Point #1

Manufacturing should be a national imperative for every country
MFG 2.0 – revolutionary changes are happening (technology, policy, education, workforce development,...)
IE should be on the forefront of a new manufacturing renaissance
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

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

Stakeholders

Big “M” Manufacturing

Enablers

Tech.  Policy  Infrast.  Education
Supply chain
Why Manufacturing Matters
Wealth creation

U.S. Exports

- Mfg Goods: 70%
- Non-Mfg: 30%
Economic multiplier effects

$1 investment
In manufacturing

$2.48 economic activity
Manufacturing drives innovation

U.S. Patents

Mfg Industry 90%

Non-Mfg 10%
Point #2

MFG 2.0 – revolutionary changes are happening
Advanced Manufacturing Partnership

“Our first priority is making America a magnet for new jobs and manufacturing.”
President Barack Obama February 12, 2013
Advanced Manufacturing Partnership
Steering Committee (6/2011 – 7/2012)

CMU,
Georgia Tech,
Michigan,
MIT,
Stanford,
UC Berkeley

Allegheny Technologies, Caterpillar, Corning, Dow, Ford, Honeywell, Johnson & Johnson, Intel, Northrop Grumman, P&G, Stryker, UTC
AMP 2.0

- FOCUS: build on the 2012 AMP report and focus on implementation

- 5 WORKING TEAMS
  1. Implementing demand-driven workforce solutions for a workforce of lifetime learners
  2. Creating a policy environment that supports technology scale-up
  3. Ensuring that the National Network for Manufacturing Innovation (NNMI) is successful
  4. Identifying, prioritizing and starting work on transformative technologies
  5. Improving the image of manufacturing
### National Network of Mfg Innovation

#### Actionable recommendations

<table>
<thead>
<tr>
<th>Technology</th>
<th>Funding Agency</th>
<th>Location</th>
<th>Total Funding</th>
</tr>
</thead>
<tbody>
<tr>
<td>Additive mfg</td>
<td>DOD/2012</td>
<td>Ohio</td>
<td>$50M + $50M</td>
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<tr>
<td>Power electronics</td>
<td>DOE/2013</td>
<td>N. Carolina</td>
<td>$70M + $70M</td>
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<tr>
<td>Lightwgt metals</td>
<td>DOD/2013</td>
<td>Michigan</td>
<td>$70M + $78M</td>
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<tr>
<td>Digital mfg</td>
<td>DOD/2013</td>
<td>Illinois</td>
<td>$70M + $250M</td>
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<tr>
<td>Lightwgt comp</td>
<td>DOE/2014</td>
<td>On-going</td>
<td>$70M + $70M</td>
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<tr>
<td>TBD</td>
<td>DOE/2014</td>
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<td>DOD/2014</td>
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<tr>
<td>Future ones</td>
<td></td>
<td></td>
<td>Up to 15/45</td>
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</table>
REPORT TO THE PRESIDENT ON
CAPTURING DOMESTIC
COMPETITIVE ADVANTAGE IN
ADVANCED MANUFACTURING

Executive Office of the President
President’s Council of Advisors on
Science and Technology

JULY 2012
2013

Global Manufacturing Competitiveness Index
2014: MANUFACTURING’S NEW MOMENTUM
Three topics to be discussed here

- Nanotechnology
- Additive manufacturing
- Regenerative medicine
IE should be leading the charge for a manufacturing renaissance
Nanotechnology: size matters
Carbon nanotubes’ amazing properties

- Strongest fiber ever been made
- Electrical conductivity of copper or silicon
- Thermal conductivity higher than that of diamond

Dr. Richard Smalley, 1996 Nobel Laureate

Can These Properties Be Realized In Bulk Materials?
How do we make nanotubes useable in an open production environment?
Scalable, continuous production of rolls of nanotube membrane
Topics requiring serious IE research

- Processing-structure-property modeling
- Optimization of nanocomposite manufacturing
- Safety and health issues
3D printing: from art to part

Computer Aided Design
Files & Metal Powder

Printed Metal Machine & Process

Post-Processing
Additive Manufacturing

Plastics  Metals  Ceramics  Printed electronics

Laser, electron beam, ultra-sound, etc.
3D metal printing applications

- Aerospace
- Automotive
- Medical
- Repair & Maintenance
SO, WITH THIS AMAZING NEW TECHNOLOGY WHAT ARE YOU PRINTING FOR US TODAY?

WELL I'M ACTUALLY PRINTING ANOTHER 3D PRINTER!

(Credit: Blake Stevenson)
Topics requiring serious IE research

- On-demand manufacturing: impact on supply chain management theories and principles
- Design for additive manufacturing
- A whole new industry sector of additive manufacturing machine tools
Regenerative medicine

Stem cell engineering
Current and future stem cells are not the same as those in the 1960’s

- Embryonic stem cells (SCs) are one category of stem cells
- They can come from your own body (autologous vs allogeneic) to cure your own illness
- Currently, lab cultures of SCs are all done manually – variability, low yield, contamination, etc.
- First-time yield is crucial
- Full-scale automated production of controlled growth of SCs is goal
Stem Cell Biology

- Isolation

Stem Cell Engineering

- Manufacturing of diagnostic platforms & regenerative therapies from stem cells
- Efficient, scalable & robust technologies

Stem Cell Applications

- Diagnostics
- Drug Discovery & Pharmaceuticals
- Tissue Repair

Pluripotent

Multipotent

Unipotent

Reprogramming

http://stemcelligert.gatech.edu
Many challenges for cell manufacturing

- Scalable production technologies $\sim 10^9$ range
- Characterization of cells and cell derivatives
- Cost of cell products
- Readiness of the supplier base
- Workforce needs
- Regulatory pipeline
Topics requiring serious IE research

- Scaling up cell culture and expansion
- Process design, monitoring and control
- Logistics and supply chain management for special handling and storage: regulatory, perishable, zero-contamination, 1st time yield, ...

- From stem cell biology to stem cell engineering to stem cell benefits
Mfg. innovation eco-system

Stakeholders

Big “M” Manufacturing

Enablers

Supply chain
ANNOUNCEMENT

Discussion Panel Scheduled for
3:30PM – 4:45PM, June 2, 2014
IIE Conference, Montreal CANADA