Reenergizing Manufacturing

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Chief Manufacturing Officer, GT
Why Manufacturing
Wealth Creation

U.S. Exports

- Mfg Goods: 70%
- Non-Mfg: 30%
Job Multiplier Effect

One mfg assembly job

Six jobs in supply chain

Ten jobs in economy
2/3 U.S. scientists and engineers are employed in manufacturing.

**STEM Employment**

- **Mfg Sector**: 66%
- **Non-Mfg**: 34%
Innovation Driving Force

U.S. Patents

- Mfg Industry: 90%
- Non-Mfg: 10%
Path Forward
Vision

Building a community of interdisciplinary experts, who are passionate about driving innovations into the big M Manufacturing, in order to solve grand challenges for the enhancement of our nation’s wealth, competitiveness and security

Through this vision, MaRC will amplify Georgia Tech’s global reputation as the world’s leader in innovation-driven manufacturing
Mfg. Innovation Eco-system

Stakeholders
- Univ.
- C.C.
- Workforce
- Governments
- Indus.
- Unions
- NGOs
- NLs
- Citizens

Enablers
- Tech.
- Policy
- Infrast.
- Education
- Supply chain

Concept → mfg. → E.O.L.
Mfg. Innovation Eco-system

Stakeholders

Big “M” Manufacturing

Enablers

Supply chain
Manufacturing is in GT’s DNA
MaRC Advisory Groups

- External Advisory Board (EAB)
- Industry Partner Program (IPP)
- Faculty Steering Committee (FSC)
- Ad Hoc Task Forces
Raising Mfg Visibility

- A campus-wide manufacturing colloquium
- Workshops on grand challenges at confluences of technologies and disciplines
- Annual Global Manufacturing Forum
- Need more out-of-box ideas, esp. student engagement: InVenture Prize, Graduate Research Conference
Thought Leadership
Thought Leadership

- Define grand challenges and technology roadmaps
- Make our position known in downtown and DC
- Others eager to find out what we think, say and do
White House
Advanced Manufacturing Partnership
President Obama announced the Advanced Manufacturing Partnership (AMP) initiative on June 24, 2011.
Reinvigorating the U.S. manufacturing competitiveness.
Creating high-quality jobs.
A private-public partnership (PPP)
AMP Steering Committee

- Formed a steering committee to provide guidance on this important national initiative
- Committee consists of six university presidents and 12 company CEOs
- Carnegie Mellon, Georgia Tech, Michigan, MIT, Stanford, UC Berkeley
- Defined five workstreams
Five Workstreams

- Advanced Manufacturing Technology Development
- Shared Infrastructure and Facilities
- Policy
- Education and Workforce Development
- Communications and Outreach
AMP Regional Outreach Conferences

- Georgia Tech, Oct. 14, 2011
- MIT, Nov. 28, 2011
- Michigan, Dec. 12, 2011
Outreach and Communications

- **Four Regional Meetings**
  - 1200 attendees
  - Millions watched via webcast and video archives

- **Targeted Outreach**
  - **Capitol Hill:** House Manufacturing Caucus, House & Senate Committee Staffs
  - **Federal Agencies:** Department of Homeland Security, Department of Commerce, Department of Defense, Department of Energy, Department of Labor, National Science Foundation
  - **Associations and Trade Groups:** Association of Public and Land-grant Universities, National Association of Manufacturers, National Center for Manufacturing Science, US Chamber of Commerce
AMP Top Line Recommendations

- Improving the business climate
- Securing the talent pipeline
- Enabling innovation
Meta-roadmapping
Manufacturing Related Roadmap Documents

- 2006: 3
- 2007: 9
- 2008: 10
- 2009: 9
- 2010: 9
- 2011: 5
Meta-Roadmapping

- Cross cutting issues, e.g., technology, workforce readiness, infrastructure, etc. independent of industry sectors
- MaRC working with EI2, and Industrial & Systems Engineering
Big M Manufacturing
Community Building
Education and Outreach
Industry Partnership
Translational RD&D

MFG @ GT
Manufacturing Innovation Leaders

- A skilled workforce is necessary, but not sufficient for long-term sustainability
- Innovation-driven manufacturing economy
- Cultivating the next generation of manufacturing innovation leaders
- Working with Sciences, GTRI and GA public school system
Developing a New Model for the National Manufacturing Extension Partnership (MEP)

- Generation 1 MEP – process improvement and training, e.g., troubleshooting, ISO 9000, lean production, etc. for small and medium-sized enterprises (SMEs)
- National MEP is changing its focus – innovation-centric, e.g., new product introduction, new metrics...
- Matching the needs of SMEs for innovation with Georgia Tech’s senior design classes
- Benefits to stakeholders
- A brand new model for the national MEP
MFG @ GT

Big M Manufacturing

Community Building

Education and Outreach

Industry Partnership

Translational RD&D
Our Core Value

- Industry-friendly, customer-focused
- “Georgia Tech is responsive to our needs”
- “Georgia Tech adds value to our business in a unique way that can’t be found anywhere else”
MFG @ GT

- Big M Manufacturing
- Community Building
- Education and Outreach
- Industry Partnership
- Translational RD&D
Value of Translational Research

What is the value of your research in to this so called “Theory of Electricity”? 

One day Sir, -- you will be able to Tax it!

Source: Wiki Commons
The US has been the first mover of many new technologies but lost considerable market
The payoffs from Federal investments in basic research have not been fully captured by the U.S. industry
Starved innovation hopper

Scholarly papers
Patent disclosures
Award patents
Licensing deals
Royalty income
Capturing Innovation Value

- Scholarly papers
- Patent disclosures
- Award patents
- Licensing deals
- Royalty income

More impact

More impact
Commercialization of Knowledge

Academia

Producers of knowledge

Users of knowledge

Industry

Translators of knowledge

TRL 1
Basic principle observed

TRL 2
App concept formulated

TRL 3
Concept proved

TRL 4
Breadboard validation in lab

TRL 5
Breadboard validation in relevant environ.

TRL 6
Prototype demo in relevant environ

TRL 7
Prototype demo in operational environ

TRL 8
System qualified

TRL 9
Mission proven
What’s Happening Now

Academia

???

Industry

TRL 1: Basic principle observed
TRL 2: App concept formulated
TRL 3: Concept proved
TRL 4: Breadboard validation in lab
TRL 5: Prototype demo in relevant environ.
TRL 6: System qualified
TRL 7: Mission proven
The Innovation Chain Is Broken

Relationship to Technology Readiness Levels

- **TRL 8**: System Qual
- **TRL 7**: Prototype in Ops Environment
- **TRL 6**: Prototype in Rep Environment
- **TRL 5**: Breadboard in Rep Environment
- **TRL 4**: Breadboard in Lab
- **TRL 3**: Proof of Concept
- **TRL 2**: Concept Formulation
- **TRL 1**: Basic Principles Observed

Relationship to System Acquisition Milestones

- **Pre-Concept Refinement**
  - **MRL 3**: Mfg Concepts Identified
  - **MRL 4**: Manufacturing Processes in lab Environment
  - **MRL 5**: Components In Production Relevant Environment
  - **MRL 6**: System or Subsystem In Production Relevant Environment
  - **MRL 7**: Pilot Line Demonstrated Ready for LRIP
  - **MRL 8**: System or Subsystem In Production Representative Environment
  - **MRL 9**: LRIP Demonstrated Ready for FRP
  - **MRL 10**: FRP Demonstrated Lean Production Practices in place

Valley of death

Low       Attention Level       High
golden opportunity for translational research
Collaboratory = Collaborative Laboratory or Collaborative Factory
Concept of Collaboratory

- Co-location of academic, industry and government experts to cross the “valley of death”
- Teams of (technology + business) professionals to rapidly insert new technologies of compelling business case
- Companies collaborate on production scale-up (TRL/MRL 4-6); compete on product design, supply chain and post-sale services
A Collaboratory Is...

- A breeding ground for innovative ideas
- A proving ground for disruptive technologies
- A training ground for a skilled workforce and future manufacturing leaders
A Major Initiative

Big M Manufacturing of small m materials
Ultra-lightweight engineered systems will be ubiquitous

**Land vehicles**

**Infrastructure**

**Alternative energy**

**Aerospace**

**Sporting goods**
Most improvements in performance and value of future engineered systems will come from nanomaterials.
Beyond carbon fibers...
From Micro Carbon Fiber Technology
To Nano Carbon Tube Technology
Turning a national crisis into a manufacturing renaissance