California Regional Manufacturing Center (CA RMC)

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CA RMC Director
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Accelerating
Your Smart Manufacturing Transformation
Overview

- Smart Manufacturing?
- Why CESMII, the Smart Manufacturing Institute
- CA-RMC Team
- Demonstration Centers
What is Smart Manufacturing?

The ability to take action, in real time, to OPTIMIZE assets in the context of business strategies and imperatives.
Affordable, Accessible, Innovative and Secure Intelligent, Seamless & Collaborative Networked-Based, Smart Manufacturing

**Connected Supply Chain**
- Agile
- Demand Driven
- Raw Material to Finished Product

**Energy Efficient**
- Lower emissions
- Less energy used
- Green manufacturing

**Safe Production**
- Improved safety
- Fewer incidents
- More user friendly

**Sustainable Production**
- Higher value products
- Data for decision making
- Product Lifecycle Management

**Optimization**
- Asset Utility/Zero Downtime
- Quality/Zero Defects
- Reliable results

**Smart Factory**

**Supply Chain**

**Smart Grid**

**Business Systems, ERP**

**Distribution Center**

**Customer**
Smart Manufacturing

A Comprehensive Approach to Manufacturing

...to achieve:
- Connected Supply Chain
- Plantwide Optimization
- Sustainability & Safety
- Increased Productivity
- Effective Risk Management
- High Quality Products
- Innovation
- Great Customer Service
SMLC and CESMII Road

- DOE defined industry’s requirements for Smart Manufacturing.
- DOE released RFP for Smart Manufacturing FY15.
- SMLC and others submitted response.
- DOE awarded contract to SMLC FY16.
- SMLC and DOE jointly outlined program objectives, FY16.
- SMLC created CESMII to be the preforming institute FY16.
- CESMII kickoff event held at UCLA Fed 23rd.
- Program infrastructure phase 1 standing up, 6 months.
- We are here today.
A National Network of Institutes focused on advanced manufacturing technologies

The NNMI

DOD Funded:
America Makes
3D Printing / Additive Manufacturing
Youngstown, OH

DMDII
Digital Manufacturing & Design
Chicago, IL

LIFT
Lightweight Metals
Detroit, MI

AIM Photonics
Photonics
Rochester, NY

FLEXTECH Alliance
Flexible Hybrid Electronics
San Jose, CA

DOE Funded:
Power America
Wide Bandgap Semiconductors
Raleigh, NC

IACMI
Composites
Knoxville, TN

CESMII
Smart Manufacturing
Los Angeles, CA

Unawarded Institutes:
Revolutionary Fibers & Textiles
Smart Manufacturing:

*Advancing Sensing, Controls, Platforms & Modeling for Manufacturing*

$140+ Million in Public-Private Investment
Our Institute will:

- Provide Breakthrough Capability to Drive Energy Reduction by $195 B
- Be Industry Led and Driven
- Service all Manufacturing Segments
- Develop the Workforce and Job Creation
- Be Open to All Size of enterprises
- Achieve Financial Independence in 5 Years or less

CESMII Objectives
CESMII
A National Network of Capability
Headquartered in LA

Northwest
California
Northeast
Southeast
Gulf Coast
The Regional Manufacturing Centers

- Test Bed Pipeline
- Drive Membership
- Develop Technology
- Implement SM Projects
- Participate in CESMII LRP
- Regional Workforce Development and Training
- Members of Advisory Committees
- Regional Budget Management
US Manufacturing Has Regional Diversity

[Map showing the diversity of US manufacturing by region with specific data points for states and regions.]

- Northwest: 1229 TBtu
- California: 366 TBtu
- California GDP: 192
- Large Med. Small: 240, 20,000, 35,000
- Gulf Coast: 1485 TBtu
- Gulf Coast GDP: 220
- Large Med. Small: 256, 1,700, 22,000
- Northeast: 1621 TBtu
- Northeast GDP: 322
- Large Med. Small: 342, 1,700, 19,000
- Southeast: 1610 TBtu
- Southeast GDP: 151
- Large Med. Small: 322, 2,900, 42,000

[Map legend and data labels for states and regions, indicating energy consumption and GDP.]
Regional Centers

Each regional center is operated according to three key tenets:

- R&D
- Workforce Development
- Testbed Infrastructure
CA RMC Team

CESMII CA-RMC
Director
Dale Turner
Technology Manager
Xiaochun Li / UCLA
Workforce Development & Training IPT

CESMII HQ, Embedded
Membership / Outreach Recruitment IPT
Project / Proposal Reponses IPT

Smart Manufacturing Implementation IPT Team
Northern California Demonstration Center
3D Printing, Simulation and Advanced Manufacturing
NOC-RDC Coordinator: Tarek Zohdi

CA-RMC Testbed Ecosystem
UCB
UCI
UCLA

Sotheen California Demonstration Center
Telecommunications and Information Technologies (Calit2)
SOC-RDC Coordinator: G.P.Li

CMTC
Workforce Development, Training and Delivery Services for CA-RMC
UCI
California State University Northridge (CSUN)
University of Missouri
University of Southern California (USC)

UCB
CMTC
UCI
UCLA

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CMTC
Workforce Development, Training and Delivery Services for CA-RMC
UCI
California State University Northridge (CSUN)
University of Missouri
University of Southern California (USC)
# Smart Manufacturing Capabilities

**CA RMC contains a wealth of Smart Manufacturing capabilities...**

<table>
<thead>
<tr>
<th>Unique Technical Capabilities</th>
<th>University of California Berkeley (UCB)</th>
<th>University of California Irvine (UCI)</th>
<th>University of California Los Angeles (UCLA)</th>
<th>University of Southern California (USC)</th>
<th>California State University Northridge (CSUN)</th>
<th>California Community Colleges (CCC)</th>
<th>Centers for Applied Competitive Technologies (CACs)</th>
<th>Michigan Technological University (MTU)</th>
<th>Missouri University of Science &amp; Technology (MS&amp;T)</th>
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</thead>
<tbody>
<tr>
<td>Internet of Things (IoT)</td>
<td>• Internet of Things (IoT)</td>
<td>• Smart worker workflow</td>
<td>• Sensors, wireless systems &amp; control</td>
<td>• Robotics &amp; Automation</td>
<td>• Software development &amp; software systems</td>
<td>• Automation &amp; Robotics Technologies</td>
<td>• Automation</td>
<td>• Process Simulation</td>
<td>• Peaslee Steel Manufacturing Research Center</td>
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<tr>
<td>Modeling &amp; Control</td>
<td>• Ultra precision sensing</td>
<td>• Cybersecurity</td>
<td>• High Performance Computing</td>
<td>• Internet of Things (IoT)</td>
<td>• Electric &amp; Hybrid Automotive Technology</td>
<td>• Carbon Fiber Composites Manufacturing</td>
<td>• System Analysis</td>
<td>• System Analysis</td>
<td>• MidAmerica Regional Microgrid Education &amp; Training</td>
</tr>
<tr>
<td>High Performance Computing</td>
<td>• Semiconductor process design &amp; control</td>
<td>• Micro/Nano design &amp; fabrication</td>
<td>• Augmented Reality / Virtual Reality (AR/VR) workflow modeling</td>
<td>• Sensors</td>
<td>• Real Time Analysis &amp; Control Systems</td>
<td>• Electronics Technology</td>
<td>• Bioenergy production</td>
<td></td>
<td>• Advanced sensors</td>
</tr>
<tr>
<td>Hybrid robotically-enabled manufacturing systems</td>
<td>• Smart worker IoT workflow</td>
<td>• Sensor systems &amp; control</td>
<td>• Science-based &amp; data-based modeling</td>
<td>• Smart manufacturing platform</td>
<td>• Advanced Sensors</td>
<td>• Industrial Automation</td>
<td>• Clean Energy manufacturing</td>
<td></td>
<td>• Multi-scale, multi-physics modeling &amp; simulation</td>
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## Smart Manufacturing domain expertise

**CA RMC Smart Manufacturing knowledge by industry's...**

<table>
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<tr>
<th>Technical Domain Expertise</th>
<th>Petroleum &amp; Coal Products</th>
<th>Primary Metals</th>
<th>Food &amp; Beverage Processing</th>
<th>Chemicals</th>
<th>Non-Metallic Mineral Products</th>
<th>Paper Products</th>
<th>Fabricated Metal Products</th>
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</thead>
<tbody>
<tr>
<td>• Life Cycle Analysis</td>
<td>• Additive manufacturing (metal-based 3D Printing)</td>
<td>• Chemicals and biologicals analysis</td>
<td>• Systems Analysis</td>
<td>• Carbon MEMS</td>
<td>• Process design</td>
<td>• Additive Manufacturing (metal-based 3D Printing)</td>
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<tr>
<td>• Bioenergy production</td>
<td>• Solidification processing</td>
<td>• Light metals</td>
<td>• Sensors</td>
<td>• Semiconductor micro-electronics</td>
<td>• Systems Analysis</td>
<td>• Thin sheet metal stamping, machining, assembly</td>
<td></td>
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<tr>
<td>• Petroleum Production &amp; Engineering</td>
<td>• Metallic nano-composites</td>
<td>• Additive manufacturing (metal-based 3D Printing)</td>
<td>• Composite Fabrication</td>
<td>• Sensors</td>
<td>• Process Measurements &amp; Controls</td>
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<td></td>
</tr>
<tr>
<td>• Energy Data Management &amp; Analysis</td>
<td>• Energy Instrumentation</td>
<td>• Life Cycle Analysis</td>
<td>• Embedded control system</td>
<td>• Actuators</td>
<td>• Process Simulation</td>
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<td>• Energy Instrumentation</td>
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California Economy
Diverse economy across both geography and industries

- 8th largest economy in the world
- Rich manufacturing cross-section
  - Manufacturers encompass virtually all industries
  - Over 96% of manufacturers are small and medium-sized
- Strong technology industry presence
  - Silicon Valley
  - Silicon Beach
- Progressive energy state
  - State policies
  - Public support
California Economy

California Energy Data Analysis Reflects a Diverse Manufacturing Ecosystem
CESMII is closely aligned with the Manufacturing Extension Partnership (MEP) Program
Nationally, MEP Centers are supporting technology transfer at nine Manufacturing USA Institutes

- MEP Embedded Staff Program
  - In residence at the Institutes
- EMUSA Leadership Group
  - Facilitating collaboration opportunities across institutes
The CA RMC Ecosystem is ready to serve our members

Northern California Demonstration Center

**Unique Capabilities:**
- Extensive 3D Printing Facilities
- Extensive simulation technologies
- Paul Wright: primarily advanced manufacturing and energy
- Tarek Zohdi (UCB Coordinator/PI): primarily adv. manufacturing and simulation
- The ME Manufacturing Group

**Technologies Demonstrated:**
- CAD to Print Technologies
- Printing of Multi-physical Materials

**Other Participating UCB Centers:**
- The UC Berkeley COE
- The Jacobs Institute for Design Innovation
- Center for Information Technology Research in the Interest of Society
- Computational and Data Science and Engineering Program

University of California Berkeley

3,500 Ft² Demonstration Facility planned for Etcheverry Hall, Department of Mechanical Engineering
The CA RMC Ecosystem is ready to serve our members

Southern California Demonstration Center

Unique Capabilities:
- Microsemi IoT Innovation Lab
- Class 100/1,000 sensors/actuators fabrication facility
- AR/VR Visualization
- Ansys IoT Innovation/Simulation Center
- IBM Watson Think Tank for Advanced Manufacturing
- Evoke Lab for User Experience Design

Technologies Demonstrated:
- Workflow centric worker/machine interactive collaboration system
- Cognitive Digital Twins for Reduced Order Modeling
- Augmented/Virtual Worlds for game based simulations
- Cognitive learning systems
- User centric actionable information display

Other Participating UCI Centers:
- Cyber-Physical Systems
- Advanced Power and Energy Program
- Institute for Virtual Environments and Computer Games
- Institute for Design and Manufacturing Innovation

3,000 Ft² Demonstration Facility
The CA RMC Ecosystem is ready to serve our members

Smart Manufacturing Test Bed Capabilities

- Real time integrated process and materials modeling, via reduced order/dimensionality modeling, improved numerical algorithms and co-processors
- Data assimilation and “real time” data analysis of process
- 9600 sq. ft. class 100/1000/10,000 clean room facility
- Power Electronics for smart grid integrated electric vehicle manufacturing
- Machine learning

- Design, fabrication, and embedding of sensors and wireless systems for harsh manufacturing environments
- Smart grid and energy use optimization
- High fidelity models and simulation schemes for chemical plants, energy systems, materials manufacturing processes and water treatment
- Discrete Element, Finite Element and Finite Difference methods
- Smart sensors and distributed controls
- Sustainable Production

- Advanced Manufacturing, Composites, Modeling, Characterization
- Data processing & management, cloud manufacturing software, cyber security & trustworthiness software,
- Adaptive real-time control, adaptive-dynamic programming based control, iterative process control, optimal control techniques, resilient networked control systems

Berkeley
UC Irvine
UCLA
USC University of Southern California
Missouri S&T
The CA RMC Ecosystem is ready to serve our members

**Workforce Development Capabilities**

- Device/Software Scalable Augmented/Virtual Reality Technology Enabled by Smart Worker IoT data derived from CESMII Testbed operations
- Enhanced with Cognitive Digital Twins of process and workflow simulations augmented with CESMII platform data
- Training students to map and analyze energy use in the built environment
- Automation Lab with rapid prototype, 3-D Printers and the latest CNC machines
- Micro-grid demonstration by employing renewable energy and alternative fuel source
- Curriculum development
- Apprenticeship and internship development
- Certificate and degree program development
- Comprehensive career pathways development (K-12, Community Colleges and University partnerships)
- Customized training in all areas of manufacturing

**Institutions**

- UC Irvine
- UCLA
- USC University of Southern California
- CSUN
- Michigan Tech
- SF State
California RMC Capabilities Summary

Sensors, Controls & Algorithms, Platforms, HPC

Energy Sustainability, Economic Development, Workforce Development, etc.
Hold Questions