

# Investing in U.S Innovation Ecosystem

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Executive Director, MForesight: Alliance for Manufacturing Foresight  
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NSF EDSE Workshop – Purdue University, Oct 07, 2019

# About MForeSight

[MForeSight.org](http://MForeSight.org)

A federally-funded (NSF and NIST), independent national consortium (think-and-do tank) on emerging technologies and advanced manufacturing with a singular focus on enhancing U.S manufacturing competitiveness

# MForesight Leadership Council

## Industry



## Nonprofits



## Academia



## Convene diverse stakeholders

Conduct “game-changing ideas” events, deep-dive workshops and expert interviews.  
 Access to over 40,000 subject matter experts

## Develop Actionable Recommendations

- R&D Priorities
- Implementation challenges
- Related policies



Over 2000 participants from 38 states (2017-18), ~60,000 report downloads

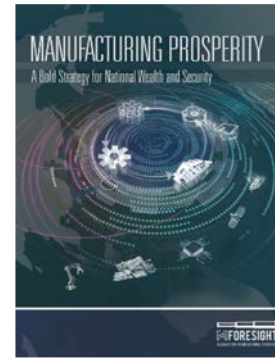
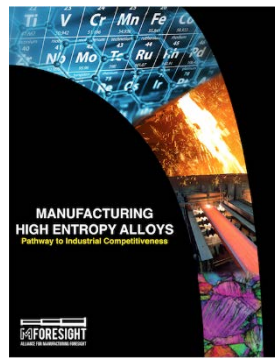
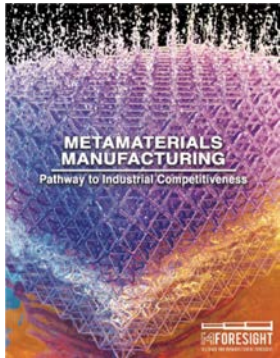
## Disseminate

Serve as a continuous source of intelligence to Federal agencies, Capitol Hill, the White House, Private sector, and Academia

## Publish Reports, Blog-posts and Community Highlights



# Accelerating Technology & Manufacturing Innovation



Metamaterials Manufacturing

Biomanufacturing: Regenerative Medicine

Manufacturing High Entropy Alloys

From Making to Manufacturing

Manufacturing Prosperity

Education and Skills Building

Next Generation Supply Chains

Cybersecurity for Manufacturers

Ideas worth scaling



Challenges worth addressing

Basic Research

Translational R&D

Applied R&D

Full Volume Manufacturing

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## U.S. Technological Innovation in *hardware*

- Scientific Discovery
- Engineering Invention
- Technological Innovation

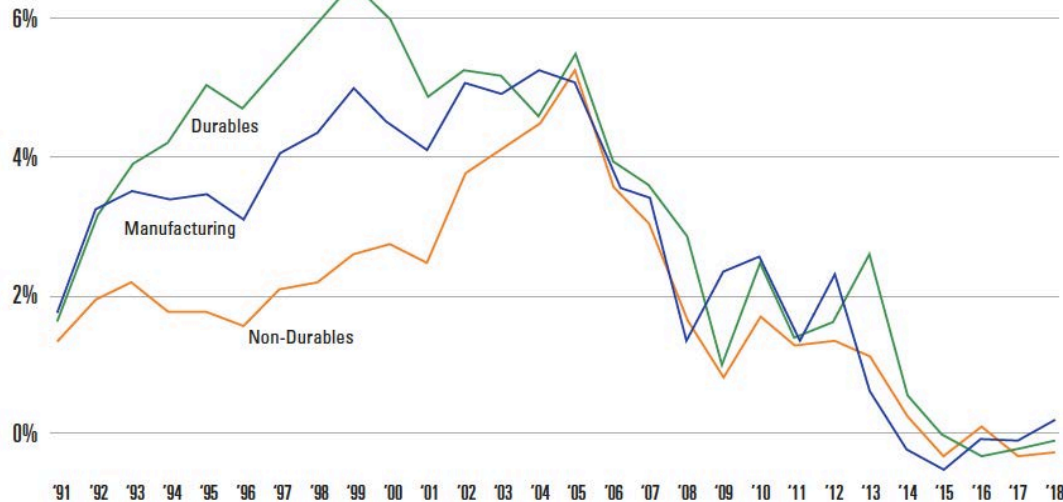
### **Industrial Commons**

– engineering skills, production know-how, infrastructure and supply chains



Contrary to popular reports of a strengthening manufacturing sector, ...

## Dramatic Decline in Manufacturing Productivity Growth



6 million jobs lost; 65,000 mfg facilities shut down between 2001 and 2010

Source: Bureau of Labor Statistics

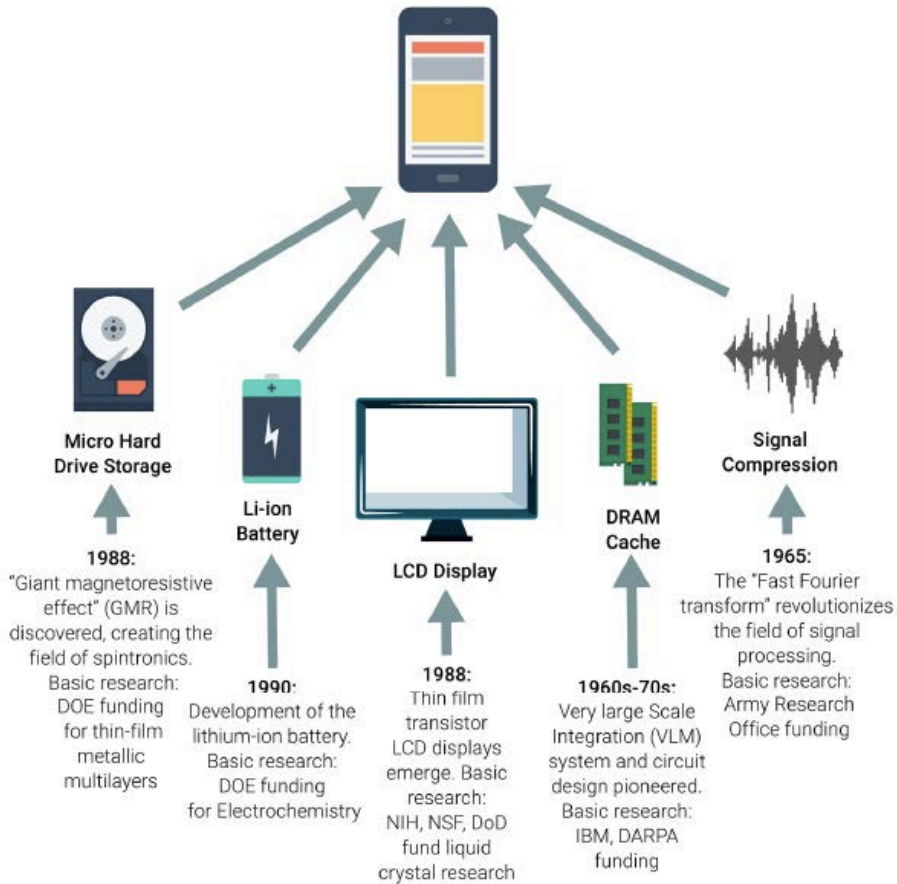
Robots and automation had almost nothing to do with job losses

Between 2006 and 2016, some of the largest reductions in output were in advanced industries:

pharmaceuticals	↓	3.1 percent,
industrial machinery	↓	2.9 percent,
communications equip	↓	2.5 percent
computers & peripherals	↓	2.3 percent.

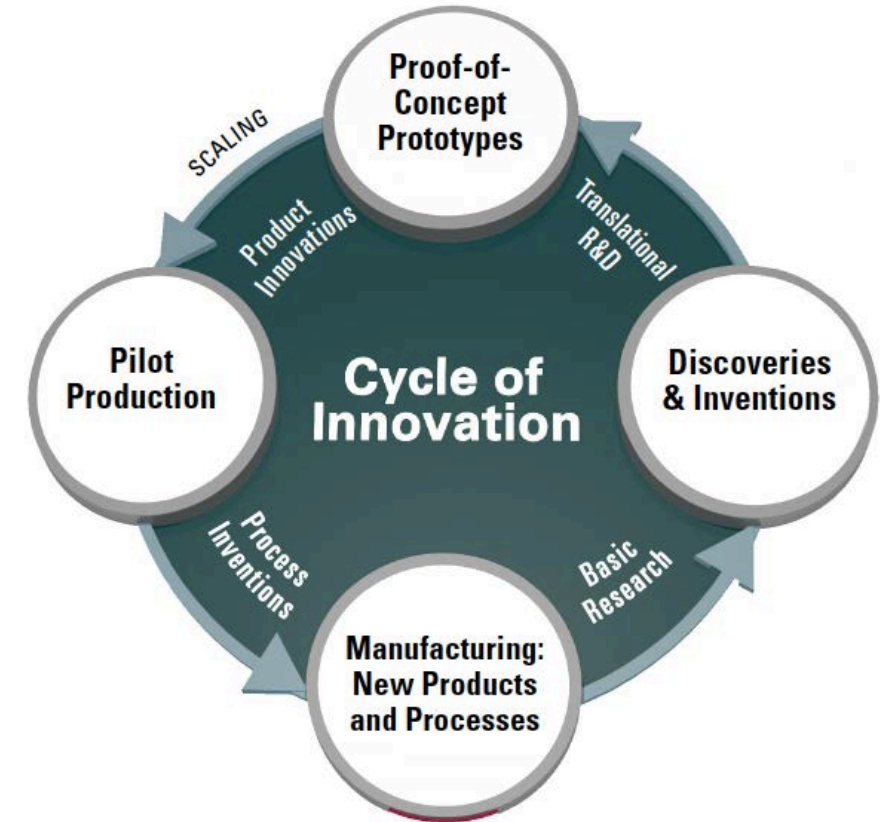
Imports increased in all of these industries

# Invent Here, Make There: Creating Knowledge, Not *National Wealth*



Federal government invests ~\$150 billion a year in S&T

~\$900 billion in mfg trade deficit; over \$100 deficit in Advanced Technology Products + major challenges in national security



Underlying research funded by the federal govt.

*Leading the world in R&D is little comfort if we are simply subsidizing it for other countries*



# ***Production in Innovation Economy Study***

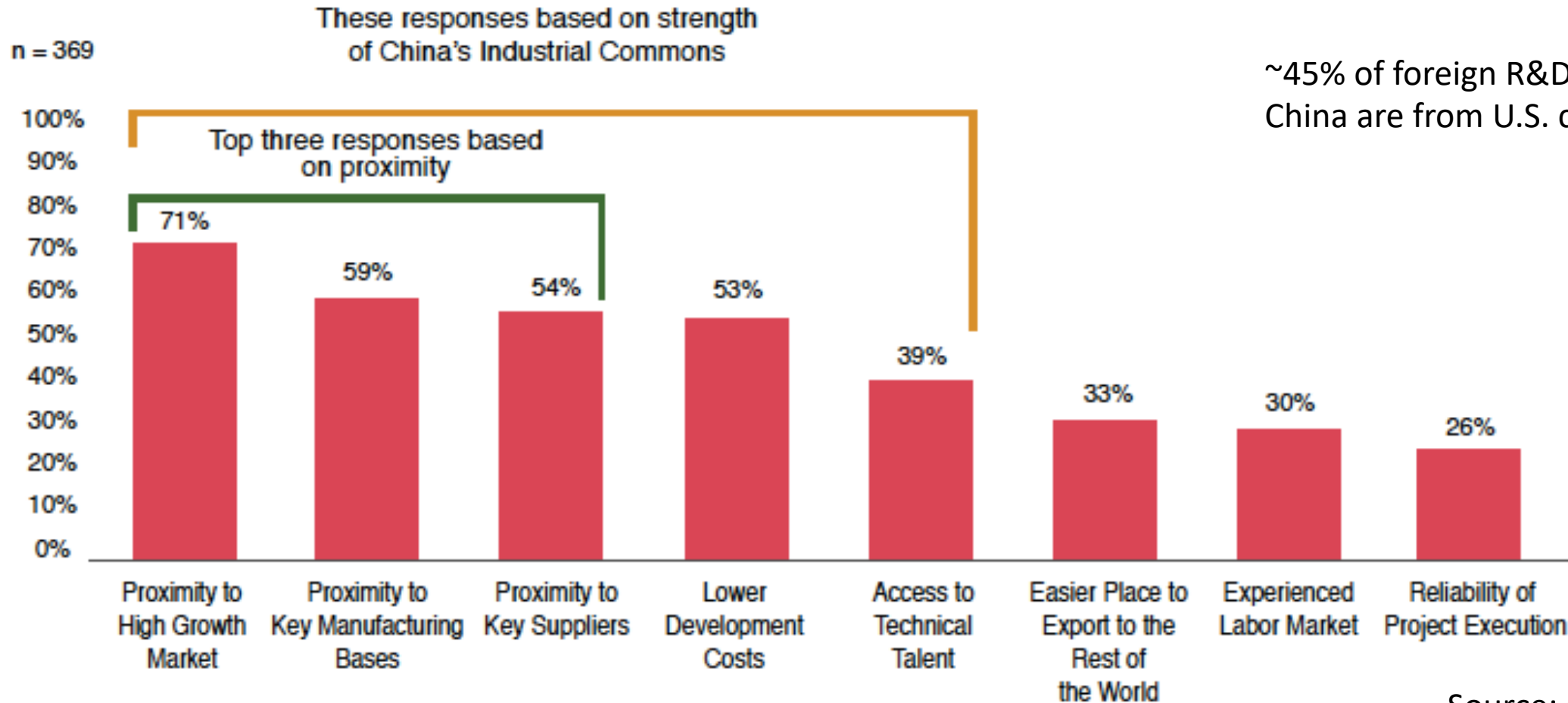
- Studied growth trajectories of **150 manufacturing startup firms** based on MIT technology and founded between 1997 and 2008
- **None of these companies were able to scale in the U.S** due to lack of funding, and know-how. All scaled in foreign countries; 70% of them scaled in China

*“.. when these firms were ready to take a giant step up to large-scale processes, the search for additional capital as well as scalable production capabilities drove many firms to relocate their production abroad.”*

# Innovate There, Manufacture There

## Factors driving manufacturing R&D to China

“ Innovation happens faster here” –  
a former Google exec referring to China



~45% of foreign R&D centers in China are from U.S. companies

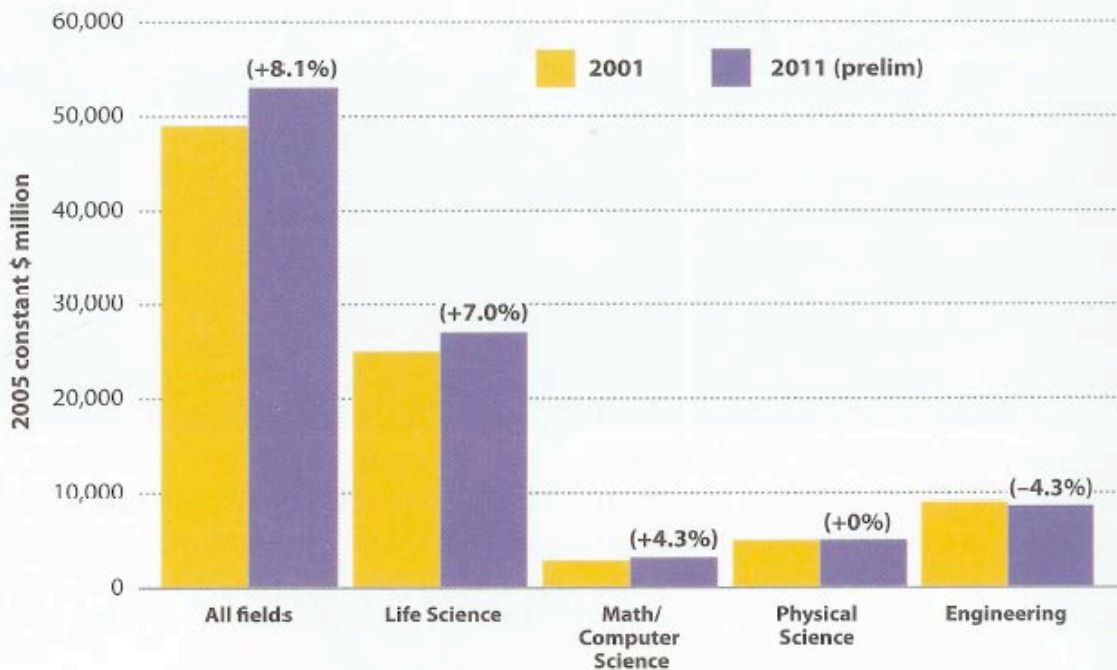
Source: ConsultancyUK, 2015

# U.S. Investments in Engineering in the last two decades

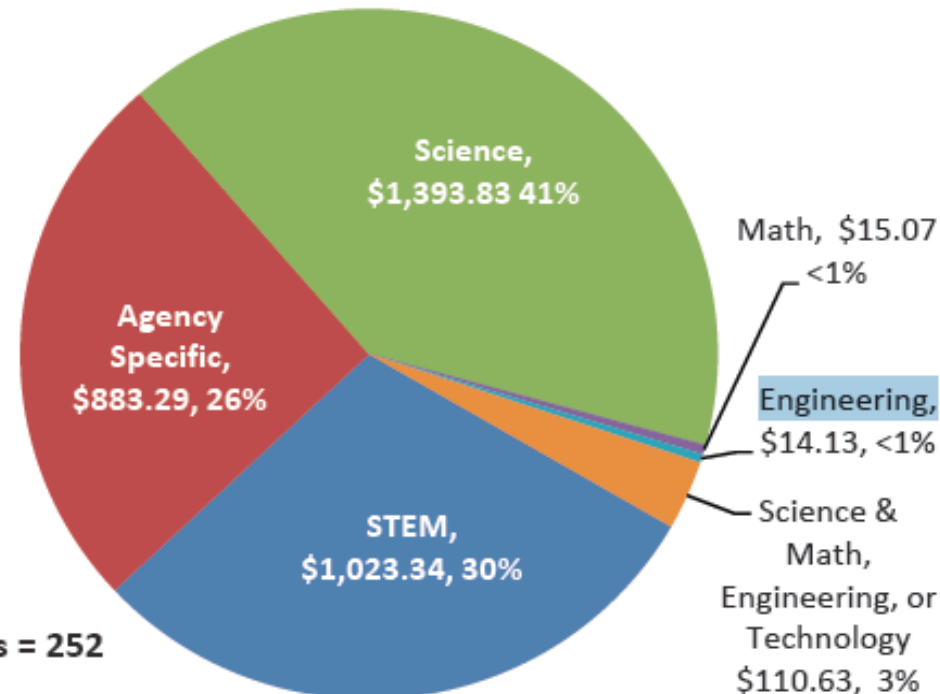
**1991-99:** Federal support of chemical, electrical, and mechanical engineering declined by 25 percent, 30 percent, and 55 percent, respectively. Meanwhile, funding for biological and medical sciences rose more than 20 percent.

## 2001-11: 4.3% reduction in engineering

Federal funding of broad fields of research, FY 2001-2011 (not including ARRA)



STEM Field of Focus (\$3,440 M)



# of Investments = 252

2011 NSF Science and Engineering Index

## *Its not how much we invest, but what we invest in*

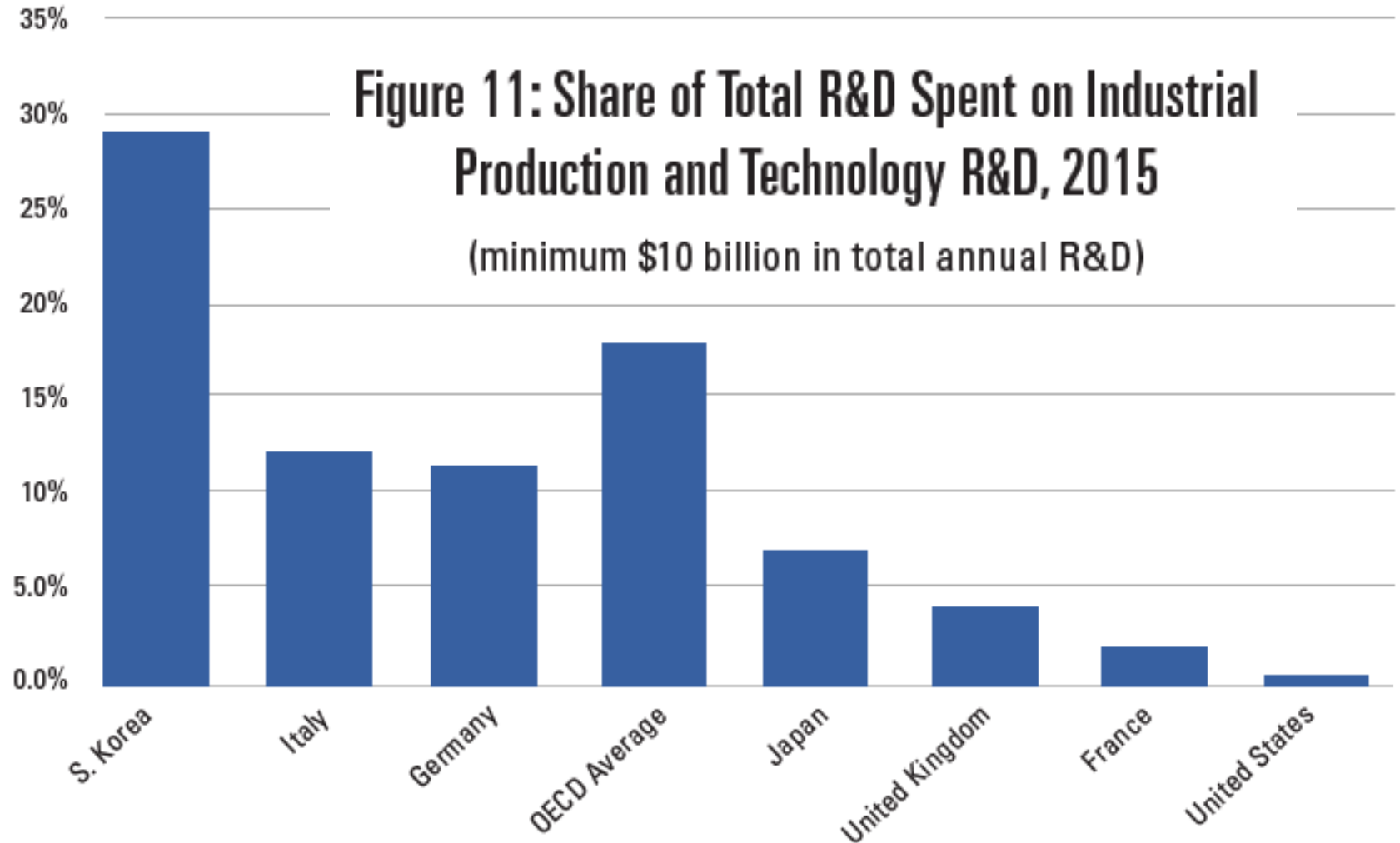
**U.S; \$150 billion S&T budget:**  
Of which, **~770 million** invested  
in **Industrial Production and  
Technology**

**Germany: \$36 Billion**  
**\$4.34 billion (12%); 6X** the  
amount U.S spends

**Japan – 7% of its budget;**  
**3X U.S**

**S. Korea – 30% of its budget; 8X**  
**US**

Source: OECD data 2015  
Engineering and Mfg R&D



**Is 5% a reasonable investment for the U.S.?**

# Round Table discussions to address the Grand Challenge

**Grand Challenge:** “Invent here, Manufacture there” has reached its logical conclusion: **“Innovate there, Manufacture there”**

Convened 7 roundtables across the nation with **over 100 thought leaders** who spent **over 1200 hours** discussing potential solutions. **How to:** 1. Rebuild America’s industrial commons; 2. Create national wealth from federal R&D investments. 3. Ensure financing for “hardware” start-ups and scale-ups

## 2018 Round Tables and Partners

Boston, MA



Massachusetts  
Institute of  
Technology



Washington, D.C.



NATIONAL ASSOCIATION OF  
Manufacturers



Austin, TX



TEXAS  
The University of Texas at Austin



NASCENT

San Jose, CA

Raleigh, NC

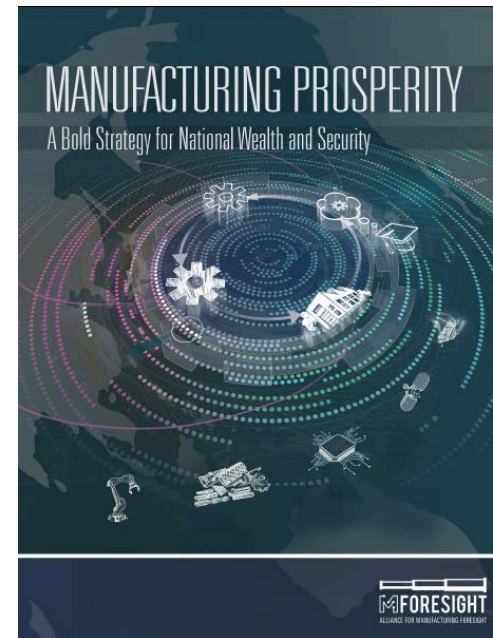
Indianapolis, IN



Boston  
Scientific



Detroit, MI



2018



2019



# Establish Translational Research Centers (TRCs) at Universities

Fund pilot production and Leverage Defense Procurement

Empower small & Med sized companies

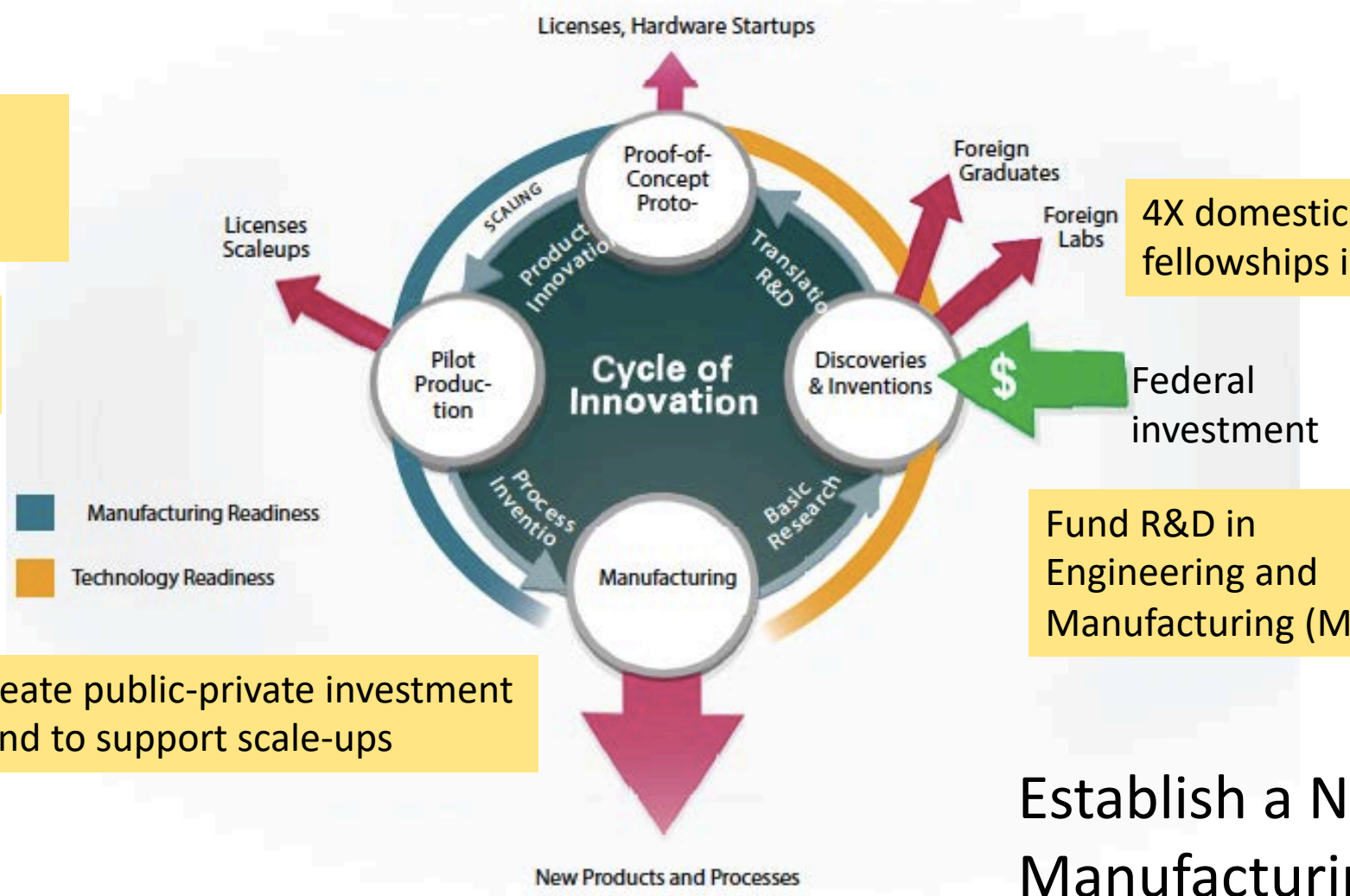
Create public-private investment fund to support scale-ups

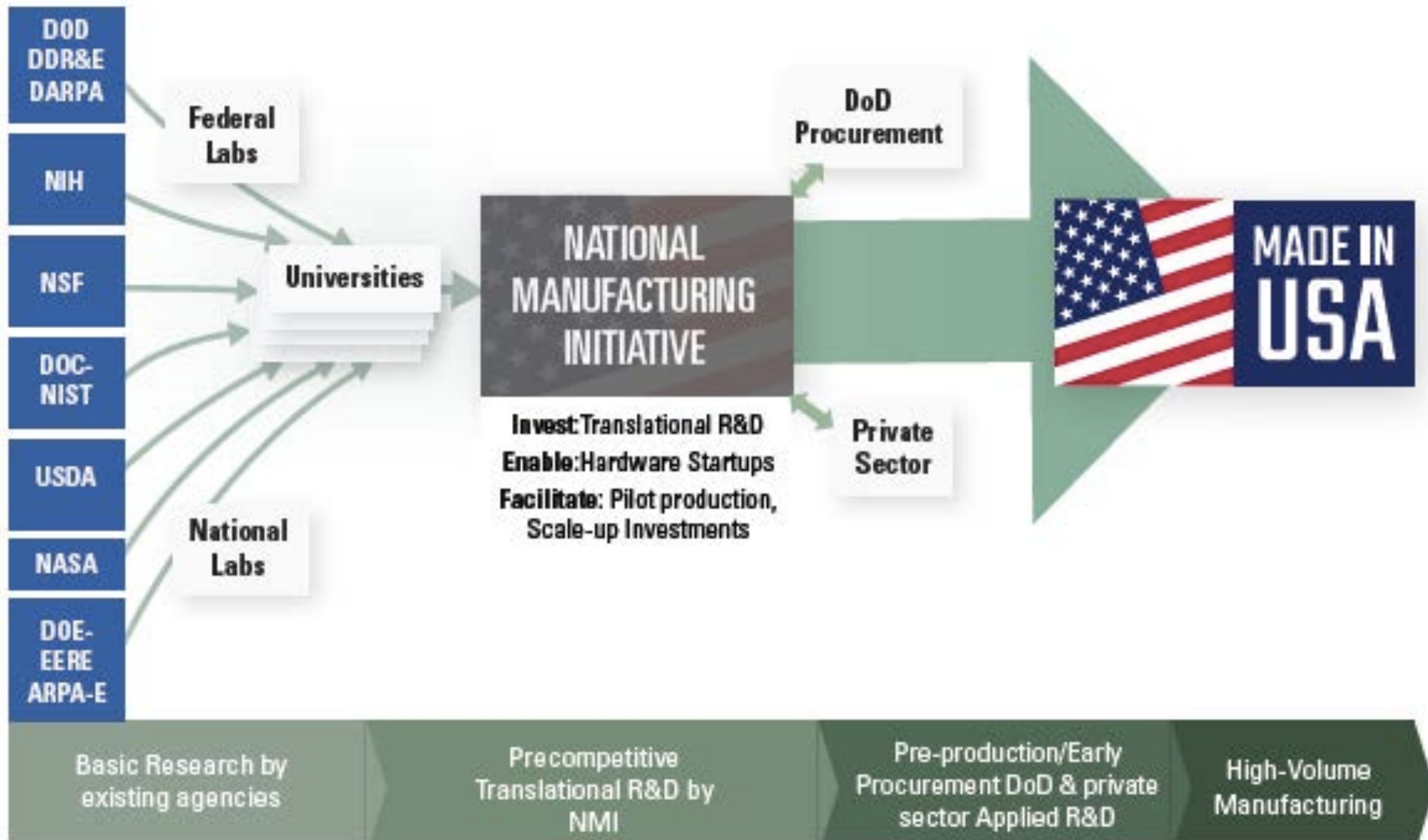
4X domestic graduate fellowships in engineering

Fund R&D in Engineering and Manufacturing (MRLs)

Establish a National Manufacturing Foundation

## Closing the Gaps in the U.S. Innovation Pipeline





### The Daily 202: A senator from Michigan will propose a National Institute of Manufacturing modeled on NIH

By James Hohmann  
June 17

With Joanie Greve and Mariana Alfaro

**THE BIG IDEA:** Sen. Gary Peters (D-Mich.) says the decline in American manufacturing is as much a failure of public policy as anything else.



06.18.19

# Peters Announces Proposal to Establish a National Institute of Manufacturing, Make Manufacturing Policy a Major National Focus

## Marco Rubio: We need to invest in America again

by Sen. Marco Rubio | May 13, 2019 11:33 PM



## Rubio Report Outlines Future of "American Investment"

By Daniel Molina / May 18, 2019

## Promising Trends

Manufacturing is increasingly *digital, democratized and distributed* and it plays to American strengths.

According to a recent survey, 37 percent of millennials perceive manufacturing as a high-technology career choice, notably higher than both the Generation X (27 percent) and Baby Boomers (23 percent).

Foreign MNCs continue to invest in manufacturing facilities in the U.S.

Investments in Battery and Electric vehicle manufacturing in the U.S.



# This Workshop

*How can EDSE research make sustained impact on diverse application domains, such as manufacturing, transportation, and smart and connected communities?*

Manufacturing – M&S tools (probabilistic reasoning), application-specific design tools, modeling and performance prediction of metamaterials, data analytics, Design for Manufacturing, design of manufacturing machines

*What are the new opportunities for EDSE research created by emerging technologies and the changing workplace and society?*

Smart Manufacturing (Industry 4.0);  
Impact of AI and automation – much hype

*How can the EDSE research community maximize the societal impact ....?*

Role of Universities in empowering small and medium sized manufacturers



Working with local MEP, Purdue Univ. faculty and students helped Jeco Plastics, Plainsfield, Indiana with Modeling and Simulation tools which led to a multi-million dollar contract from a global Automotive OEM for large plastic pallets which used to be made in China until 2011.

# #1: M&S Powered SME Manufacturing

Democratizing Access to Complex, Costly Computing Services

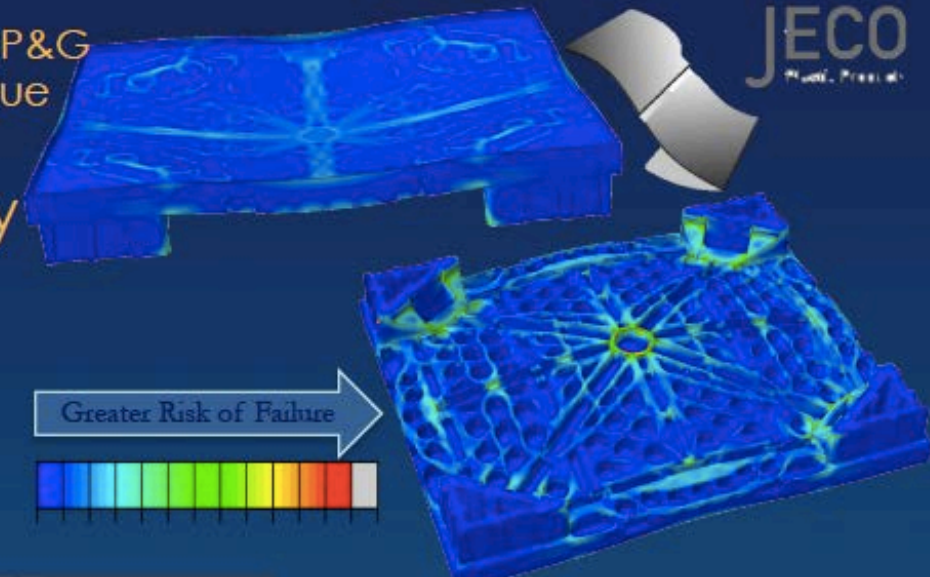
Digital Eng. & Manf. Consortium

Jeco Plastics (Indiana)

NDMEC – Midwest Pilot Initiative (2011)

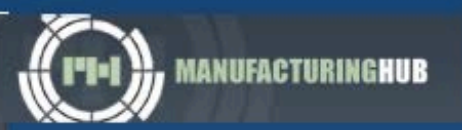
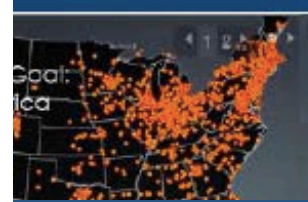
25-person SME Poised to Win \$2.5M+ Order

OEMs: Boeing, GE, John Deere, Lockheed, P&G  
 Solution providers: NCMS, NCSA, OSC, Purdue



Lowering the barrier is the gateway

Access to simulation across apps  
 Easy to download or install  
 Application specific applications  
 Live content  
 Live content  
 Service business model



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## A Progress Report on Modeling & Simulation for the Economy

Subscribe

Posted by Sridhar Kota on February 15, 2012 at 01:06 PM EDT

Last week Aneesh Chopra addressed the inaugural National Modeling and Simulation Coalition with an update to an important R&D initiative focused on an industry of the future. In May 2010, an interagency working group made five priority recommendations to deliver on the promise of modeling and simulation (M&S) tools that spur productivity in advanced manufacturing, health care and education. We reported on our progress:

- 1. Lowering Barrier to Entry:** To lower the cost and training barriers on the use of M&S tools by small and medium sized manufacturers (SMEs), the Economic Development Administration and the U.S. Council on Competitiveness launched the National Digital Engineering and Manufacturing Consortium (NDMEC) last March focused on pilot activity in the Midwest. We reported on early success stories last month so we took this occasion to announce a challenge – Purdue University’s Manufacturing HUB.org launched an Apps Competition to develop easy-to-use, application specific simulation capabilities using OpenFOAM- an open source code for computational fluid dynamics.

## Benefits:

- 1. Students gain real-world experience** by applying knowledge gained in the classroom to a real-world setting and by demonstrating value to a local SMM.
- 2. SMMs gain necessary and deep insights** into opportunities and challenges with implementing computational tools on company-specific products and processes.
- 3. By engaging with local industry, faculty can** enrich classroom instruction and research with practical examples
- 4. Universities add significant value** to the local community and SMMs

Other examples:

Systems engineering design and education

Smart manufacturing

- Assessment

- Data analytics

- Virtual and augmented reality opportunities

- Design for Additive Manufacturing

Design tool for emerging technologies

- Metamaterials

- Batteries and electric vehicles

- etc.

# Summary

## *From Offshoring Production to Offshoring Innovation - A Dangerous Trend for a Developed Country*

Invest in innovation ecosystem to rebuild our capacity to innovate (hardware)

Science is not engineering.

Engineering theory v. Engineering Success

Rethink engineering research and engineering education in ways that maximizes societal impact  
– provides a return on investment to taxpayers who are funding our research

How do we define basic research in engineering that has academic rigor and is also practical?