Overview of ManufacturingHUB and the Federal Manufacturing Initiative

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ManufacturingHUB.org

• Spun out of Purdue nanoHUB.org at urging of White House Office of Science and Technology Policy
ManufacturingHUB

• Created for NDEMC – National Digital Engineering and Manufacturing Consortium
• Public, private, academic partnership to reduce barriers to small- and medium-sized enterprise (SME) use of simulation and high-performance computing
• Mar. 2, 2011 – NDEMC MOU signed at White House
  – NEC, OSTP, EDA, NIST, DoE, NASA, NSF
  – P&G, Lockheed Martin, Deere, GE
  – Ohio Board of Regents, Purdue University
• NDEMC can be viewed as a small pilot to the National Network for Manufacturing Innovation (NNMI)

ManufacturingHUB.org

Access to high-performance computing via Apps that run in the Browser
Example: OpenFOAM®, simply

Manifold flow analysis using OpenFOAM before ManufacturingHUB.org

1. Place the STL file in the constant/triSurface directory within the parent directory where simulation must be run.
2. Determine bounding box vertices for the manifold geometry and enter this information into blockmeshDict in /constant/polymesh/
3. Follow guidelines in the HELP menu for Particle Tracking.
4. Select where particles will be released into the flow.
5. Decide the number of particles and mass, rebound, and other effects.

Leveraging VizSpace for rapid impact

VizSpace: Business opportunities automatically matched to SME capabilities

- Announced by President Obama June 24, 2011
- Manufacturing and Materials components
  - NNMI and Manufacturing Demonstration Facilities
  - Materials Genome Initiative

- Pilot NNMI Center launched in August 2012
  - NAMII – focused on additive manufacturing w/ metal
  - Youngstown, OH
  - ~ $35 million federal + 1:1 match for 3 years

- Pilot MDF at Oak Ridge Natl Lab – composites
From the Materials Genome Initiative White paper section on Materials Innovation Infrastructure on page 9:

the pace of innovation, which currently occurs in isolated academic settings. An existing system that is a good example of a first step toward open innovation is the nanoHUB, a National Science Foundation program run through the Network for Computational

their data. nanoHUB.org supports the use of computational tools in nanotechnology research. Researchers can access state-of-the-art modeling algorithms and collaborate with colleagues via the website. To rapidly increase knowledge of first principles and advance

NNMI Vision

• Up to 15, linked, regional institutes each with a unique technical focus
• Common approach by Institutes to
  – infrastructure
  – intellectual property
  – contract research
  – and performance metrics
• MDFs support via access to advanced facilities
• Fraunhofer Institute - like
NNMI for the **Missing Middle**

- **Bidirectionally link** national lab and university research investments and expertise with private sector expertise and commercialization investments, TRL 4-7 focus

- **Innovation** (à la Bell Labs)
  - Interdisciplinary; **experts**; critical mass;
    - technically savvy management;
    - mix of near, medium, and long term projects;
    - then make it and deploy it in quantity

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**Positioning of NNMI Centers**

![Diagram showing positioning of NNMI Centers]

Involved (funding) federal agencies: Dept. of Edu, Dept. of Commerce, DoD, NSF, NASA, DoE
NNMI Positioning (cont.)

- **Co-invest** $$$ + existing resources by academia, industry, professional societies, foundations, and gov’t
- **Collaborate** to innovate and commercialize
- **Build** **workforce skills**
- **Showcase + Deploy** new capabilities, processes, products
- **Advance** **domestic** manufacturing

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**Funding Opportunity Illustration**

![Chart](chart.png)

**Notional Spending Plan – Federal Funds**

- Federal Funds: $70-120 million, over 5-7 years

**Categories:**
- Equipment, especially in first years
- Startup, administrative costs
- Base project grants, commitment with funded proposal
- Competitive project grants, allows a gate system to reward performance

Institute investment of federal-only funds (does not illustrate matching funds or other revenue streams)
Purdue & Indiana Strengths

- Purdue research results (TRL 3-4) leadership in relevant areas
- Strong Colleges of Engineering and Technology
- Manufacturing orientation of Krannert School of Mgmt
- 4 statewide business incubator sites (PRF)
- IvyTech – Indiana’s unified community college system
- Manufacturing, logistics are major Indiana economic sectors
- Located adjacent to IL, OH, MI, KY (strong partners)
- Purdue HUBzero cyberinfrastructure
- World-class land-grant universities in the Midwest
More Purdue Strengths

• TAP and MEP
• IN-MaC effort
• Purdue participation in NDEMC

Summary

• Federal Manufacturing Initiative represents a sea-change in opportunity for universities

• Gain insight into direction for NNMI by watching the play-out at NAMII
• Build partnerships inside/outside Indiana
• Line up match $$$
• Focus on how to deliver results with SMEs and for domestic manufacturing
**Proposed NNMI Selection Criteria**

- Technology focus – critical nat’l need/opportunity
- RD&D plan – the transition to industry use
- Broad impacts
- Partner resources – personnel, facilities
- Co-investments; amount and sustainability
- Financial plan
- Business model
- Education and workforce development plan
- Adequacy of governance and oversight

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**Proposed NNMI Performance Metrics**

- Number of partnerships
- IP portfolio size; # of IP licenses; domestic impact
- Retention rate for Institute members; openness to new members
- Participation of SMEs
- Industry $$ received; focus on industry needs
- # projects moved from TRL 5 to TRL8
- Workforce skill development
- Linkages with all other NNMI centers
- Etc. – reviewed annually
NNMI Funding Opportunities

- [my opinion] Some topic areas may be difficult to scale up to the federal support maximum
- Via NDEMC, on 3 centers this FY
  - 2 primarily DoD $$$ with likely foci
    - The Advanced Manufacturing Enterprise, and one of
    - Composites, Wide Bandgap Materials, or Materials Joining
  - 1 primarily DoE $$$ with focus perhaps on
    - Light-weighting for Transportation Applications

Other Opportunities

- Via NDEMC, grow our participation in the NNMI network of centers as a provider of non-commercial simulation services

- Propose an NNMI focused on Pharmaceutical and Food Manufacturing
  - if FDA joins the set of NNMI federal agencies
Timelines

- **NNMI**
  - 3 centers initiated in FY 2013; foci probably set
  - [my guess] ~3 centers per FY subsequently
  - Future foci may come from proposer making the case

- **Proposers, now and over the next year**
  - Communicate ideas with agency personnel for feedback
  - Build collaborations and consortia
  - Assemble match $$$ commitments
  - Plan Showcase and Deploy sequences with SMEs

**How does the platform work?**
Open source HUBzero® platform

- Standard web server of LINUX, Apache, MySQL, PHP (LAMP)
- Content Database
- Physical Machine
- Virtual Machine
- Simulation tool session
- Cluster computer
- Rendering farm

High-performance Computing Resources

Open-source HUBzero®

Simulate

Rappture: Rapid Application Infrastructure

- Simulation Code
- Scientist
- Works with your favorite programming language
- Open Source
- Online at http://rappture.org

Rappture

MATLAB®

F77

C

Perl

Ruby
Hundreds of simulation apps online at nanoHUB.org
more added daily

Simplified simulation for SME partners
nanoHUB.org example
PADRE electronic device simulator

PADRE input deck – LENGTHY, FRAGILE
Focus on one use, fewer inputs, visual guidance, in browser, guaranteed valid input deck

Impact of Apps built on PADRE

PADRE used directly via input deck

MOSFET
3,996 users
76 classes
4 cites

MuGFET
582 Users
5 cites

MOSCap
3,681 users
45 classes
1 cite

PN junction
6,546 users
113 classes

BJT
1,931 users
38 classes

Drift-Diffusion
2,209 users
17 classes

6 Apps quickly built on a good simulation engine and cheaply web-deployed yields:

18,945 users
289 classrooms
10 citations

Apps grow community fast (~ 10x)

Data from nanoHUB.org
Mhub example: OpenFOAM®, simply

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