Manufacturing Research Trends

October 26, 2015

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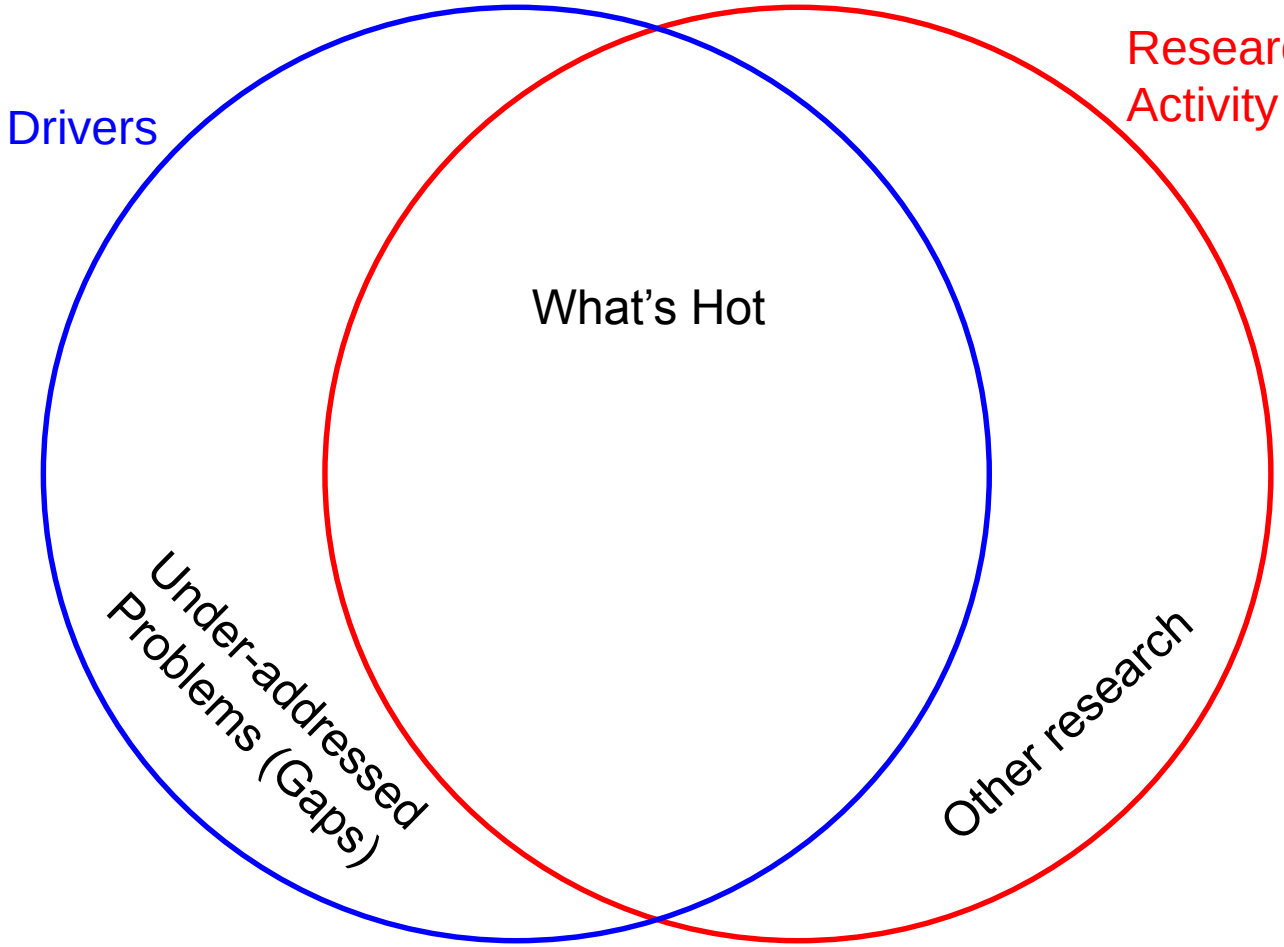

Drivers
Research Activity
What's Hot
Under-addressed Problems (Gaps)
Other research

Drivers

- Energy Efficiency
- Renewables integration

  (Manufacturing meets smart grid)
- Sustainability
- Interoperability
- Skills

“Hot” Cybermanufacturing Research Areas*

- Advanced Sensing, Control, and Platforms for Manufacturing (ASCPM)
  - Smart sensor networks (aka Industrial Internet of Things)
  - Modeling & simulation
  - Cloud based manufacturing
  - Cybersecurity
- Visualization, Information, and Digital Manufacturing (VIDM)
  - Integrated information systems, Digital Thread
  - Big Data and Analytics

* Drawn in part from the PCAST Report to the President Accelerating U.S. Advanced Manufacturing, October 2014

“Hot” Non-Cyber Research Areas

- Additive manufacturing
- Advanced materials manufacturing (AMM)
  - Structural composites
  - Biomanufacturing
  - Critical materials (e.g. molybdenum)
  - Multi-materials
- Energy harvesting for ubiquitous sensors
- Nanomanufacturing and MEMS

Some relevant National Science Foundation programs

Advanced Manufacturing & Nanotechnology (SBIR/STTR)

- Roughly 40% of NSF SBIR/STTR funding went to manufacturing projects in 2014 (~$170M)
- 50% were associated with academia

- Top 3 categories were
  - Nanotechnology/Nanomanufacturing
  - Additive Manufacturing
  - Sustainable Manufacturing

M1. Personalized Manufacturing
M2. Maker Manufacturing
M3. Additive Manufacturing
M4. Manufacturing for Emerging Markets
M5. Modeling & Simulation
M6. Sustainable Manufacturing Technology
M7. Manufacturing Processes
M8. Rare Earths and Critical Materials Processing Technology
M9. Transportation Technologies
M10. Manufacturing Technologies involving Chemical Transformations
M11. Machines and Equipment

N1. Nanomaterials
N2. Nanomanufacturing
N3. Nano-enabled Commercial Solutions to Global Problems

Examples

- Smart Sensor Networks
  - NIST - Wireless Platforms for Smart Manufacturing
  - DOE - Innovation Institute on Smart Manufacturing (solicitation announced September 2015)
  - Osceola County & University of Central Florida investing $77M in the Florida Advanced Manufacturing Research Center to work on smart sensor technology

Interoperability Standards Battles for the Internet of Things

industrial internet CONSORTIUM

AT&T, Cisco, IBM, Intel…
plus ~165 others

oneM2M

IoT-A Internet of Things - Architecture

SIoT Open Source Internet of Things

OPEN INTERCONNECT CONSORTIUM

Intel, Samsung, GE, Cisco, Dell…
plus ~50 others

INTERNET OF THINGS IoT-GSI GLOBAL STANDARDS INITIATIVE ITU-T

Thread Group
Google (Nest), ARM,
Samsung appliance…
plus ~120 others

?

ALLSEEN ALLIANCE
Microsoft, Cisco,
Qualcomm, Sony, LG…
plus ~140 others

THE Open GROUP
Hewlett-Packard, Cisco,
IBM, Oracle, Philips
Plus ~400 others

Apple Homekit
"*dozens of partners*"
as of May 14, 2015

IPSO Alliance

OASIS
Advancing open standards for the information society

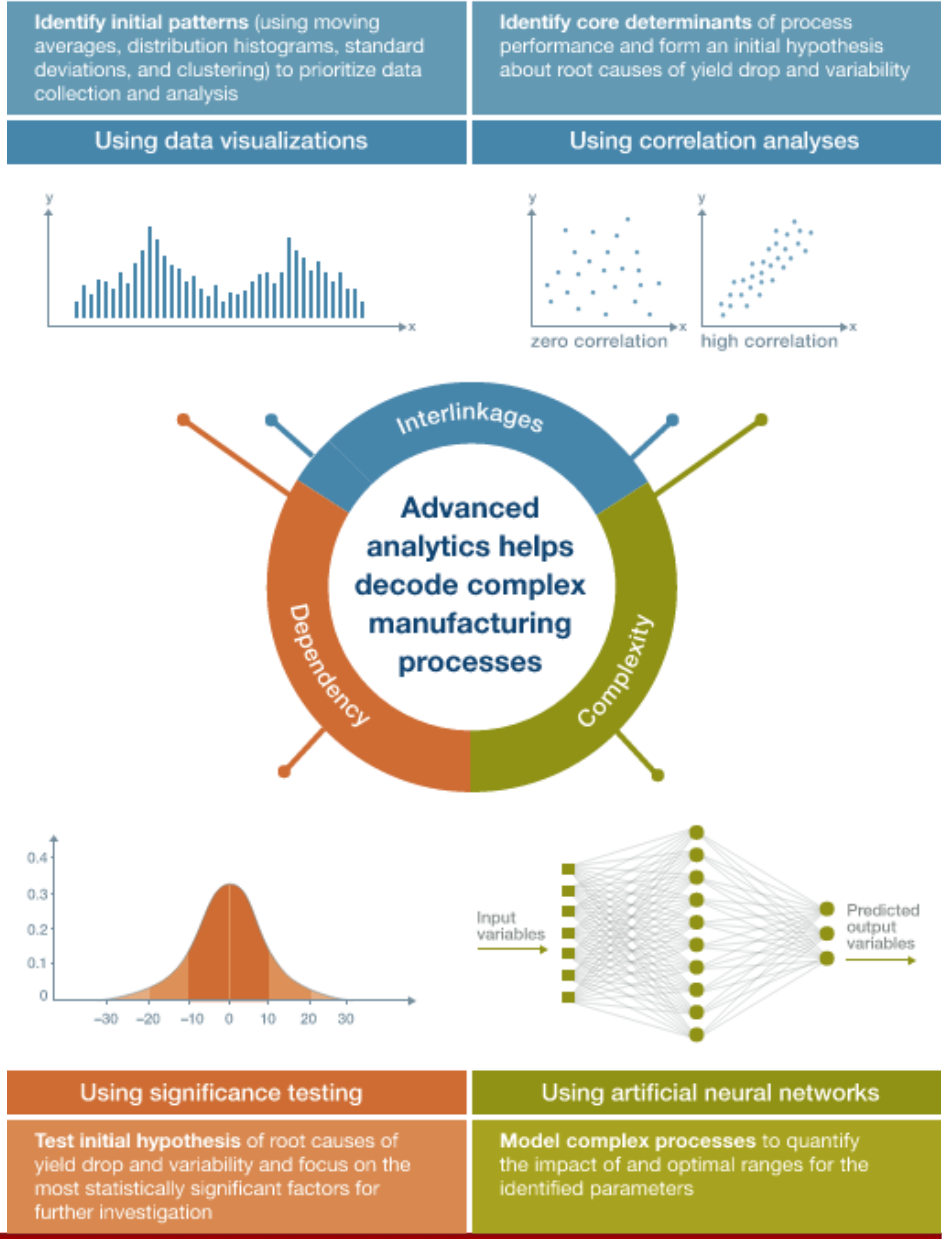
Carnegie Mellon University
Silicon Valley

Examples

Big Data and Analytics

"*The manufacturing industry generates more data than any other sector of the global economy*"

* Source: http://www.forbes.com/sites/louiscolumbus/2015/09/06/10-ways-analytics-are-accelerating-digital-manufacturing/



Source: How Big Data can Improve Manufacturing, McKinsey & Company, 2014

Examples

- Cloud-based manufacturing
  - Still in R&D, but some commercial offerings are appearing
    - Quickparts, by 3DSystems
    - Livesource, by MFG.com

Source: Dazhong Wu, David W. Rosen, Lihui Wang, Dirk Schaefer, Cloud-based design and manufacturing: A new paradigm in digital manufacturing and design innovation, Computer-Aided Design, Volume 59, February 2015

Examples

Additive Manufacturing

GE engine bracket competition
84% weight reduction

Many issues remain

- Surface finish
- Material properties
- Performance prediction

Possible Gaps*

- Open standards and interoperability
- Real-time optimization and equipment management
- Fault tolerant systems

* Excerpted from PCAST Report to the President Accelerating U.S. Advanced Manufacturing, October 2014