SG 8 – Smart Manufacturing
Alec McMillan, USNC SMB Member, Sponsored by NEMA & Rockwell Automation
Smart Manufacturing Standards

- Manufacturing Automation standards currently address the planned:
  - Safety of plant, equipment and personnel
  - Security of data, and equipment
  - Sustainability and Environmental Regulation Compliance
  - Quality of Product
  - Energy Efficiency of Equipment
  - Lean / Just In Time Material Utilization
  - Machine / Process Diagnostics and Preventive Maintenance

- Smart Manufacturing requires the collection of real time data that can improve decision making in manufacturing value chains which enhances the efficiency and performance of the plant and increases overall productivity.
Manufacturing Value Chain Examples

- MATERIAL: Sourcing of material and its passage through many process stages resulting in the disposal or delivery of material in a product form to a customer
- ENERGY: Sourcing of energy in the form of Labor, Water, Air, Gas, Electricity, Steam, to the consumption and generation of energy of individual processes to the delivery of re-useable energy (e.g. heat, steam) or waste products for recycle purposes.
- PRODUCT LIFE CYCLE: defines the process steps from the creation of the product idea, through the design, prototype, build, assembly, test, delivery, application, use and service of the product.
- FACTORY LIFE CYCLE: addresses the investment, process and automation planning, modeling and simulation of the designed plant, acquisition of plant resources, build and commissioning, production operation, maintenance and the ultimate tear down and disposal of the plant assets.
- SUPPLY CHAIN: addresses the Purchasing and Quality Management of incoming materials and resources, together with the sales, and delivery logistics of the completed products.
- ORDER to ENTRY: addresses order entry, production planning, manufacturing execution systems, production operation including equipment monitoring and control, order status reporting, order delivery, installation, service and invoicing.
- HUMAN RESOURCE MANAGEMENT: organizes the acquisition, training, deployment, development, and maintenance of skilled employees with required capabilities to perform needed functions.
- ACCOUNTANCY: collects cost and utilization data from each of the functions within the organization to manage the ultimate productivity and profitability of the enterprise.
Activity domains within an enterprise

Activity domains differ by functional clusters and decision horizons

References: ISO 15704, IEC 62264, ISO 18435
Value Chains Relative to Enterprise Operations
Smart Manufacturing Enterprise Challenge

- Actionable, accurate validated data delivered to the right place and right time within the enterprise to facilitate improved decision making
- Consistent terminology, definitions and data representation within the industry
- A high level of security and safety integrated within the smart systems deployed
- Ability for the installed base to evolve and adapt to changing production requirements
- Complete Life Cycle Management to be addressed across the enterprise
  - For the Product from Concept to Market to Obsolescence
  - For the Production facility from Concept to Installation, Commission and end of life
  - For the Supply Chain from Initial offer to obsolescence of the product – Asset, Resource and Supply management
  - For the sales order to product delivery and after sales support
  - For Finance from Customer Quote to Cash
The IEC SMB SG8 Smart Manufacturing Goal

- Identify which functions, domains are within the IEC scope.
- Identify which functions, areas are being standardized in other organizations.
- Identify the interfaces, overlaps and gaps within and between domains and functions that need to be addressed by the standards communities.
- Create a standards roadmap of the smart safe secure sustainable enterprise standards activities and create a portfolio of deliverables to form a cohesive set of standards to sustain smart manufacturing system implementation.
- Leverage new technology e.g. Internet of Things, Cloud, Big Data Analytics, new sensor technologies where applicable in the scope.
Standards Enable Smart Manufacturing

Alec McMillan, Director, Global Standards & Trade
Leading global provider of industrial power, control and information solutions

Serving Customers for 110 Years

- Technology innovation
- Domain expertise
- Culture of integrity & corporate responsibility

22,000 EMPLOYEES
80+ COUNTRIES
$6.2B Fiscal 2012 Sales

20+ INDUSTRIES
THE CONNECTED ENTERPRISE

Optimized for Rapid Value Creation

- Supply Chain Integration
- Collaborative, Demand Driven
- Compliant and Sustainable

AGILITY

PRODUCTIVITY

SUSTAINABILITY

Enterprise

Smart Grid

Supply Chain

Distribution Center

Customers

THE CONNECTED ENTERPRISE

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THE CONNECTED ENTERPRIE
Remote sensing of objects and environment

Cameras deployed for monitoring and security

Everything has a URL

7100 kWh of energy used today

Subscribe to my status updates

Just plug me in! I am online and ready for configuration with the line. Here is my configuration

My yield will meet today’s production needs

Clean me next shift

In a plant, it’s not just about data… Integrated Control & Information matters
CONVENTIONAL: SEPARATE IT & AUTOMATION

FUTURE: UNIFIED INFRASTRUCTURE

ENABLER ▶ Common Secure Ethernet Infrastructure
The Connected Enterprise

CHALLENGES

Organizational Alignment

Talent Gaps

Technology Adoption

Security

Standards
Customer Value

- Faster Time to Market
- Lower Total Cost of Ownership
- Improved Asset Utilization
- Enterprise Risk Management
US Industry-Academia Initiatives (a sample)

http://www.iiconsortium.org/about-us.htm
Industrial Internet Consortium

https://smartmanufacturingcoalition.org/
Smart manufacturing (leadership) coalition

http://smartmanufacturing.com/what/
Smart manufacturing web page

http://manufacturing.gov/amnpo.html
NIST advanced Manufacturing Program Office

http://www.nist.gov/cyberframework/
NIST Cyber Security Framework

http://www.cdait.gatech.edu/
Georgia Tech Activities

University of Kentucky Activities

http:\\digitallab.uilabs.org
DIGITAL MANUFACTURING and DESIGN INNOVATION INSTITUTE (DMDII)
The Industrial Internet Consortium®

A global nonprofit partnership of industry, government and academia

The Industrial Internet Consortium (IIC) was founded in March 2014 to bring together the organizations and technologies necessary to accelerate growth of the Industrial Internet by identifying, assembling and promoting best practices. Membership includes small and large technology innovators, vertical market leaders, researchers, universities and governments.

The Industrial Internet Consortium (“IIC”) is a trademark of the Object Management Group®, Inc. (OMG®), a not-for-profit 501(c)(6) tax-exempt organization.
The goal of the IIC is to:

- Drive innovation through the creation of new industry use cases and test beds for real-world applications;
- Define and develop the reference architecture and frameworks necessary for interoperability;
- Influence the global development standards process for internet and industrial systems;
- Facilitate open forums to share and exchange real-world ideas, practices, lessons, and insights;
- Build confidence around new and innovative approaches to security.
The membership of IIC

- Membership is open to those interested in advancing the implementation of the Industrial Internet. Download the one-page overview, the Fact Sheet or visit the Become a Member page for more information.

- Membership: 136 Organizations
  - 81 US
  - 6 Germany, Japan
  - 5 China, UK
  - 4 Taiwan, Canada
  - 1 member from Brazil

  5 Founders (AT&T) Cisco Intel IBM GE

  26 Non Profit
  42 Large
  63 Small

The NIST Engineering Laboratory, through its Cyber-Physical Systems and Smart Grid Program Office, is leading a NIST-wide program to advance Cyber-Physical Systems. The program is moving forward on three fronts:

- The Cyber-Physical Systems Public Working Group (CPS PWG), formed by NIST in 2014, brings together experts to help define and shape key aspects of CPS to accelerate its development and implementation within multiple sectors of our economy. Through its five subgroups, the CPS PWG is preparing a CPS Framework.

- The Global City Teams Challenge is a nine-month initiative to advance the deployment of Internet of Things (IoT) technologies within a smart city environment. More than 40 teams or “action clusters” are pursuing projects related to energy, transportation, public safety, and other key sectors.

- CPS research and standards development are carried out in multiple NIST Laboratories, including programs in advanced manufacturing, cybersecurity, buildings and structures, disaster resilience, and smart grid. A key goal for 2015 is to design and begin development of a CPS testbed to characterize CPS equipment, systems, performance, and standards.
Cyber-Physical Systems or “smart” systems are co-engineered interacting networks of physical and computational components. These systems will provide the foundation of our critical infrastructure, form the basis of emerging and future smart services, and improve our quality of life in many areas. Cyber-physical systems will bring advances in personalized health care, emergency response, traffic flow management, and electric power generation and delivery, as well as in many other areas now just being envisioned. Other phrases that you might hear when discussing these and related CPS technologies include:
- Internet of Things (IoT)
- Industrial Internet
- Smart Cities
- Smart Grid
- "Smart" Anything (e.g., Cars, Buildings, Homes, Manufacturing, Hospitals, Appliances)
Smart Manufacturing

“Information that drives the 21st Century structural shift in manufacturing.”

Smart Manufacturing Leadership Coalition (SMLC) - 501c (6)

Making real-time info available:
• when it is needed,
• where it is needed
• and in the form it is needed throughout the Manufacturing ecosystem

Multi-Layered Smart Manufacturing Workflow Management
Time Managed as Workflow

Machines – People - Materials Dynamic Manufacturing Ecosystem

**Macro Layer**
- Focus: 10x Multiple Pass Variability Reduction; Supply Chain Information

**Meso Layer**
- Focus: 100x Event Variability/Tradeoff Adjustment; Dynamic Performance Mgmt.; Integrated Metrics

**Micro Layer**
- Focus: Insertion, Qualification, ICME, High Fidelity Dynamic Operations

**Design**
- Prototype
- Materials & Process Tech
- Product Manufacturing
- Qualification

**Data**
- Prototype
- Materials & Process Tech
- Product Manufacturing
- Qualification

**Service**
- Prototype
- Materials & Process Tech
- Product Manufacturing
- Qualification

- 10s of control loops
  - Time – days

- 100s of control loops
  - Time - hours

- 1000s of control loops
  - Time - minutes

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**OBJECTIVES**

**Lower cost barriers** for applying advanced data analysis, modeling, and simulation in core manufacturing processes

**Build pre-competitive infrastructure** including network and information technology, interoperability, and shared business data

**Integrate requirements** of small, medium and large enterprises

**Facilitate efforts to secure funding** through public-private and private-private partnerships to address priorities

**Create and provide broad access** to next-generation sensors, including low-cost sensing and sensor fusion technologies

**Develop a standards-based reference architecture** based on industry-driven collaboration with IT suppliers

**Implement R&D projects** for joint investment and execution of SM Systems

**Ensure multi-level cyber security** and protection at a scalable level

**Establish an industry-shared SM Platform** that includes an open architecture software development framework

**Operate industry test beds** for Smart Manufacturing System concepts and make them available to companies of all sizes
Industrial Energy Efficiency Coalition (IEEC)  
A NEMA Industrial Automation program

- **Opportunity** – industrial energy efficiency through systemic implementation of control/automation
  - identify, generate, and promote industry energy efficiency and savings
  - Identify energy savings opportunities especially at the system level (versus product).
  - improve energy efficiency in industrial systems and processes within business ecosystems.

- **Coalition Goals** – unify industry efforts to promote
  - processes, methods, best practices, technologies, and metrics
  - Improve energy efficiency in industry
  - Provide leadership in industrial energy efficiency
Standards-based Interoperability in the Oil and Gas Industry

WCEAM 2012
Daejeon, Korea
October 8, 2012

Alan T. Johnston
MIMOSA President
ISO TC 184/WG 6 Convener
In Cooperation with:
Nils Sandsmark
PCA General Manager
ISO TC 184/WG 6 Co-convener
Current Situation - People, Processes and Systems in Silos

- People
- Processes
- Systems

good enough in the past
ISO TC184 Task Force March 2009 Example

ISO TC184 Manufacturing Asset Management Integration Task Force
Total Asset Life-Cycle Summary

FIATECH
MIMOSA/OpenO&M™

POSC CAESAR

Continuous Improvement Feedback Loops

Product/Asset/Plant/Facility/Vehicle Life-Cycles

Product Design
Asset MFG
Construction
Operations & Maintenance (O&M)
End of Life

SC1 & SC4
Other Standards
IEC TC 65 Standards
SC5, SC5-IEC/JWG5, SC4-SC5/JWG8
OpenO&M & Other Standards
Other Standards

ISO/IEC UID

Services Oriented Architecture Using Standards-based Federated Data Model
The OPEN O & M Initiative

The OpenO&M™ Initiative
Brings People Processes and Systems Together

Enterprise Business Systems
Enterprise Resource Planning (ERP), Enterprise Risk Management

Operations

Physical Asset Control
Real-time Systems

Maintenance
MIMOSA Summary

An Operations and Maintenance Information
Open Systems Alliance

- Organized as a Trade Association in 1997
- A 501 (c) (6) non profit organization
- Funded by membership
  - Suppliers
  - Integrators
  - Researchers/Academia
  - End-Users- Owner/Operators
- Key Standards
  - OSA-EAI – Enterprise Application Integration
  - OSA-CBM – Condition Based Maintenance
  - OpenO&M CIR and ISBM

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Oil and Gas Interoperability Project

ISO TC 184/WG 6
Oil and Gas asset management operations and maintenance Interoperability (OGI)
Technical Specification Project Update

Alan T. Johnston
Convener
Nils Sandsmark
Co-convener

September 23- 25, 2012
Orlando, FL

ISO TC 184/WG 6
The OGI TS specifies the use of a combination of ISO and industry standards to meet the interoperability requirements of the Oil and Gas industry and appropriate closely related industry groups such as the Petrochemical industry.

Major associated deliverables include:

- Industry developed and owned pilot & compliance data sets
  - Downstream Data Set – Plant Light Ends Unit with debutanizer and depropanizer towers
  - Upstream – Rigs and Wells Data Sets – In cooperation with SPE DSATS
  - Upstream Platform Data Set – In cooperation with PCA

- Detailed industry use cases prioritized by owner/operators
  - OpenO&M Digital Handover of O&M information and Provisioning of O&M Systems
  - Upstream Production Optimization
  - OpenO&M Maintenance Use Case

- Industry use case driven pilots
  - Downstream Pilot
  - Upstream Pilot
Questions ?