The Digital Manufacturing and Design Innovation Institute (DMDII)

Overview

Indiana Road Show
July 30, 2015
"If you went to bed last night as an industrial company, you're going to wake up today as a software and analytics company. The Change is happening in front of us."

Jeff Immelt, Chairman and CEO of General Electric
What is DMDII?

- One of the Institutes for Manufacturing Innovation (IMI) established as part of National Network for Manufacturing Innovation (NNMI)
- Set up under parent organization - UI Labs 501c(3) non-profit organization
- A public-private partnership created to foster development and implementation of digital manufacturing technology to US industry to accomplish goals that neither industry, academia nor government can accomplish on its own
- Leverage best research and technology in the country to deploy solutions on a broad scale
  - Focused on TRL 4-7 - Addresses the market failure of industry underinvestment in “pre-competitive” applied R&D.
- Established through 5-year cooperative agreement w/$70M in federal government funding + over $250M in matching funding from industry, academia, local govt, community partners
- **DOD is primary federal sponsor; U.S. Army executing Program Management for DMDII**
FACILITY – The Future Today

Operating on Goose Island Facility in Chicago, IL

94,000 square feet facility – home to the digital manufacturing lab, instructional & meeting space, + traditional office

- 24,000 ft manufacturing floor with $3.5 million in consigned equipment;
- 7 Manufacturing Cells designed to develop and demonstrate different types of manufacturing technologies and processes all in an integrated environment.
Inside the Demonstration Test Facility

Cell #1 – Multi-Axis High End Machining
Cell #2 – Traditional/Legacy Standard Machining
Cell #3 – Additive
Cell #4 – Metrology Room
Cell #5 – Welding & Fabrication
Cell #6 – Micro Machining
Cell #7 – Electronics
Tool Crib – Auto Tool Pre-setter

Zeiss CMM & Software
DMG NHX6300
DMG NZ2000 T3Y3
Wolf Robot Cell
Haas ST-10 Lathe
Haas ST-30 Lathe
Haas VF-2 3-Axis VMC
Haas VF-5/50 3-Axis VMC
Haas UMC-750 5-Axis
Haas OM-2A Micro Mill
Haas TM-2 Tool Room Mill
The application of computing and data analytics to improve manufacturing across the product lifecycle.
What are DMDII’s 3 Principal Missions?

1. **R&D projects:** Push envelope for digital manufacturing & design
   
   **$50 Million Projects Funded (Cost Share + DMDII Funds) end of 2015**

2. **Outreach:** To Thousands of SME’s

3. **Workforce development** to educate employees in digital technologies
   
   **Over 600,000 OPEN jobs in Manufacturing**
Challenge: US losing leadership in manufacturing

ISSUE: Economy, Jobs, and future competitiveness
- When U.S. loses manufacturing base in advanced technology products, we lose ability to innovate on next generation of those products

U.S. Trade Balance for Advanced Technology Products

Source: Census Bureau
The “Scale-up” Gap or Missing Middle

The Need – Create the space for industry and academia to work on industry-relevant problems

- Government investment in private-sector led partnerships
- Addresses the market failure of industry underinvestment in “pre-competitive” applied R&D
- Focus on “de-risking” new technologies and materials to scale-up for U.S. manufacturers

Basic R&D

Commercialization
What forces are driving the digitization of manufacturing operations?

<table>
<thead>
<tr>
<th>Challenges</th>
<th>Opportunities</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Separation of designers and makers has slowed innovation</td>
<td>• Digital link between designers and makers</td>
</tr>
<tr>
<td>• Barriers for sharing data and information including: technology, skills, incentives, security, trust, IP, standards</td>
<td>• Digital connections to physical assets, machines, factories, and supply chains</td>
</tr>
<tr>
<td>• Increasing cost of labor globally, skills gap</td>
<td>• Decreasing cost due to data aggregation and analysis, do more with existing resources</td>
</tr>
</tbody>
</table>
Despite the recognition of importance most organizations feel they lack the necessary capabilities

Participants indicating digital ops is a critical driver of future competitiveness

Organizations with "high" digital capability today

SOURCE: DMDII workshop, May 2014
What is “Digital Manufacturing”?  

*Digital Manufacturing is an integrated suite of tools that work with product definition data to support tool design, manufacturing process design, visualization, modeling and simulation, data analytics, and other analyses necessary to optimize the manufacturing process” – CIMData (modified)*
What are the Institute’s Goals?

*Use the technology portfolio to:*
- Demonstrate and apply digital manufacturing technologies
- Accelerate these technologies to market
  - Digital links between design and fabrication
  - Connected machines, factories, and supply chains
  - Transparency into supplier factories
  - Data aggregation, analysis, and action across the product lifecycle
  - Leverage the power of data analytics and networks to do more with existing resources

*Increase the competitiveness of American manufacturing firms*
TECHNOLOGY FOCUS AREAS

ADVANCED MANUFACTURING ENTERPRISE (AME)

Information systems integration throughout the product lifecycle.

Digital links between design and fabrication.

Smart factory and supply chain management.

INTELLIGENT MACHINING (IM)

Integration of smart sensors and controls to enable equipment to automatically sense and understand current production environment in order to conduct “self-aware manufacturing.”

ADVANCED ANALYSIS (AA)

Utilization of high performance computing to model materials, products and processes to enable “design with manufacturing in mind.”

OPEN SOURCE PLATFORM

DIGITAL MANUFACTURING COMMONS

An open source software platform that enables data aggregation, analysis, and action.

CYBER PHYSICAL SECURITY

Meet industry and national needs for security, trust, and IP protection within the manufacturing environment.
Project Calls to Date

- 3 project calls released
- 12 project subject areas addressed
- 25-51 projects anticipated from these efforts

<table>
<thead>
<tr>
<th>AVM</th>
<th>DMDII-14-01</th>
<th>DMDII-14-02</th>
<th>2-8 projects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core</td>
<td>DMDII-14-06</td>
<td>DMDII-14-07</td>
<td>DMDII-14-08</td>
</tr>
</tbody>
</table>

**DMDII Internal Project**

*Digital Manufacturing Commons (online collaboration platform) 15Q1*

Quickly brings to life DMDII approach to value creation
## 2014 Project Calls

<table>
<thead>
<tr>
<th>Advanced Manufacturing Enterprise</th>
<th>AVM DMDII14-01 and DMDII14-02</th>
</tr>
</thead>
<tbody>
<tr>
<td>Information systems integration throughout the product lifecycle.</td>
<td>Transition of technologies from DARPA AVM program. Focus on improving a manufactured product or manufacturing process.</td>
</tr>
<tr>
<td>Digital links between design and fabrication.</td>
<td><strong>AME DMDII14-06</strong></td>
</tr>
<tr>
<td>Smart factory and supply chain management.</td>
<td>Model-based engineering principles and infrastructure.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Intelligent Machines</th>
<th>IM DMDII14-07</th>
</tr>
</thead>
<tbody>
<tr>
<td>Integration of smart sensors and controls to enable equipment to automatically sense and understand current production environment in order to conduct “self-aware manufacturing”.</td>
<td>Geometric adaptive machining.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Advanced Analysis</th>
<th>AA DMDII14-08</th>
</tr>
</thead>
<tbody>
<tr>
<td>Computing to model materials, products and processes to enable “design with manufacturing in mind”.</td>
<td>Integrated design and manufacturing models with metrology.</td>
</tr>
</tbody>
</table>
2015 Strategic Investment Plan

Advanced Manufacturing Enterprise
- Information systems integration throughout the product lifecycle
- Digital links between design and fabrication
- Smart factory and supply chain management.

AME1 Systems design using the digital thread
AME2 Smart factory visibility and real-time optimization
AME3 End to end supply network integration
AME4 Full system integration of the digital fabric
AME5 Completing the model based definition
AME6 Gap in SME engagement in digital manufacturing

Intelligent Machines
- Integration of smart sensors and controls to enable equipment to automatically sense and understand current production environment in order to conduct “self-aware manufacturing”

IM1 Communication standards for intelligent machines
IM2 Cybersecurity for intelligent machines
IM3 Operating system for cyber physical manufacturing
IM4 Intelligent machine toolkit

Advanced Analysis
- Computing to model materials, products and processes to enable “design with manufacturing in mind”.

AA1 Agile manufacturing to compensate for production variability
AA2 Shop floor augmented reality and wearable computing
AA3 Virtually guided certification

Red = 2015Q1 Project Call
Current Projects

DMDII 15-01
Factory Infrastructure Cybersecurity Assessment

Key Idea: Protecting the operational systems of a manufacturing organization presents a different set of challenges from protecting enterprise IT systems and networks.

This project has specific objectives:

- Identify minimum capabilities that satisfy DFARS requirements (252.204-7012) for incorporating information security measures in a typical industry setting
- Estimation of the costs to reach and maintain those DFARS-compliant capabilities
- Develop and test a vulnerability assessment tool
Current Projects

**DMDII 15-02**
Smart Factory Visibility and Real Time Optimization

Key Idea: Aggregate and analyze process data within a factory in order to make real-time decisions that improve factory operations, and to make this data available to factory operators and to other parts of the value chain.

**DMDII 15-03**
Communication Standards for Intelligent Machines

Key Idea: Apply standards and demonstrate plug-and-play digital integration that enables machine tool data collection, transfer and analysis. Significantly reduce the cost and complexity of machine tool digital integration. The ultimate goal is a smart factory that has full systems integration of hardware, software, and data.

**DMDII 15-04**
Shop Floor Augmented Reality

Key Idea: Integrate the manufacturing workforce with the digital thread. Capture product and process data. Capture and share manufacturing knowledge.
Current Projects

**DMDII 15-05**
Systems Design using the Digital Thread

**Key Idea:** Demonstrate technologies that can use data from across the product lifecycle and from across the value chain to improve product design and manufacturing.

**DMDII 15-06**
Operating System for Cyberphysical Manufacturing

**Key Idea:** Demonstrate an operating system for manufacturing that provides both horizontal and vertical resource management from the lowest hardware to the highest enterprise level.

**DMDII 15-07**
Virtually Guided Certification

**Key Idea:** Demonstrate technologies that use advanced computing, modeling and simulation, and data analysis to significantly reduce the time and cost of certifying a material, manufacturing process or design.
Project Funding Summary

Projected Project Funding (Cost Share + DMDII Funds) = $54,800,000
Project Call Status

AVM
- Proj. Call Released
- Eval. Board
- Req. Gov Approval
- Gov. Approved
- Projected Kick Offs

CORE
- Proj. Call Released
- Eval. Board
- Req. Gov Approval
- Gov. Approve
- Projected Kick Offs

Jan 2015 #1
- Proj. Call Released
- Work-SHOP
- Eval. Board
- Cost Proposal
- Req. Gov Approval
- Projected Kick Offs

Jan 2015 #2
- Proj. Call Released
- Work-SHOP
- Eval. Board
- Cost Proposal
- Req. Gov Approval
- Projected Kick Offs

Cyber Sec.
- Proj. Call Released
- Eval. Board
- Cost Proposal
- Req. Gov Approval
- Projected Kick Offs

Approved for Public Release
Project Call Process Overview

1. Project Call
2. Workshop
3. White Paper
4. Evaluation Board
5. Project Awarded
6. Government Approval
7. Cost Proposal
8. Project Kickoff

Approved for Public Release
RFP Documents

- **Project Planning Document (PPD)**
  - Project Summary, Submission Information, Requirements, Background

- **Proposal Preparation Kit (PPK)**
  - Project Call Process Overview
  - White Paper & Cost Proposal Submittal, Evaluation, and Award
  - Instructions for White Paper and Cost Proposal Preparation
  - Resumes, Letters of Commitment (Stage 1)
  - SOW, Reps & Certs, IP Management Plan, Technical Data/IP Disclosure and Assertion Form (Stage 2)
Evaluation Process

- Participants selected from industry, academia and govt.
- Subject Matter Experts provide technical assessments
- Evaluators conduct individual assessments and submit resulting scores and comments
- Results aggregated, meeting convened, consensus established
- Recommendations pushed forward (*incl. request for clarifications*)
- Proposals selected for formal Cost Proposal submittal

<table>
<thead>
<tr>
<th>Evaluation Criteria</th>
<th>Points Available</th>
</tr>
</thead>
<tbody>
<tr>
<td>Problem Statement and DMDII Relevance</td>
<td>0-15 Points</td>
</tr>
<tr>
<td>Methodology</td>
<td>0-25 Points</td>
</tr>
<tr>
<td>Innovation</td>
<td>0-10 Points</td>
</tr>
<tr>
<td>Program Management Plan</td>
<td>0-15 Points</td>
</tr>
<tr>
<td>Technology Transition and Impact to Industrial Base</td>
<td>0-10 Points</td>
</tr>
<tr>
<td>Workforce Development and Education</td>
<td>0-5 Points</td>
</tr>
<tr>
<td>Team Qualifications</td>
<td>0-10 Points</td>
</tr>
<tr>
<td>Cost Factors</td>
<td>0-10 Points</td>
</tr>
<tr>
<td><strong>Total Points Possible</strong></td>
<td><strong>100 Points</strong></td>
</tr>
</tbody>
</table>
Membership Model

• Open membership model to U.S. registered entities. Encourages widespread participation of industry, non-profit organizations, government and academic institutions;

• Three categories of membership with 4 Tiers:
  - Industry
  - Academic/Non-Profit
  - State/Local governments

• Membership not offered to individuals

• Also open to affiliates and subsidiaries of foreign-based companies...IF the entity was incorporated under the laws of one of the 50 U.S. states

• No specific technical qualifications or other obstacles to membership

• Benefits correspond to financial commitment
Membership Model

Three tiers of Industry Partners:

**Tier 1 Industry** = $5 Million over 5 years ($2M cash & $3M R&D cost-share)

**Benefits:**
- Seats on Exec. Committee and Technical Advisory Committee
- Royalty-free access to IP from *all projects* for internal R&D & operations
- Government funds significant portion of R&D Projects

**Tier 2 Industry** = $1 million over 5 years (or $200k unrestricted cash per year)

**Benefits:**
- Representation on Exec. Committee plus seat on and Tech. Advisory Committee
- Royalty-free access to IP from *all projects* for *internal R&D only*
- Government funds significant portion of R&D Projects
**Membership Model**

**Tier 3 Industry** = $2,500 over 5 years ($500 membership fee per year)

**Benefits:**

- Representation on Exec. Committee and Technical Advisory Committee
- Participation on R&D projects
- Networking with Industry and Academic Partners
- Access to the DMC – Digital Manufacturing Common
- Access to Workforce Development programs
Membership Model
Academic/Nonprofit Partners

**Tier 1**

$5 million in cost-share over 5 years, which can be fulfilled with R&D project cost-share or with capacity building expenditures on campus

  Seat on EC and TAC

**Tier 2**

$2 million over five years.

  Representation on EC and TAC

**Tier 3**

$1 million over 5 years

  Representation on EC and TAC

**Tier 4**

$500 per year in membership fee.

  Prohibited from participating in R&D projects