

M Foresight: Alliance for Manufacturing Foresight

History, Operation and Impact

Sridhar Kota

Executive Director, M Foresight: Alliance for Manufacturing Foresight
Herrick Professor of Engineering, University of Michigan

Engineering Research Framework Visioning Summit – July 17, Alexandria, VA



Brief History

- Recommendation from PCAST's *Report to the President: Accelerating U.S. Advanced Manufacturing*, October 2014.
 - “Create an Advanced Manufacturing Advisory Consortium to provide coordinated private-sector input on national advanced manufacturing technology research and development priorities.”
- NSF issued an open solicitation for proposals in 2015. University of Michigan proposal was selected.
- MForesight was established in October 2015 under a 3-yr Cooperative Agreement between NSF and UM. The project was co-sponsored by NSF and NIST.
- MForesight began operations in October 2015 as a federally-sponsored, independent consortium of national thought leaders from industry, academia, and NGOs focused on the future of American manufacturing.

MISSION, STAKEHOLDERS AND OPERATION

Mission: Accelerate technological innovation and align R&D opportunities with national priorities to enhance U.S. manufacturing competitiveness.

MForesight connects researchers and practitioners and harnesses their collective wisdom in order to:

- Forecast emerging technologies across engineering disciplines and cross-cutting challenges
- Provide industry, academia, and government with insights into engineering and manufacturing R&D opportunities, technology deployment, and workforce development to strengthen U.S. manufacturing competitiveness

Stakeholder Engagement and Community Building

4 Phases

- ***Discover***
- ***Prioritize***
- ***Develop***
- ***Disseminate***



M Foresight Leadership Council

Industry members

Representation from a wide range of industry sectors and engineering disciplines



Academia



Nonprofits

MForesight Executive Committee & Leadership Council

Executive Director: Sridhar Kota, Herrick Professor of Engineering, University of Michigan

Associate Director: Tom Mahoney

Executive Committee

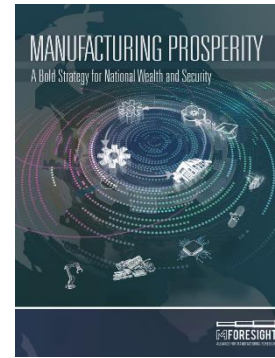
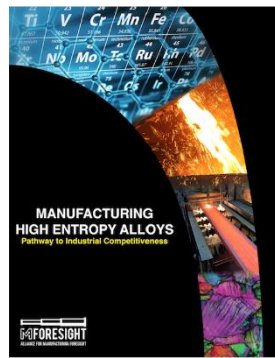
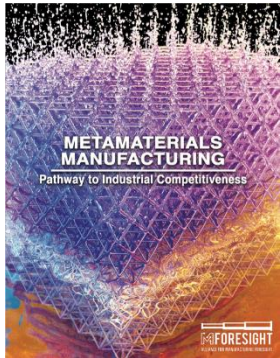
Glenn Daehn	The Ohio State University – Professor of Matl Sci & Eng, Exec Director of Ohio Manufacturing Institute
Pramod Khargonekar	University of California, Irvine – Vice Chancellor for Research
Sridhar Kota	Executive Director, MForesight (Ex-Officio)
Mike Russo	SEMI – Vice President, Public Policy and Talent Advocacy

Leadership Council

Jeffrey Abell	General Motors – Director & Chief Scientist, Manufacturing Systems Research
Robert Atkinson	Information Technology & Innovation Foundation (ITIF) – President
Dean Bartles	National Center for Defense Manufacturing and Machining – President & CEO
Keith Belton	Indiana University - Director of the Manufacturing Policy Initiative
Kurt Bettenhausen	Siemens Corporation – Senior Vice President
Gregg Bogucki	Boeing - Senior Technical Fellow, Materials and Manufacturing Technology
Robyn Boerstling	National Association of Manufacturers–Vice President, Infrastructure, Innovation & HR Policy
Megan Brewster	Launch Forth –Vice President of Advanced Manufacturing
Curt Cline	Deere & Co. – Director of Enterprise Strategic Manufacturing
James Davis	UCLA – Vice Provost for IT & Chief Academic Technology Officer
Emily DeRocco	Lightweight Innovations for Tomorrow (LIFT) – Director of Workforce Development
Peter Friedman	Ford – Manager of Structures and Stamping
Christine Furstoss	General Electric (GE) – Vice President & Technology Director of Global Research
Mauricio Futran	Johnson & Johnson – Vice President for Advanced Technology

Wes Hallman	National Defense Industrial Association – Senior Vice President for Policy
Susan Helper	Case Western Reserve University – Professor of Economics
Michael Holland	University of Pittsburgh – Vice Chancellor, Science Policy & Research Strategies
Suzzane Marzano	SME – Industry Manager
Raj Machanda	American Society of Mechanical Engineers – Director of Business Development
Sheila Martin	Association of Public & Land-Grant Universities (APLU) – Vice Pres, Econ Dev & Community Engagement
Mark Muro	Brookings Institute – Senior Fellow, Director of Policy
Om Nalamasu	Applied Materials – Senior Vice President & Chief Technology Officer
Shirish Pareek	Hydraulex Global – Founder and Vice Chairman
David Parrillo	Dow Chemical – Vice President of Research & Development
Scott Paul	Alliance for American Manufacturing – President
Randy Schiestl	Boston Scientific Corporation–Vice President of Research & Development, Global Technology
Tim Shinbara	Association for Manufacturing Technology (AMT)–Vice President for Manufacturing Technology
Scott Smith	Oak Ridge National Laboratory – Machining and Machine Tool Research
Diego Tamburini	Microsoft – Principal Industry Lead – Manufacturing
David Vasko	Rockwell Automation – Director of Advanced Technology
Daniel Walczyk	Rensselaer Polytechnic Institute – Prof, Assoc. Dir of Mfg, Ctr for Automation Tech & Systems
Jeffrey Wilcox	Lockheed Martin – Vice President for Engineering
Christie Wong-Barrett	MacArthur Corporation – CEO

Accelerating Technology & Manufacturing Innovation



Metamaterials Manufacturing

Regenerative Medicine

Manufacturing High Entropy Alloys

Manufacturing 101

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

Types of Activities

To identify emerging technologies and cross-cutting challenges, we engage in a range of activities including:

- Visioning (Gamechanger) workshops
- Topic-specific deep-dive workshops
- Technology transfer workshops: Convene industry and academia on a specific topic to enable technology transfer
- Multiple round-table discussions around the country on a specific topic
- Survey manufacturers and researchers at trade shows and professional meetings
- Interview subject matter experts (phone/in-person) on a specific topic

Our strategy is to leverage the strength of existing organizations when appropriate

Emerging Technologies & Manufacturing Challenges

Serving as the voice of the nation's advanced manufacturing community, we seek "Gamechanging ideas" in *basic and translational research* (engineering and manufacturing) of national importance through various means including:

- Ideas submitted by researchers in academia and industry
- Ideas submitted by MForesight Leadership Council (industry academia, NGOs)
- Rapid Response Requests submitted by various federal S&T agencies
- Extensive online search of emerging technologies by MForesight staff
- Ideas generated by Gamechanger Workshops conducted in collaboration with Professional Engineering Societies
- Survey of manufacturers at Trade shows
- National Competitions conducted by MForesight (Ex: Making to Manufacturing Competition)

Discover

Emerging Technologies & Manufacturing Challenges

Scouting and Surveys

Professional Societies	Tech Transfer
Trade Associations	Universities
Federal Agencies	Industry
Federal Programs	Shows/Events

“Gamechanger” Events Partners



The Minerals, Metals & Materials Society



MSEC

Manufacturing Science
and Engineering Conference

Outreach

Seeking innovations and
disruptive technologies
MForesight.org

SUBMIT YOUR GAMECHANGER



A national consortium
focused on the future of
American manufacturing

Prioritize

Emerging Technologies & Manufacturing Challenges

With our singular focus to enhance U.S. Manufacturing Competitiveness by leveraging federal R&D investments in basic research, we prioritize topics for deep-dive workshops/reports based on the following 5 criteria:

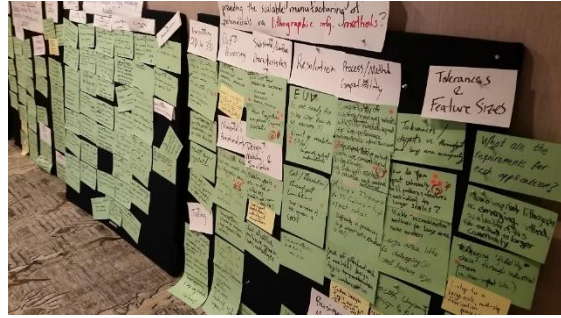
1. Cross-cutting appeal for the emerging technology or the cross-cutting challenge identified
2. Impact on economy, national security, energy production/efficiency, or health outcomes
3. Prior federal government investments in basic research
4. Evidence of industry interest and investment
5. First-mover advantage to the United States

Planning and Executing Workshops

1. Identify 3-5 steering committee members (renowned experts in the field) in consultation with LC members
2. Identify 60-80 potential participants in consultation with Steering Committee members
3. Down select and invite a set of no more than 40 *diverse* participants
4. Prepare a read-ahead on challenges and state-of-the art in collaboration with steering committee members
5. Seek written input on new ideas from invited participants
6. Develop and share the agenda and expected outcomes (in advance of the workshop)
7. Engage a professional moderator (MForesight staff working in close collaboration)
8. Identify 1-3 actionable recommendations by the end of the day of the workshop
9. Follow up for detailed analysis and interview additional experts identified
10. Participants contribute where appropriate
11. MForesight staff develops first draft in consultation with the steering committee
12. Participants review and make suggestions to the first draft
13. Peer review by three independent experts
14. Preparation of Executive Summary in collaboration with the steering committee
15. Final draft preparation – organization, editing, formatting, etc.
16. Develop a blog-post for non-technical audience

Develop

Actionable Recommendations



1. R&D Priorities
2. Implementation challenges
3. Related policies



- Deep Dive Workshops:
 - 50% Industry, 25% Academia, 25% Government
 - Community-led Steering Committee
- Industry interviews
- Roundtables
- Internal Research



Technology Workshops

Example – Multiple Round Table discussions to address a 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

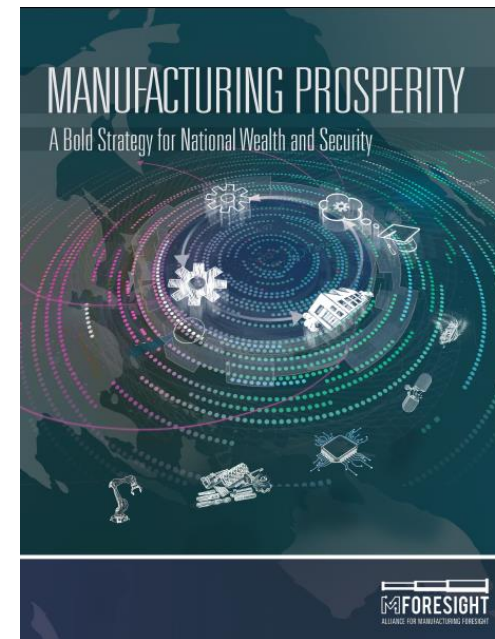
Indianapolis, IN



Boston
Scientific



Detroit, MI



2018



2019

Disseminate

Capitol Hill Briefings



HOUSE
**MANUFACTURING
CAUCUS**
CO-CHAIRS TOM REED and TIM RYAN



M Foresight celebrated the release of the report *Cybersecurity for Manufacturers: Securing the Digitized and Connected Factory* by giving a briefing in Washington, DC on Friday, September 22.



Disseminate

Informing National Action

Reports and Briefings



Dissemination Partners

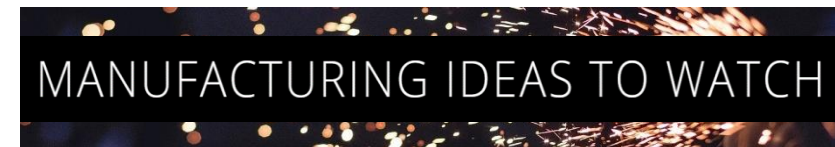


Op-eds

“How the U.S can Rebuild Its Capacity to Innovate” – Harvard Business Review

“America is outsourcing innovation and we need to bring it back” – The Hill

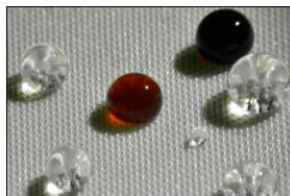
Digital



MForesight.org
MFORESIGHT ON MEDIUM

ENGAGING THE U.S. MANUFACTURING COMMUNITY TO DISCOVER, PRIORITIZE, DEVELOP, AND DISSEMINATE EMERGING TECHNOLOGIES AND MANUFACTURING NEEDS ALIGNED WITH NATIONAL PRIORITIES.

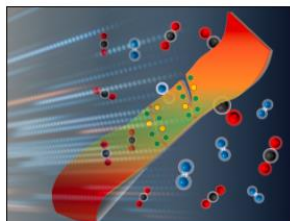
MANUFACTURING IDEAS TO WATCH



CHEMICAL VAPOR DEPOSITION OF WATERPROOF COATINGS ON NATURAL FIBERS



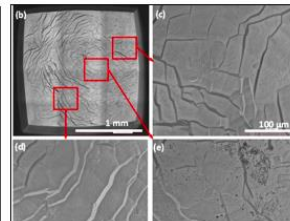
MIND-READING QUALITY CONTROL



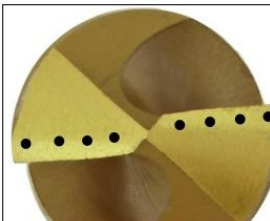
SELF-HEALING POLYMERS MOVING FORWARD



TITANIUM AND CARBON FIBER ULTRASONIC BONDING



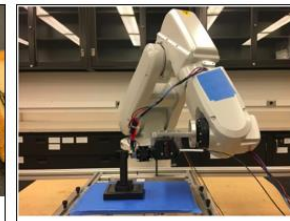
TOWARDS LOW-COST DIAMOND ELECTRONICS



REAL-TIME DRILL BIT HEALTH MONITORING



"WRITING" GRAPHENE ON ORGANIC MATERIALS



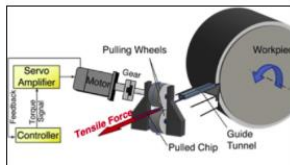
SIX-AXIS ADDITIVE-SUBTRACTIVE MANUFACTURING



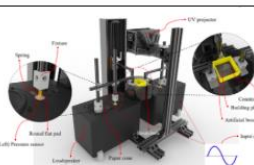
TURNING FOOD PROCESSING WASTE INTO USEFUL BIOGAS



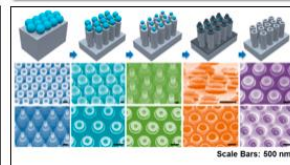
FAST, LOW COST, HIGH DENSITY METAL 3D PRINTING USING JOULE HEATING



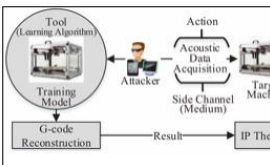
CHIP-PULLING FOR REDUCED CUTTING ENERGY AND TOOL FORCE



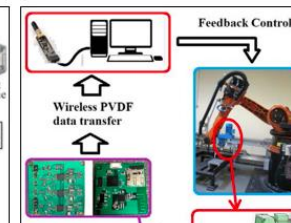
IMPROVING STEREO LITHOGRAPHY SEPARATION USING VIBRATIONS



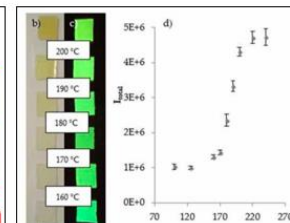
SCALABLE THREE-DIMENSIONAL NANOSTRUCTURE FABRICATION



INTELLECTUAL PROPERTY THEFT USING ACOUSTICS OF ADDITIVE MANUFACTURING



WIRELESS FORCE SENSORS IMPROVE ROBOTIC MILLING ACCURACY



THERMOCHROMIC POLYMERS FOR EARLY DETECTION OF THERMAL DAMAGE IN COMPOSITES

REPORTS AND IMPACT

Serving as the Voice of the Nation's Advanced Manufacturing Community

Nearly 2000 experts from 38 states participated in our workshops, meetings, and events in the last 18 months

Geographic Distribution of MForeSight Contributors and Events

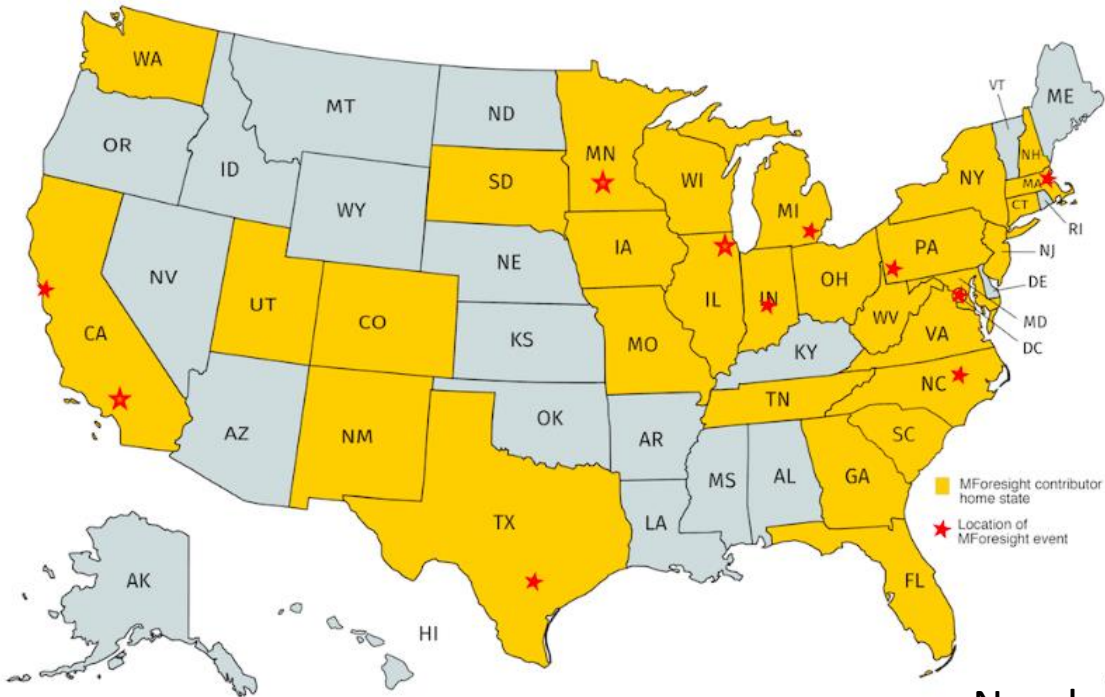
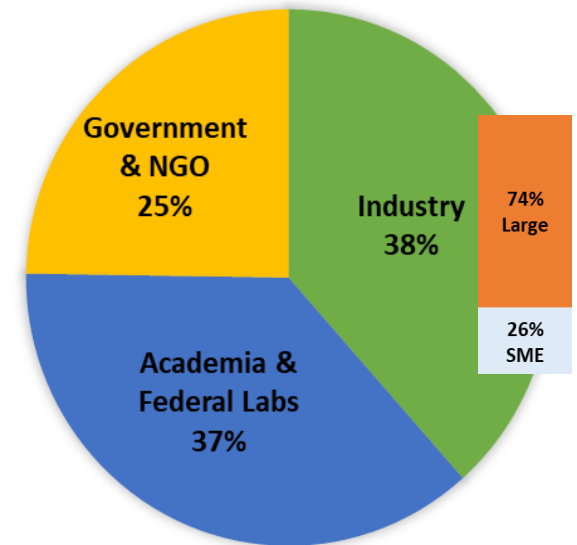


Table 1: Contributor Sectors & Disciplines

Acoustics	Manufacturing Equipment
Additive Manufacturing	Materials
Aerospace	Medical Devices
Automation	Metallurgy
Automotive	Nanotechnology
Chemical	Optics/Photonics
Electronics	Packaging
Energy/Power	Pharmaceuticals
Funding/VC	Plastics
Furniture	Semiconductors
IT/Computing	Systems Engineering
Machinery	Tech Transfer
Manufacturing Education	Technology Policy

Contributor Distribution



Nearly 100,000 website page views, over 1,000 subscribers, ~20,000 report downloads, 50 Medium posts with ~10,000 views, ~ 90,000 impressions

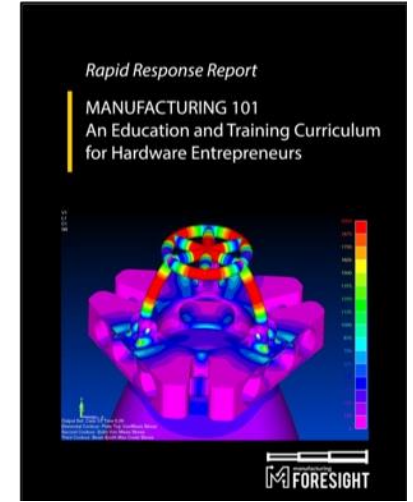
During Yr.3 alone, over 300 members of the advanced manufacturing community provided direct contributions to MForeSight's reports and briefings.

MForeSight Events and Key Partners (Oct 2017-Aug 2018)

MForeSight Events	Key Partners
Manufacturing Prosperity Roundtables	Boston Scientific, Cummins, Massachusetts Institute of Technology, National Association of Manufacturers, North Carolina State University, SME, University of Texas-Austin
Metamaterials Manufacturing	California Institute of Technology, HRL Laboratories, Lawrence Livermore National Lab, Lockheed Martin, PARC (a Xerox company), University of California-Irvine, University of Massachusetts-Amherst, University of Texas-Austin.
High Entropy Alloys	Air Force Research Lab, Arconic Technology Center, Massachusetts Institute of Technology, North Carolina State University, Oak Ridge National Lab, University of Tennessee
Harnessing Material Innovations	The Mineral, Metals & Materials Society (TMS), GE
Practitioner Interviews	SME FABTECH
University-Industry Partnership Forum	Association of University Technology Managers (AUTM), LIFT, TechTown Detroit, Wayne State University
Briefings	White House, Department of Defense, Department of Commerce, House Manufacturing Caucus, Materials Research Society, ASME, SME
Outreach Events	SSTI, NAMRC, IMTS, STEM on the Hill
MForeSight National Summit	DEKA , Harvard Business School, Rockwell Automation, White House, DoD, DoE, DoC, House Manufacturing Caucus, U.S. Senate, ITIF, ARPA-E, EWI, SCRA, Eccalon, Cascade Engineering, Univ. of Buffalo, UT-Austin, MIT, SEMI

Reports & Impacts

- Rapid Response Report (jointly requested by US Army, FDA and NIH) on “Biomanufacturing Technologies for Regenerative Medicine”
 - Informed the solicitation for a new ManufacturingUSA institute on Regenerative Medicine (ARMI – New Hampshire)
- “Manufacturing 101: An Education and Training Curriculum for Hardware Entrepreneurs”
- “Democratizing Manufacturing: Bridging the Gap Between Invention and Manufacturing”
 - Impact: DoE has created a new program called ‘Build4Scale’ based on MForesight’s report recommendations.



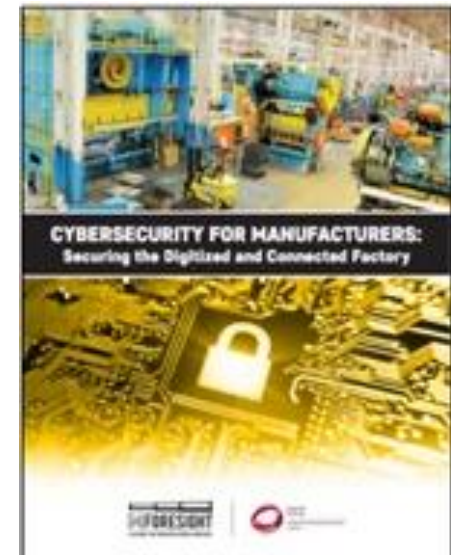
As Senior Policy Advisor for Advanced Manufacturing at the White House Office of Science and Technology Policy during MForesight's first two years of existence, I was a recipient of MForesight's rapid, thorough, and insightful investigations into advanced manufacturing technologies critical to America's competitiveness. **Dr. Megan Brewster, Vice President – Launch Forth**



Reports & Impacts

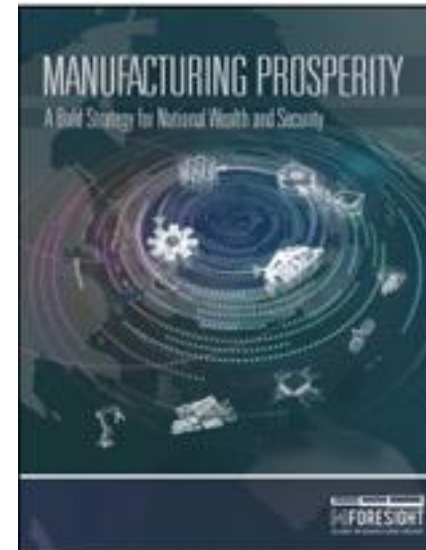
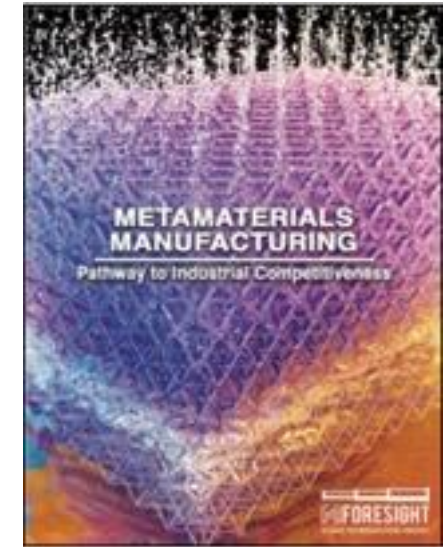
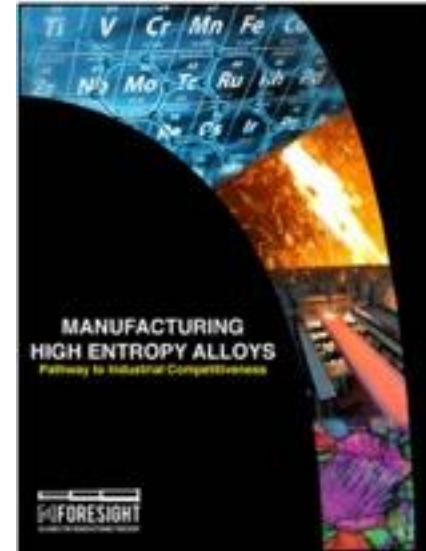
- “Ensuring American Manufacturing Leadership Through Next-Generation Supply Chains”
 - Nominated for Daniel Meckstroth Award for Excellence In Manufacturing Research
 - Impact: New MEP initiatives

- “Cybersecurity for Manufacturers: Securing the Digital and Connected Factory”
 - Workshop conducted in collaboration with Computing Community Consortium (CCC)
 - Impact: Informed DoD’s activities at MxD, new research at CESMII, and a DoE solicitation for a new ManufacturingUSA institute on Cybersecurity for Manufacturing



Reports & Impacts

- “Manufacturing High Entropy Alloys: Pathway to Industrial Competitiveness”
 - DOD and DOE are planning a joint-solicitation
- “Manufacturing Prosperity: A Bold Strategy for National Wealth and Security”
 - Impact: Congressional initiatives to support manufacturing; SBA reauthorization; draft Executive Order; New Senate bill announced to create a National Institute of Manufacturing; article in *Harvard Business Review*

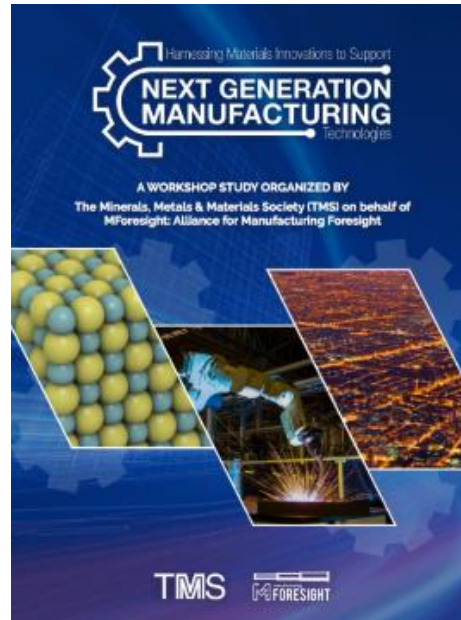




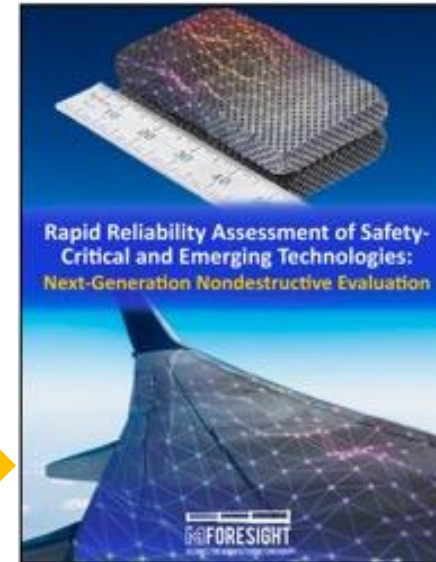
Harnessing Materials Innovation to Support Next Generation Manufacturing (TMS-MForesight Report)

Leading experts in the materials and manufacturing community identified 7 areas of innovation that are likely to have significant impacts on the next wave of U.S. manufacturing.

1. **Analytics for Nondestructive Evaluation (NDE) and Sensors**
2. Joining of Dissimilar Materials
3. Machine Learning for Accelerated Materials Discovery and Design
4. Qualification for New Materials and Processes
5. Next-Generation Conductive Materials
6. Materials for Smart Manufacturing & Digital Thread Technologies
7. Smart Materials



Nondestructive Evaluation & Sensors



The MForesight workshop was able to bring together a range of thought leaders from the community and to identify and document many of the significant challenges as well as proposals for a path forward to address critical quality, reliability and safety needs - **Prof. Leonard Bond, Iowa State Univ.**

I have been working in the NDE industry for over 30 years. The MForesight workshop on current and future NDE challenges and opportunities was the most effective gathering of its type I have ever attended. - Dr. Gary Georgeson, Senior Technical Fellow, NDI, Advanced Inspection Technology , Boeing Research & Technology

Annual National Summits in D.C.

M Foresight's National Summits held in D.C. for the past four years were well attended by senior leaders from academia, industry, federal government and non-governmental organizations

AMERICA'S NEW MANUFACTURING MOMENT - MFORESIGHT NATIONAL SUMMIT 2016



AMERICA'S NEW MANUFACTURING MOMENT
THURSDAY, SEPTEMBER 29, 2016 | WASHINGTON, DC
The Mayflower Hotel
mforesight.org/national-summit-2016
Twitter Hashtag: #MForesight16



M Foresight in a relatively short period of time has become an important mechanism for furthering U.S. advanced manufacturing, working very effectively with industry, universities and government. It's annual advanced manufacturing summits **have become the "Go To" events ...** - **Bill Bonvillian**, Massachusetts Institute of Technology

In Summary...

- MForesight has evolved significantly in three short years
 - Established efficient and effective processes
 - Developed a vast network of participants from across the nation representing a wide range of industry sectors and engineering disciplines.
 - Active participation by the Leadership Council members in various activities & events.
 - Partnerships with established organizations, including many professional societies
- Demonstrated ability to convene very high-caliber individuals from diverse backgrounds to participate and contribute to workshops, round-table discussions and annual summit.
- Actionable recommendations outlined in multiple reports have led to new initiatives.