National Association of State Energy Officials (NASEO) Webinar April 28, 2025

Impacting Operational Performance and Energy Productivity Through Smart Manufacturing



Haresh Malkani, CTO



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The Storyline **Smart Manufacturing** – Definition, Building Blocks

CESMI* – Who we are, What we do

Our Strategy – Technology, Education, Ecosystem

Use Cases – Relevant Project Examples

Q&A

* Collaborative Ecosystems for Smart Manufacturing Innovation Institute

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Smart Manufacturing is...

Information-based, event-driven, efficient and collaborative orchestration of business, physical and digital processes within plants, factories and across the entire value chain.





Smart Manufacturing is...

...the information-based, event-driven, efficient and collaborative orchestration of business, physical and digital processes within plants, factories and across the entire value chain.





SM Technology Building Blocks and Information Flow







mission. strategy. role.

Driving the **next wave** of manufacturing productivity, energy productivity and competitiveness through smart manufacturing innovation.



2017

Founded by the **D.O.E**, A Program in **UCLA**



\$200M+

Private/public partnership



Improve energy productivity

through sensing, control, modeling, analytics & platform technologies

How.

Fund the Innovation and R&D necessary to dramatically **reduce the cost & complexity** of using real time operations data to drive revenue & cost improvements.

CESMII represents the **voice of manufacturing;** engaging the smart

Menbers

through a membership model



Manufacturers Small, Medium & Large



System Integrators & Consultants







Technology Providers



Academia & Labs



The **CESMII** Story

THE SMART MANUFACTURING INSTITUTE

Develop SM technologies to solve manufacturing problems



SM Building Block Technologies

Energy Intensive Industries



10-25% reduction in energy for steel and cement industries

- Senergy Productivity
- **Quality**, Yield, Waste

P

Oecarbonization

Accelerate SM Adoption in SMMs and Supply Chain

SM Innovation Platform, Profiles, Marketplace

Small & Discrete Manufacturing



25-50% reduction in SM implementation costs

- Performance & Productivity
- Implementation Cost/Complexity
- SMM & Supply Chain Adoption

Upskill the Workforce Through Education, Training



SM Education and Training

Talent Pipeline & Incumbent Workforce



6+ new curriculums, >6000+ students and professionals trained



Smart Manufacturing Innovation Centers (Dissemination of Technology and Training)



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Accelerating the Democratization of Smart Manufacturing

CESMII is enabling smart, sustainable operations for ALL manufacturers, driving the next wave of manufacturing productivity, energy productivity and competitiveness through smart manufacturing innovation.





Industries We Impact



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Low Cost, Low Complexity Smart Manufacturing

One Investment in Data Collection Infrastructure (based on standards), Many Applications





Providing Tools & Ecosystem Support for Manufacturers

During every phase of their journey...





Meeting manufacturers 'where they're at'







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Smart Manufacturing Innovation Centers

CESMII enables businesses of all sizes to connect assets to our SM Interoperability Platform while advancing policy, industry awareness, and workforce development through SMIC satellite locations.





Relevant Use Cases



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Impacting Operational Efficiency and Energy

Platform







Model based **simulation** Process **optimization** Process **Analysis**

> Performance Productivity Precision

Realtime **decisions** Predictive **analytics** Optimized **control** ✓ Optimized Manufacturing **Process**

- ✓ Improved Equipment **Performance**
- ✓ Improved **Productivity**
- Reduced Waste
- ✓ Improved Yield
- ✓ Improved Quality







Smart Manufacturing for Cement

University of Louisville, Argos USA



- Lab scale kiln constructed and instrumented with burner and sensors for conducting experiments
- Multi-physics thermal and flow models developed and validated with instrumented kiln
- Machine learning model developed to predict clinker quality based on operational parameters
 - Real-Time Process Assessment and Control System developed for energy optimization

Significance and Impact: Validated multi-physics predictive models will lead to optimized operating conditions contributing to up to 15% reduction in energy usage in production kilns



Smart Manufacturing in Steel Continuous Casting

ArcelorMittal, RPI, Purdue, Missouri Science & Technology University

3D Sliding and Debonding Sensor



Liquid Core and Plugging Detection





Optical Strain Sensing



Continuous Caster Digital Twin

- Data acquisition infrastructure implemented and configured for caster health monitoring
- Advanced strain measurement and 3D displacement sensors to detect liquid core in continuous steel caster developed and tested
- Digital twin for simulating caster operation developed and demonstrated for maintenance applications
- Machine learning based model developed to predict caster plugging.

Significance and Impact: Realtime sensing and predictive modeling will improve caster performance and downstream product quality. Potential impact of \$90M in energy savings for steel industry from improved quality, and \$2M/strand from predictive maintenance.



Smart Manufacturing in Chemical Industry

Texas A&M, Emerson, AspenTech, PSE, RPI, OSISoft, UT Austin



- Steady state and dynamic models (Digital twins) developed and validated for predicting operational behavior of Air Separation Unit (ASU)
- Surrogate models developed for ASU control application including fault detection, real-time optimization, scheduling and predictive control
- Real-time asset monitoring solution for the ASU and auxiliary equipment has been implemented
- Asset templates for ASU equipment developed

Significance and Impact: Predictive modeling and real-time monitoring for air separation units will lead to increase in operating efficiencies and energy savings worth \$10M/yr for one large manufacturer, with potentially similar impact to other manufacturers with similar ASUs.



Smart Manufacturing in Food Industry

ThinkIQ, General Mills



Energy as ingredient

YP GREEK FAT ULTRA MILK 577.76 kw	Historical	Integrating ML & Pr	ediction
681,469 lb 0.848 W/lb	3.097 10	💐 ThinkiQ	Logged in as Holger Amort Log out IM
YP GREEK GOODBELLY MILK 276.47 kw 435,756 lb 0.634 W/lb	Historical 1.784 W/Ib	tions tasks Addet in Report Addets in Report Report Report Report Control Cont	- culation based on object\instance
YP HERCULES STYLE BASE 440.78 kw 35,487 lb 12.421 W/lb	Historical 10.592 W/Ib	Every for Proces Proce	ction based Calculations
YP LIGHT STYLE BASE 2,025.56 kw 852,978 lb 2.375 W/lb	Historical 2.171 W/lb	Exacute to Time Exacute Factore Audity -	eatures
YP ORIGINAL STYLE BASE 18,204.88 kw 8,046,885 lb 2.262 W/lb	Historical 2.244 W/lb	Machine Learning Contractor Dataset Terr and For This From NGC 111 bint from v Autoria - V Stritt bint from v	
YP PAULA STYLE BASE 910.39 kw 393.358 lb 2.314 W/lb	Historical 2.314 W/lb	Mediae Lawrey Constantiae Lawrey Constantia	

- SM Platform installed at two General Mills locations and extensive energy data collection completed
- Equipment and energy ontologies created and captured in data models for both plants
- Machine learning based energy prediction and analytics tools created and implemented
- Energy monitoring tools implemented, and improvement opportunities identified

Significance and Impact: Validated inferred energy tools will contribute to 5% reduction in energy wastage worth national savings in excess of \$2B



Smart Manufacturing in Composite Brake Mfg

Virginia Tech, Honeywell, University of Virginia, Penn State University, Commonwealth Center for Adv. Mfg.



- Data acquisition and platform infrastructure developed
- Computational Models for Energy Consumption and Product Quality Prediction developed & validated
- Process anomaly detection algorithm developed and validated
- Physics based and data driven prediction models developed and validated for process optimization

Significance and Impact: Automated process monitoring and control will lead to a reduction of 15% in energy consumption for Honeywell's CVI process



Smart Manufacturing in Paper

Auburn University, Rayonier Advanced Materials, Georgia Pacific



- Developed a hybrid mechanistic/datadriven soft sensor to enable the accurate prediction of the entrained air content
- Developed a multi-objective control strategy for brownstock washing covering defoamer dosing, wash water flow, and washed pulp quality
- Control strategy tested at industrial sites

Significance and Impact: 72% reduction defoamer usage, and 5% reduction in water usage at industrial facility, and maintaining target pulp quality



