaknesses ↓</p>	<p>Awareness of the importance of manufacturing to national economy and security higher than ever (Federal)</p>	<p>Be the one to define manufacturing future, when new global trends &amp; new technologies are emerging – <i>this is a vision not opp/</i></p>	<p>GT offers fertile ground for engagement of GTRI and other IRIs to foster rich and unique <u>interdisciplinary</u> opportunities</p>	<p>Engagement with TCSG, GaMEP, and GDEcD to be the national leader in workforce development for future of manufacturing</p>	<p>Next generation (NSF) ERCs and IUCRCs</p>	<p>AFOSR interest in manufacturing for the first time</p>	<p>Greater use of R&amp;D consortium (DOD, Army – these two don't have a cost share requirement)</p>
<p>Usable space/equipment is a chokepoint</p>	<p>Refer to national discussion in arguing for more space</p>		<p>2) Promote sharing of under-used equipment obtained by indiv researchers. Engage GTRI &amp; others in forming ideas on how to use space more collaboratively</p>	<p>1) Broaden scope of current partnerships w/ TCSG to focus on advocacy efforts at state level for funding equipment and/or space to assist in training workforce of the future.</p>			
<p>Funds to purchase and maintain high-end equipment are extremely limited</p>	<p>Refer to national discussion in arguing for more money for equipment</p>		<p>Engage GTRI &amp; others in arguing for more money for equipment</p>	<p>Engage with industry</p>	<p>GET \$ from ERC or IUCRC for equipment</p>	<p>Get \$ from AFOSR for more equipment</p>	
<p>State's support for manufacturing R&amp;D is relatively scarce</p>	<p>1) Ensure GT VP of state relations is familiar with mfg issues, GTMI programs. Capitalize on innovation ctrs, partner w/</p>			<p>2) Communicate existing and future workforce development programs for Dene Sheheane to relay to state legislators. Approach state in partnership with tech schools on workforce development programs. E.g. get more involved in existing</p>			<p>2) Where cost share is needed, approach state in partnership with industry</p>
	<p>industry in approaching the state. Make funding requests to state more focused.</p>			<p>TCSG programs like the adv. manf. center in South Georgia.</p>			

Appendix 1, continued...

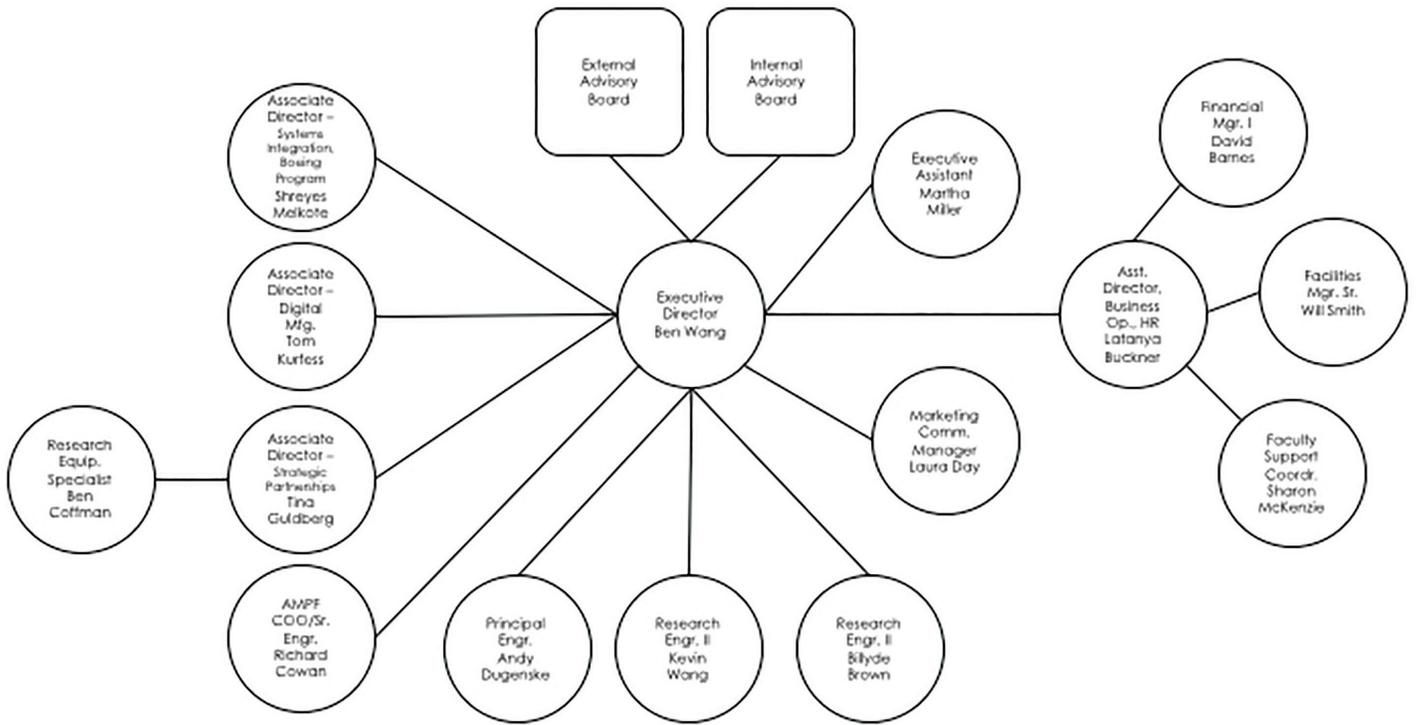
IRI model is not fully embraced across campus	2) Visit faculty meetings to develop understanding and support for IRIs. Help them be more informed on national discussion on manufacturing.	2) Communicate value of collaborating with IRIs at faculty meetings and other venues.	1) Coord IRI strat plans. ID synergistic areas (e.g. cybersecurity). AMPF facility planning might be a good vehicle for dialogue.		1) Leverage faculty connections. Inform faculty about larger opportunities avail thru IRI consortium activity	1) Same as NSF actions	Let faculty know about changing env & more need to be able to work in large consortium of same
Internal support processes have not kept up with the growth of research activities (contracting, NDAs, patent apps.)	Refer to national discussion in arguing for more improvements		Engage GTRI & others in arguing for more improvements				
Inadequate (collective) faculty leadership: lack of interest, resources, time, champions for focus areas, etc.	Refer to national discussion in faculty meetings visits to recruit leaders	1) Develop a value statement for faculty to consider GTMI and mfg apps in their technology areas			2) Reach out to faculty experts to collaborate with on consortium research. Broaden the pool of faculty experts.	2)Let faculty know about changing env & more need to be able to work in large consortium and so know how to be a leader of same	1) Communicate our core competencies -- what we are BEST at. (IRIs lack coherent focus areas, and we keep spinning up new ones.)
<i>Other ideas not captured under a stated weakness</i>	Create an overall "pool" of IRIs where companies can join and be members of more than one IRI. GTMI can come up with a model that links different IRIs.						

Table 2: How can you minimize the weaknesses to avoid the threats?

Threats →	National investments in manufacturing R&D (basic and translational) are behind competing nations	Other states invest heavily in manufacturing-related R&D and translational efforts	Strong competitions for thought leadership position and funding from these universities: Michigan, MIT, Carnegie-Mellon, UC Berkeley, Ohio State, Penn State, NC State	Overall S&T funding for academia may decline
Weaknesses ↓				
Usable space is a chokepoint	Get data, use in arguing for more space	Get data, use in arguing for more space	Get data, use in arguing for more space	
Funds to purchase and maintain high-end equipment are extremely limited	Get data, use in arguing for more money for equipment	Get data, use in arguing for more money for equipment	Get data, use in arguing for more money for equipment	
State's support for manufacturing R&D is relatively scarce	1) Advocate/inform GA participation in national forums on mfg (e.g. Congressional mfg caucus). Approach Congress in partnership w/ industry.	1) Get data, make sure Dene Shehane knows and that he lets the state know. Partner w/ industry in GA sectors of interest (aerosp, automotive, ...)	Get data, make sure Dene Shehane knows and that he lets the state know	Get data, make sure Dene Shehane knows and that he lets the state know
IRI model is not fully embraced across campus	Find similar efforts abroad and let faculty know about them	2) Identify faculty that have needed expertise in areas that state is looking for	Find similar efforts at these universities and let faculty know about them	1) Offer IRI as an alternative to getting funding through traditional routes. Need to visit with faculty to communicate value.
Internal support processes have not kept up with the growth of research activities (contracting, NDAs, patent apps.)				
Inadequate (collective) faculty leadership: lack of interest, resources, time, champions for focus areas, etc.	competition landscape might motivate a few to take leadership		1) Engage GT faculty to gain better visibility of competition landscape. Use to motivate a few to take leadership, seek out co-authors, or otherwise pursue collaborations where we are the leader or the supporter.	2) Difficulty getting funding through traditional routes might push faculty into taking leadership if these routes are more successful
Other ideas not captured under a stated weakness	2) Need to be more visible and active in national discussion on manufacturing Partnering with industry to advocate for funding would be stronger than not.		2) Develop actionable intelligence – IRI intel gathering; communications with faculty to discover potential competitors or collaborators. Be selective – find the best person to sit on a board, for example, to create a more broad and diverse expertise base	



# Appendix II: GTMI Organizational Chart



For additional information about GTMI, visit [www.manufacturing.gatech.edu](http://www.manufacturing.gatech.edu).

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