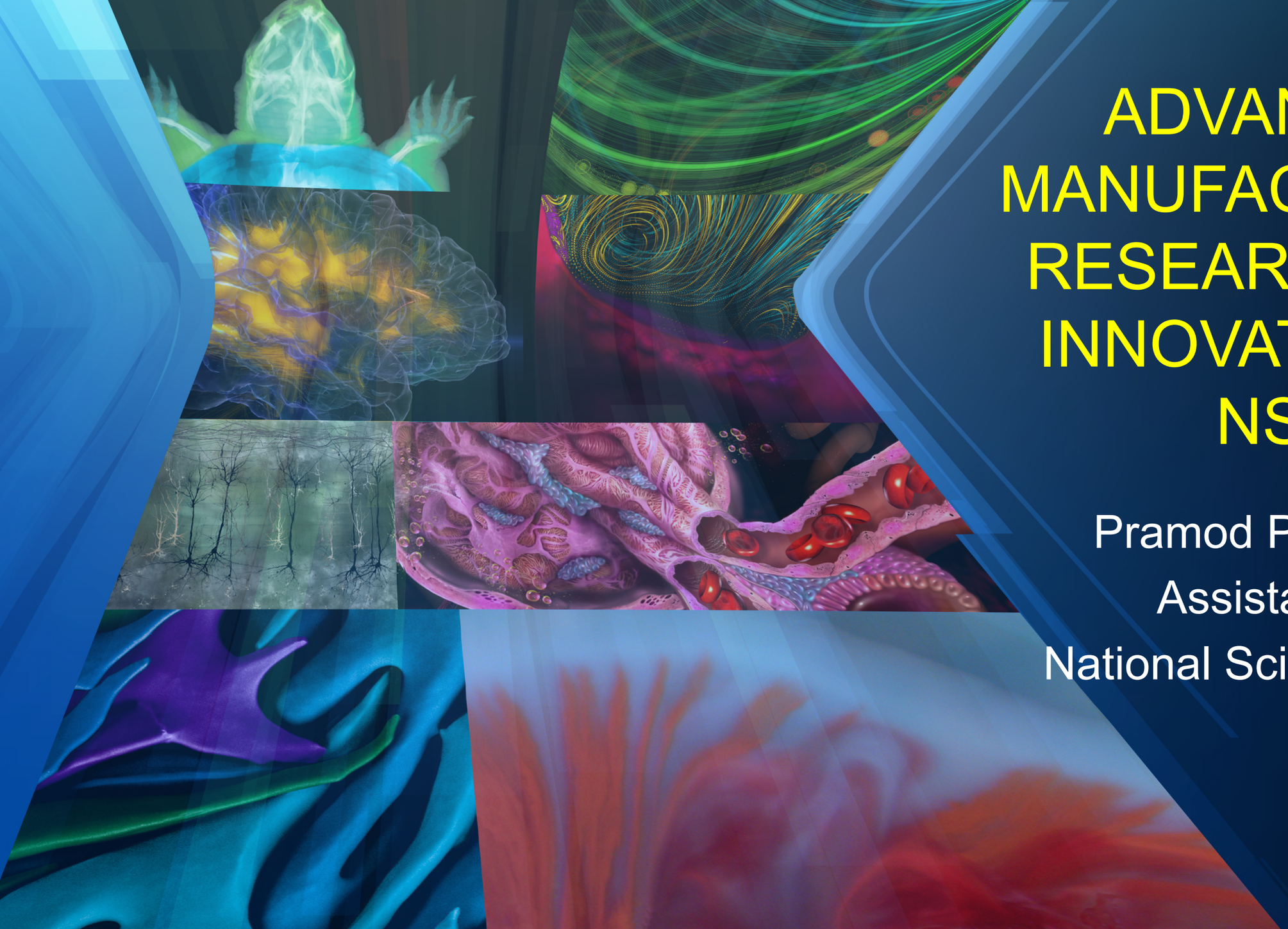


ADVANCED MANUFACTURING RESEARCH AND INNOVATION AT NSF

Pramod P. Khargonekar
Assistant Director
National Science Foundation

NSF Mission

"To promote the progress of science; to advance the national health, prosperity, and welfare; to secure the national defense..."

NSF Role in Advanced Manufacturing

- Support basic research in engineering and science to enable future manufacturing technologies

- Prepare the next generation workforce for manufacturing research, innovations, and industry practices

NSF Laid the Foundations of 3D Printing in the 80's

'Revolutionary'

Machine makes 3-D objects from drawings

By Kathleen Sullivan
American-Statesman Staff

Wedged into the corner of an unused photo lab at the University of Texas is an ungainly machine that can transform a computer drawing into a three-dimensional model at the touch of a button.

Sometime next year, the machine, which was developed by a UT graduate student, will make its way out of the lab and into the commercial arena. It will leave with the blessing of the UT Board of Regents, which Thursday gave an Austin company exclusive licensing rights to the "revolutionary" new technology embodied in the machine.

The licensing pact paves the way for the first transfer of technology from the University of Texas at Austin to a commercial venture.

The company that won the right to market the invention is Nova Automation Corp., whose principal shareholders are an Austin consulting engineer and Nova Graphics International Corp., an Austin-based computer graphics software firm.

The agreement represents a "hard fought" victory for UT's fledgling Center for Technology Development and Transfer, said Meg Wilson, coordinator of the center, which was given life during the last Texas Legislature and got

See Inventor, A11

Staff photo by Ralph Barrera

Associate Professor Joe Beaman shows some three-dimensional plastic models made by the 'selective laser centering' device developed by Carl Deckard, left.

3D Printing will be $550B Industry by 2025 - McKinsey

- 3-D printers can handle materials ranging from titanium to human cartilage
- Produce wide variety of components and products
- Example: In 2016, GE Aviation will introduce the first 3D-printed parts in an aircraft engine.

NSF FREEDM Engineering Research Center leads to Manufacturing Institute

FREEDM systems center

NSF ERC

DoE - EERE

PowerAmerica

NSF Role in Manufacturing Innovation Institutes (MIIs)

- Connecting NSF research communities to MIIs
- Education programs to address workforce development at MIIs; Ex: ATE program
- MIIs as “teaching factories” for university students
- Partnership with other agencies

Response to AMP 2.0

- Alliance for Manufacturing Foresight (MForesight)
  - co-funded by NSF and NIST
  - channels rapid input from industrial, academic and nonprofits
  - helps align advanced manufacturing research with national priorities and challenges to ensure efficient use of funding for the greatest possible return on investment

- I/UCRC Clusters for Grand Challenges
  - Partnership of three I/UCRCs with one ERC
  - Processing of advanced structural composites using embedded sensing, measurement and control systems with scalable IT platforms

Where is NSF Investing today for Tomorrow's Revolutions?

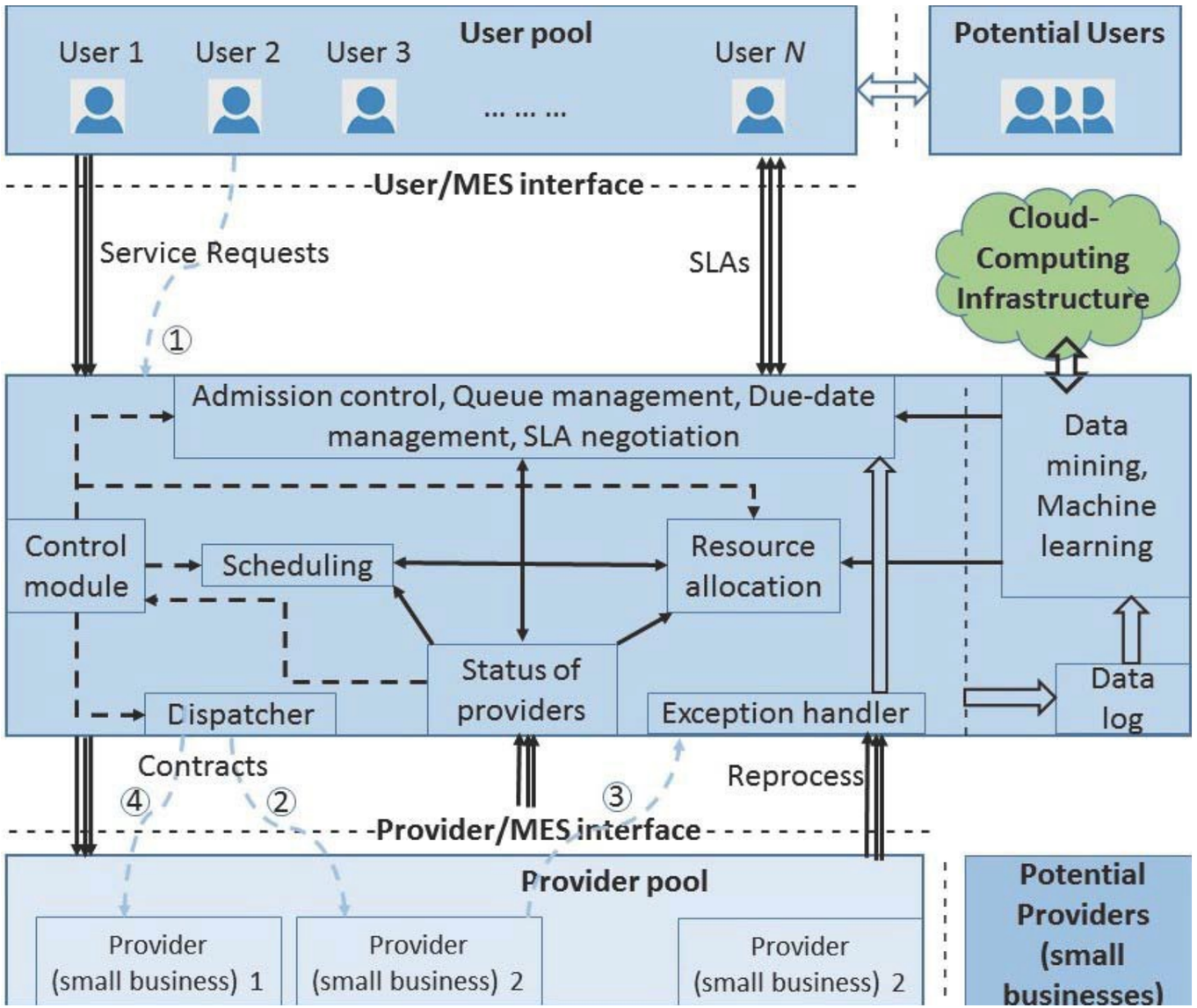
- Cyber-Manufacturing
- Cellular Biomanufacturing
- Nanomanufacturing

"The Internet of Things has already set in motion the idea of a fourth industrial revolution—a new wave of technological changes that will decentralize production control and trigger a paradigm shift in manufacturing."

-Markus Löffler, McKinsey

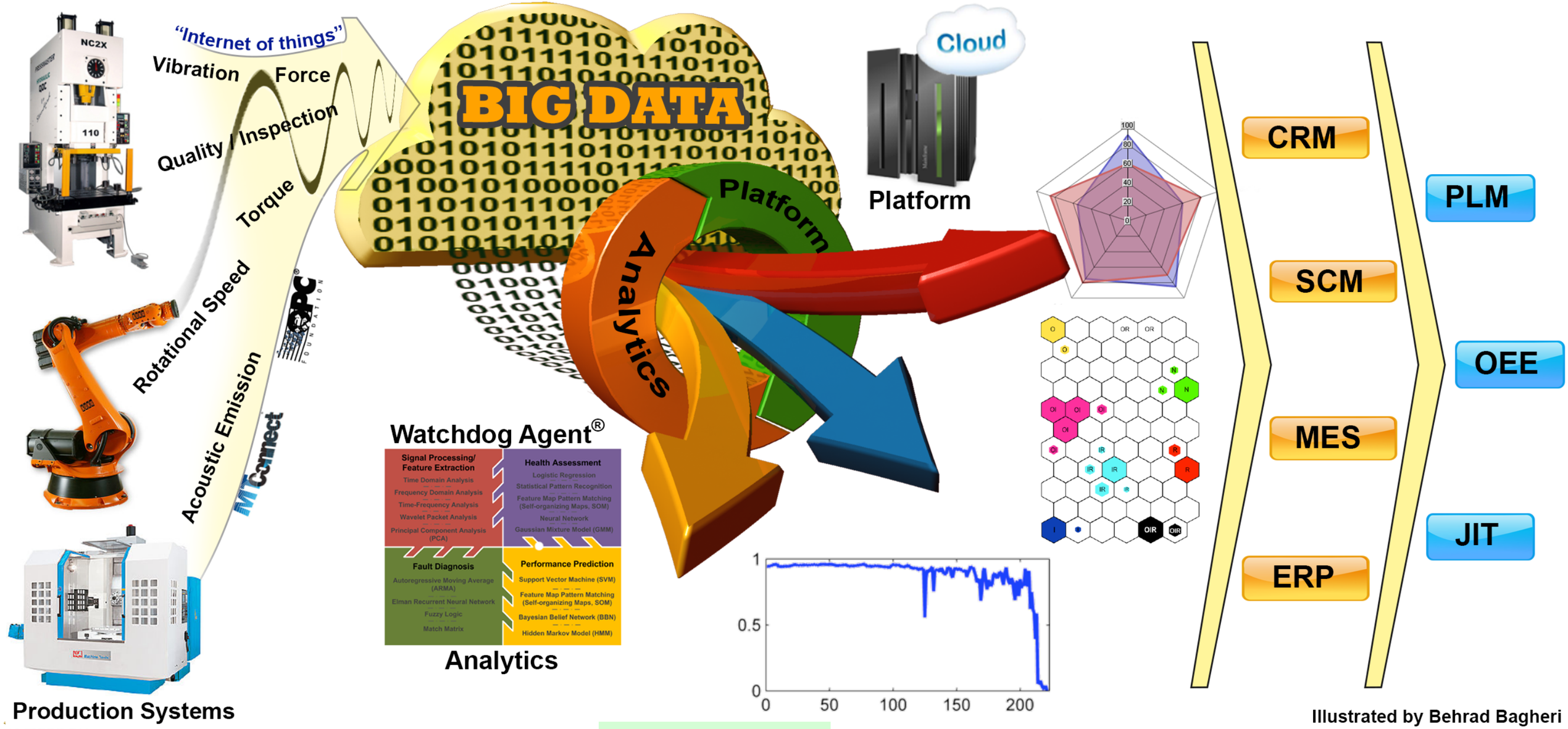
Advanced Manufacturing
Cybermanufacturing

- FY 2015: $6.5M for 30 research projects to explore manufacturing research in the internet age
- Key themes:
  - production-as-a-service
  - manufacturing apps and operating systems
  - manufacturing exchanges, security
  - predictive analytics



Design of an Agile and Smart Manufacturing Exchange, ECCS-1543872, Chakrabbarty, Maggs and Zavlanos, Duke University

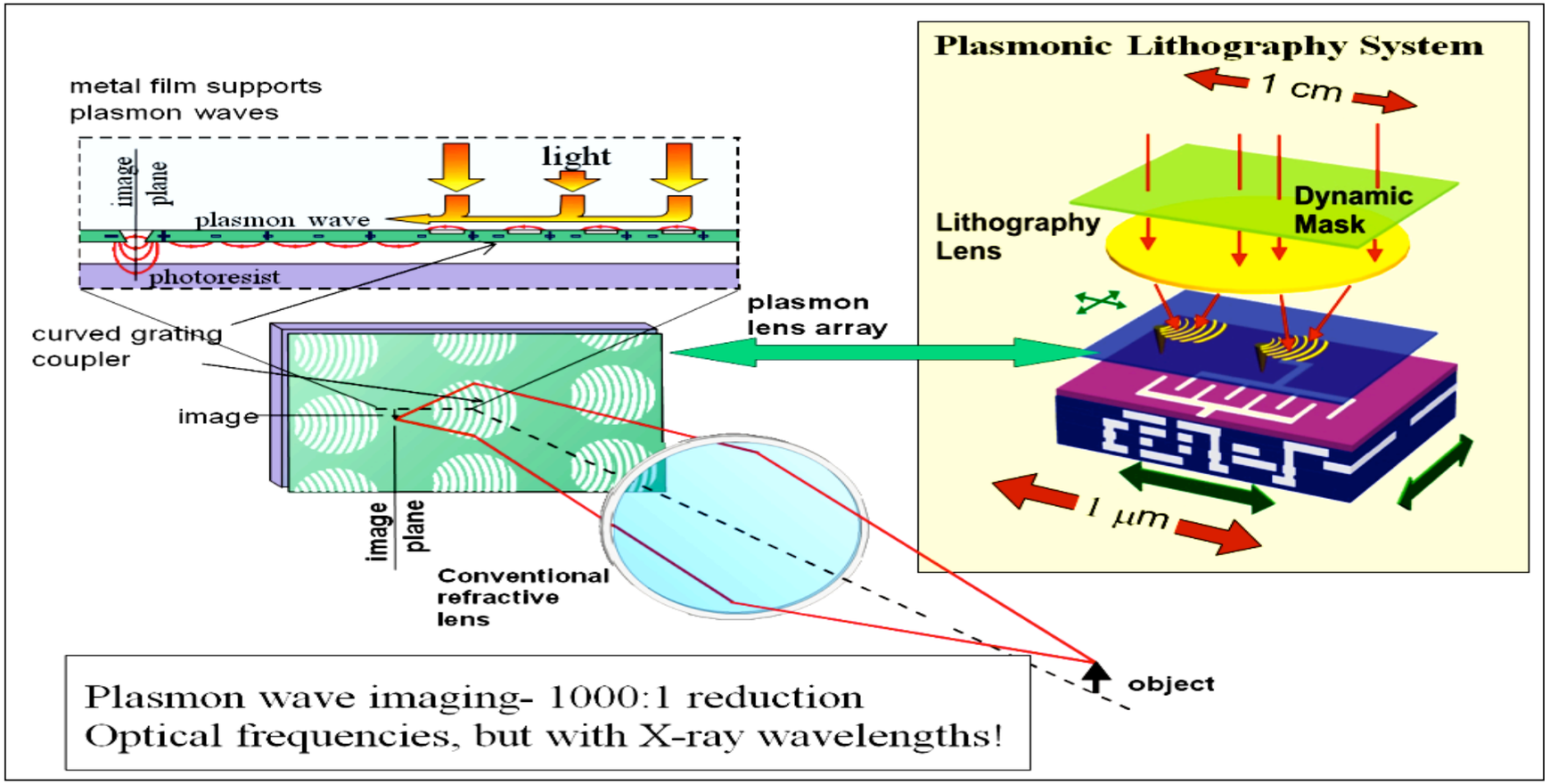
Predictive Manufacturing – The IMS Center



U. Cincinnati

How can we do Nano-Manufacturing at Scale?

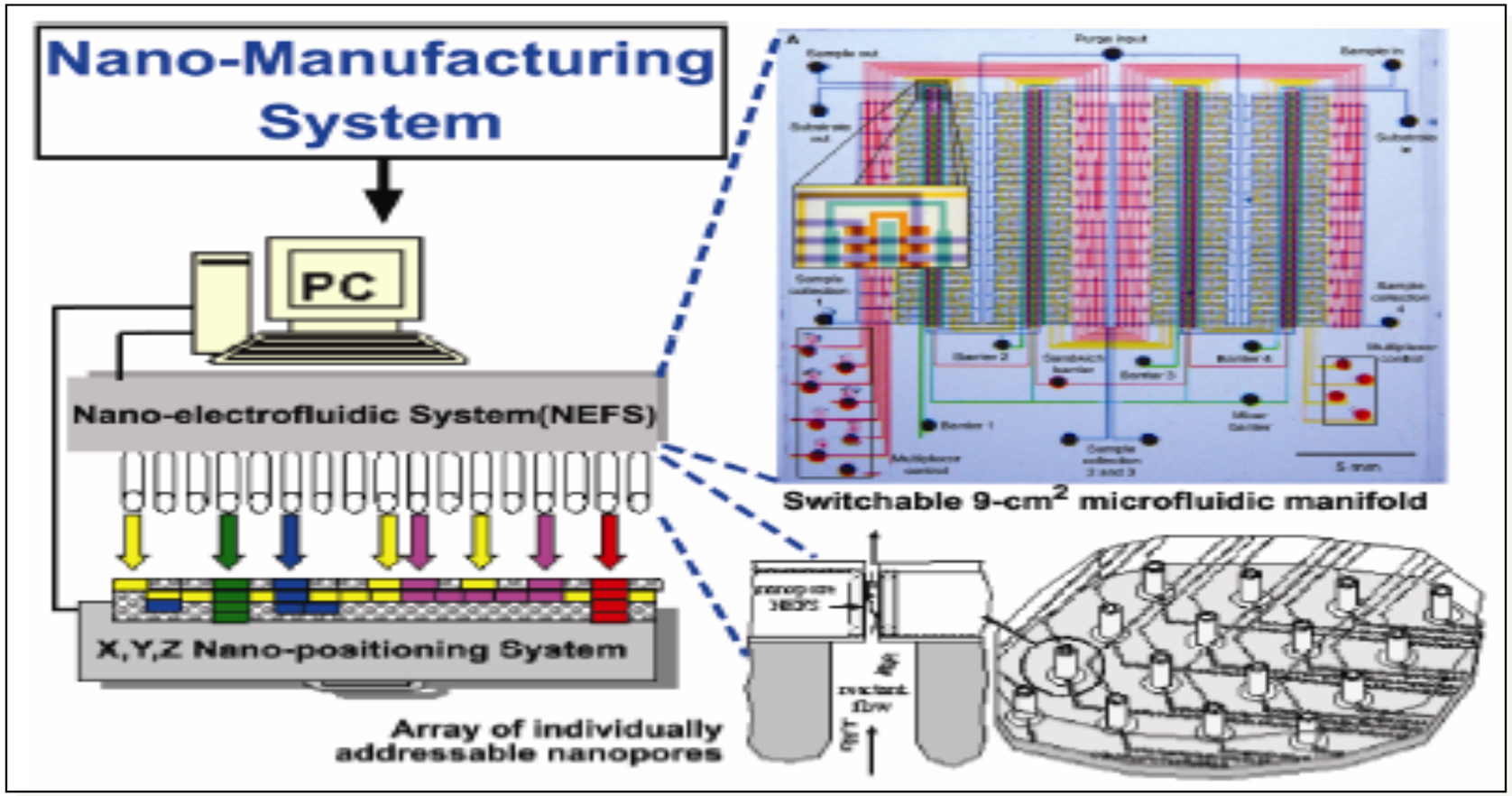
Goal: Establish new manufacturing paradigms that integrate an array of new nanomanufacturing technologies for manufacturing at scale



UC-Berkeley, UCLA, Stanford, UC-San Diego, UNC-Charlotte, HP Labs

Nano-Chemical-Electrical-Mechanical Manufacturing System

Goal: Develop reliable and robust nanomanufacturing systems to make nanostructures from multiple materials



Illinois, Stanford, NC State, UC-Irvine, Notre Dame, Northwestern

Advanced Cellular Biomanufacturing

Significance: Cell-based therapies and diagnostics have the potential to revolutionize human healthcare

Goals of the Program: Fundamental research on biomanufacturing of cellular therapies

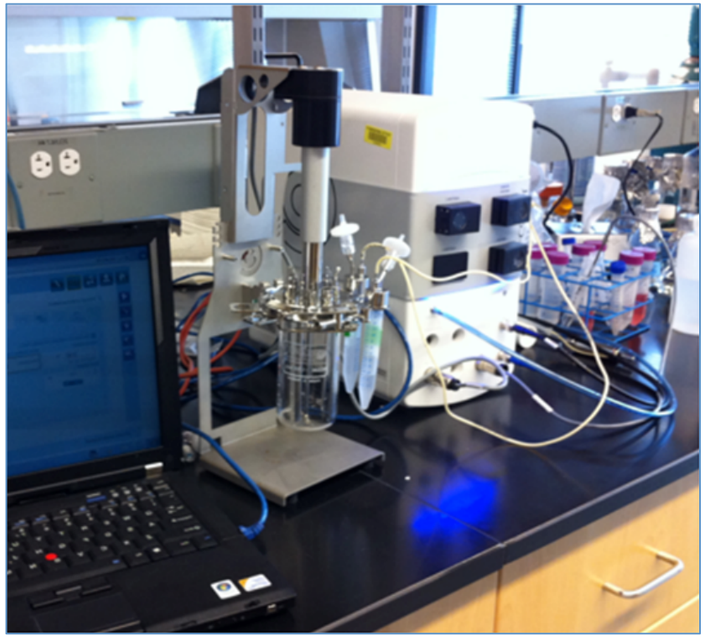
Potential Impact:

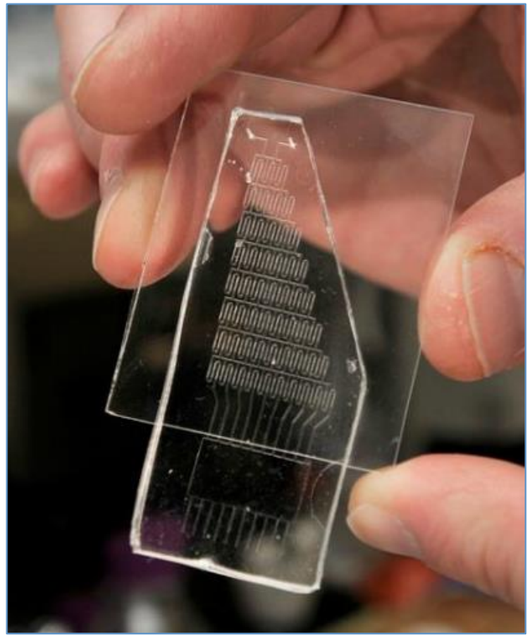
- Enabling implementation of new therapies
- Economic impact through a new type of industry
- Education of the new generation of bioengineers

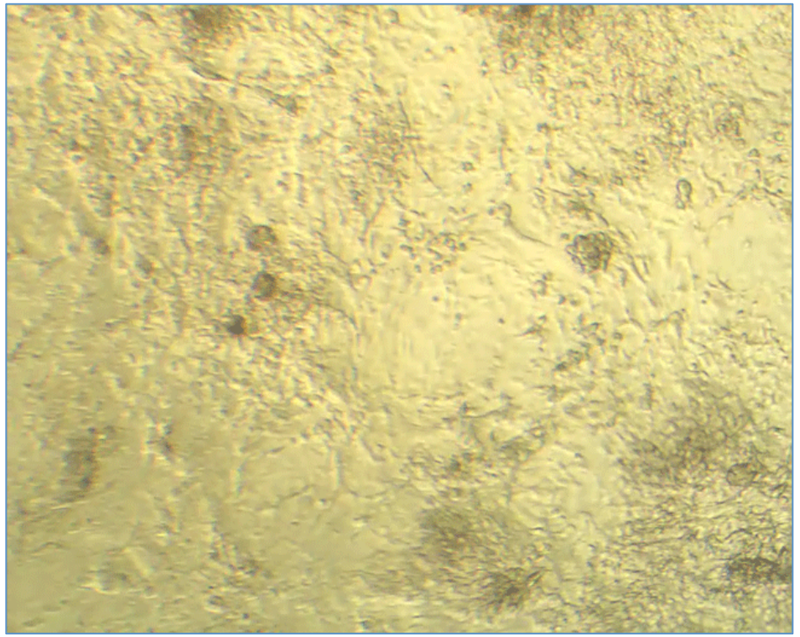
Advanced Manufacturing

Cellular Biomanufacturing

- FY 2015: $3.7M for 13 high-risk, high-impact research projects on the manufacturing of cells and cell-based products for future healthcare.







heart cells at right grown outside the body. *Credits, L to R: Emmanuel Tzanakakis, Chemical and Biological Engineering, Tufts University; Brendan Harley, University of Illinois at Urbana-Champaign; Xiaoping Bao and Sean Palecek, University of Wisconsin-Madison*

Conclusions

- NSF is planting the seeds for new manufacturing industries of the future by investments in basic research
- NSF is collaborating with federal agencies, the academic and private sectors
- NSF is enabling the future workforce in manufacturing

Thank you!