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SG 8 – Smart Manufacturing

Alec McMillan , USNC SMB Member, Sponsored by NEMA & Rockwell Automation

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Smart Manufacturing Standards

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- 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

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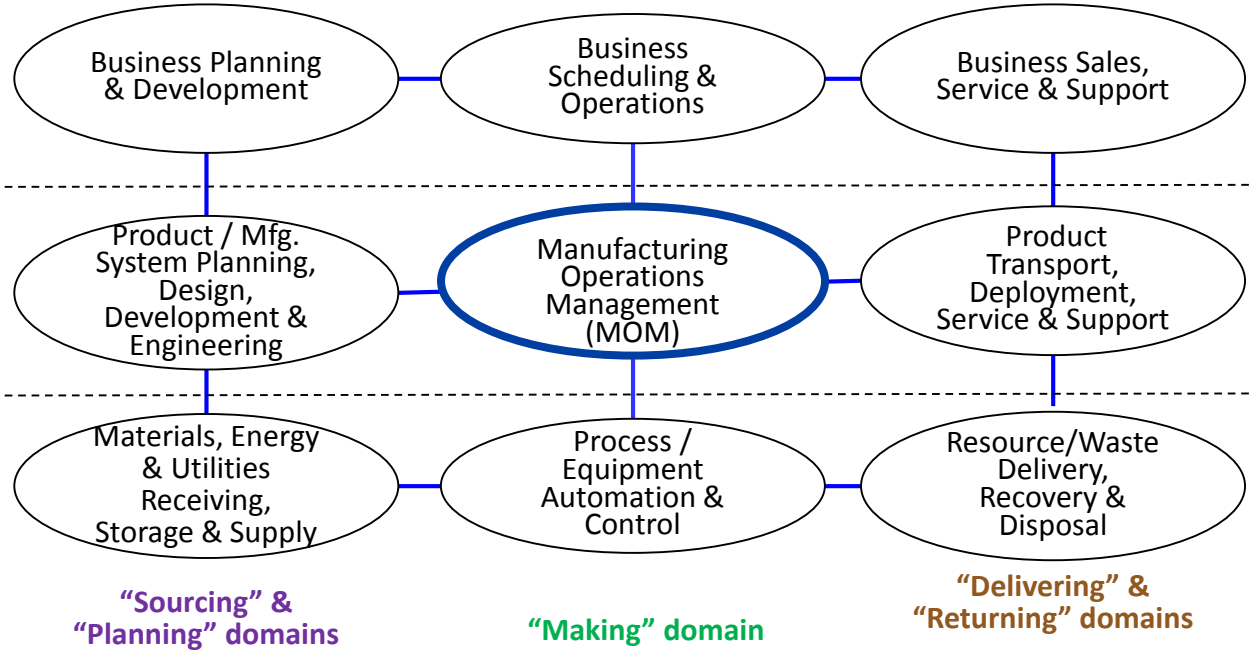
- MATERIAL: Sourcing of material and its passage through many process stages resulting in the disposal or delivery of material in a product form to a customer
- ENERGY: Sourcing of energy in the form of Labor , Water, Air, Gas, Electricity, Steam , to the consumption and generation of energy of individual 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



Level F4
Establishing demand for production, material use, delivery, and shipping. Determining enterprise wide inventory levels.
Time Frame - Months, weeks, days

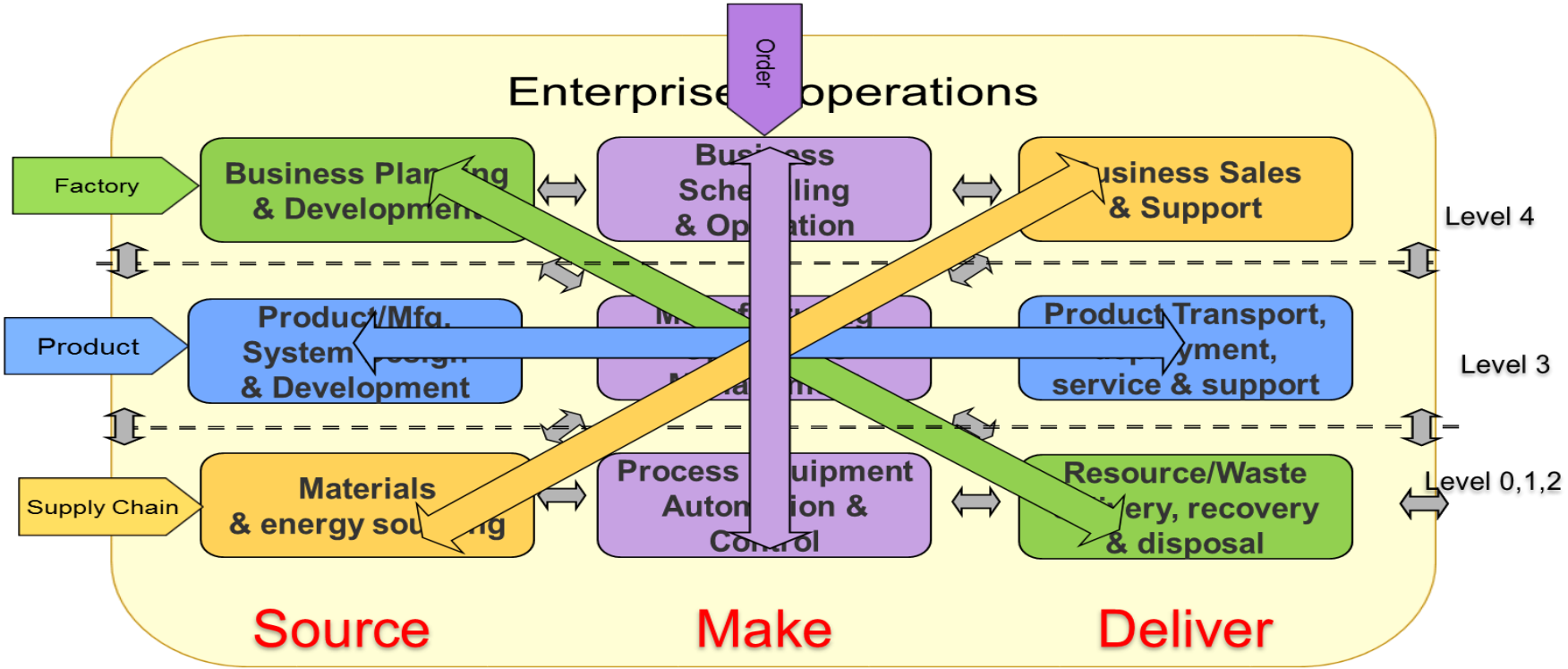
Level F3
Work flow / recipe control, schedule, assign and managed the jobs to produce the desired end products. Maintaining records and optimizing the production process.
Time Frame - Days, Shifts, hours, minutes

Level F2 - Monitoring, supervisory control and automated control of the production process
Level F1 - Sensing and manipulating the production process
Level F0 - Actual physical processes
Time Frame – Hours, minutes, seconds, fractions of a second

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

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- 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

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- 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

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Rockwell Automation at A GLANCE

22,000
EMPLOYEES

80+
COUNTRIES

$6.2B
Fiscal 2012 Sales

Leading global provider of industrial ***power, control and information solutions***

20+
INDUSTRIES

Serving Customers for 110 Years

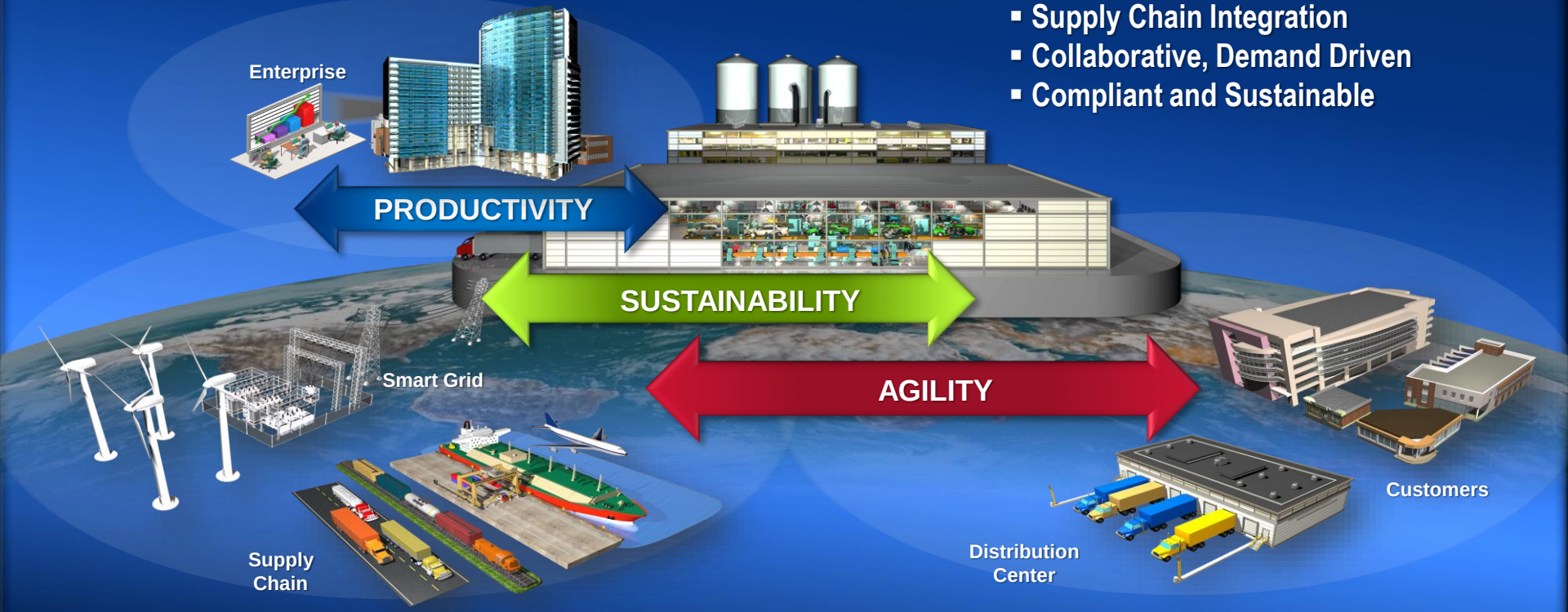
- Technology innovation
- Domain expertise
- Culture of integrity & corporate responsibility

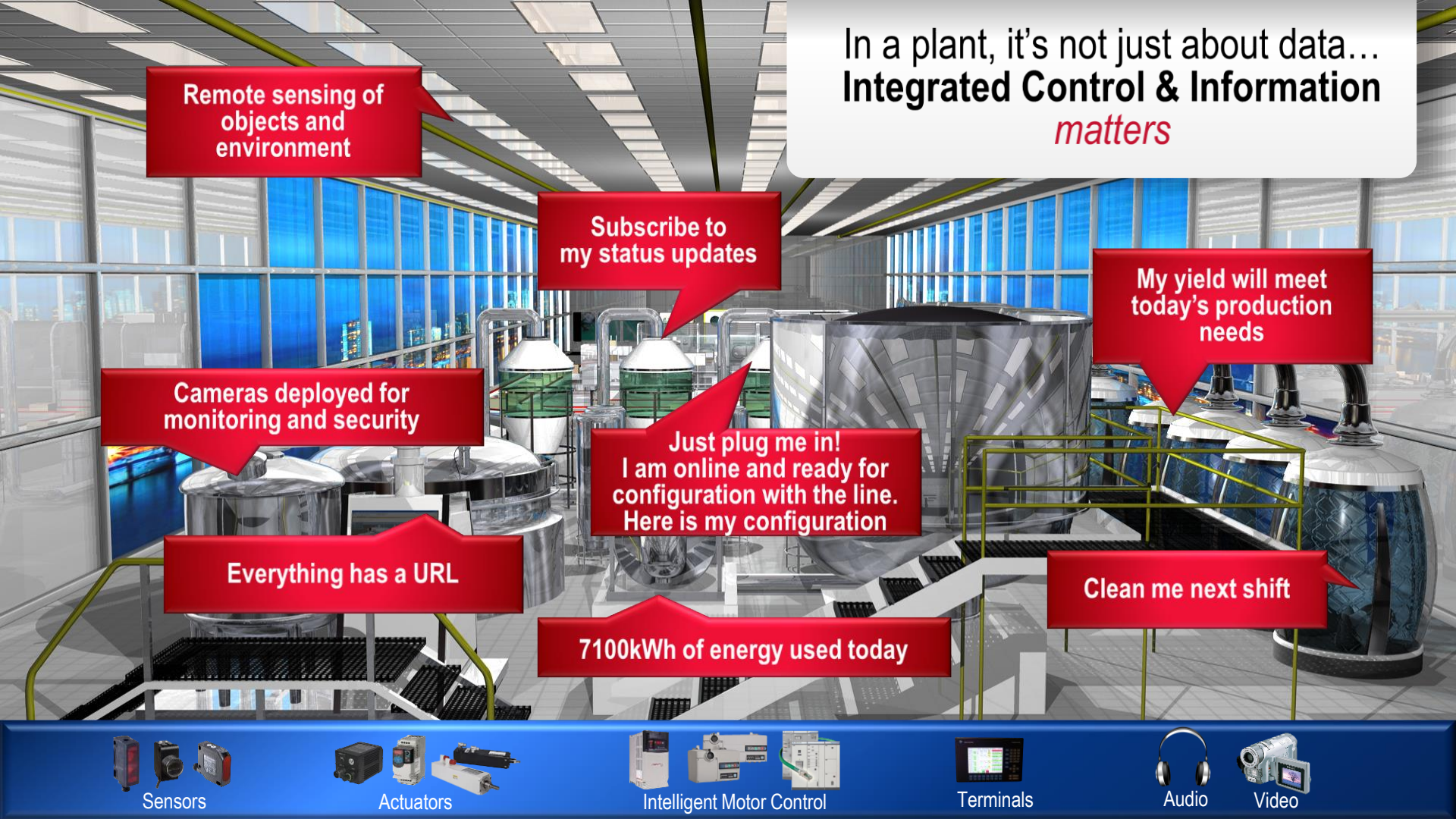
A-B QUALITY

THE CONNECTED ENTERPRISE

Optimized for Rapid Value Creation

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

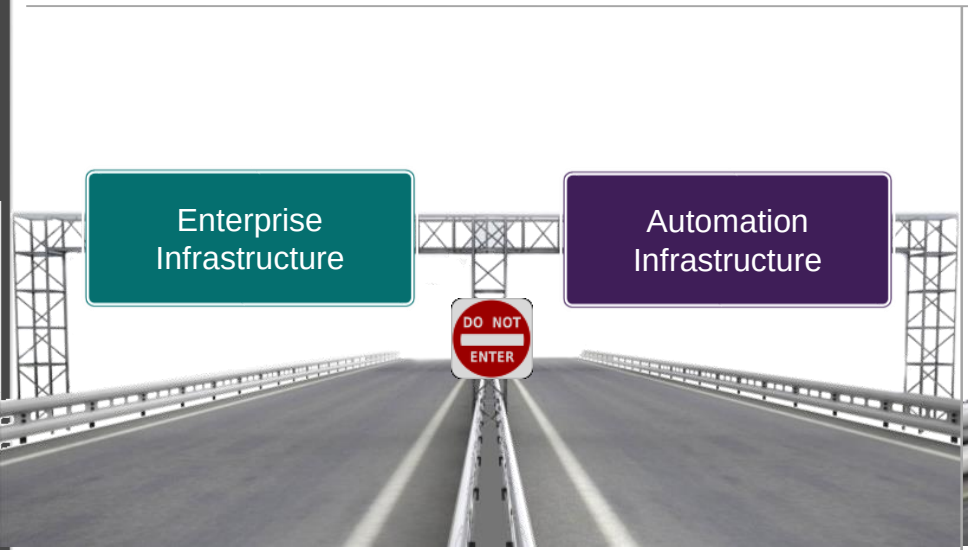



In a plant, it's not just about data…
Integrated Control & Information
matters
Remote sensing of objects and environment
Subscribe to my status updates
My yield will meet today's production needs
Cameras deployed for monitoring and security
Just plug me in! I am online and ready for configuration with the line. Here is my configuration
Everything has a URL
Clean me next shift
7100kWh of energy used today
Sensors
Actuators
Intelligent Motor Control
Terminals
Audio
Video

TRANSFORMATION

INTEGRATED **CONTROL** AND **INFORMATION**

ENABLER ▶ Common Secure Ethernet Infrastructure



CONVENTIONAL: SEPARATE IT & AUTOMATION

FUTURE: UNIFIED INFRASTRUCTURE

The Connected Enterprise
CHALLENGES

- Organizational Alignment
- Talent Gaps
- Technology Adoption
- Security
- Standards

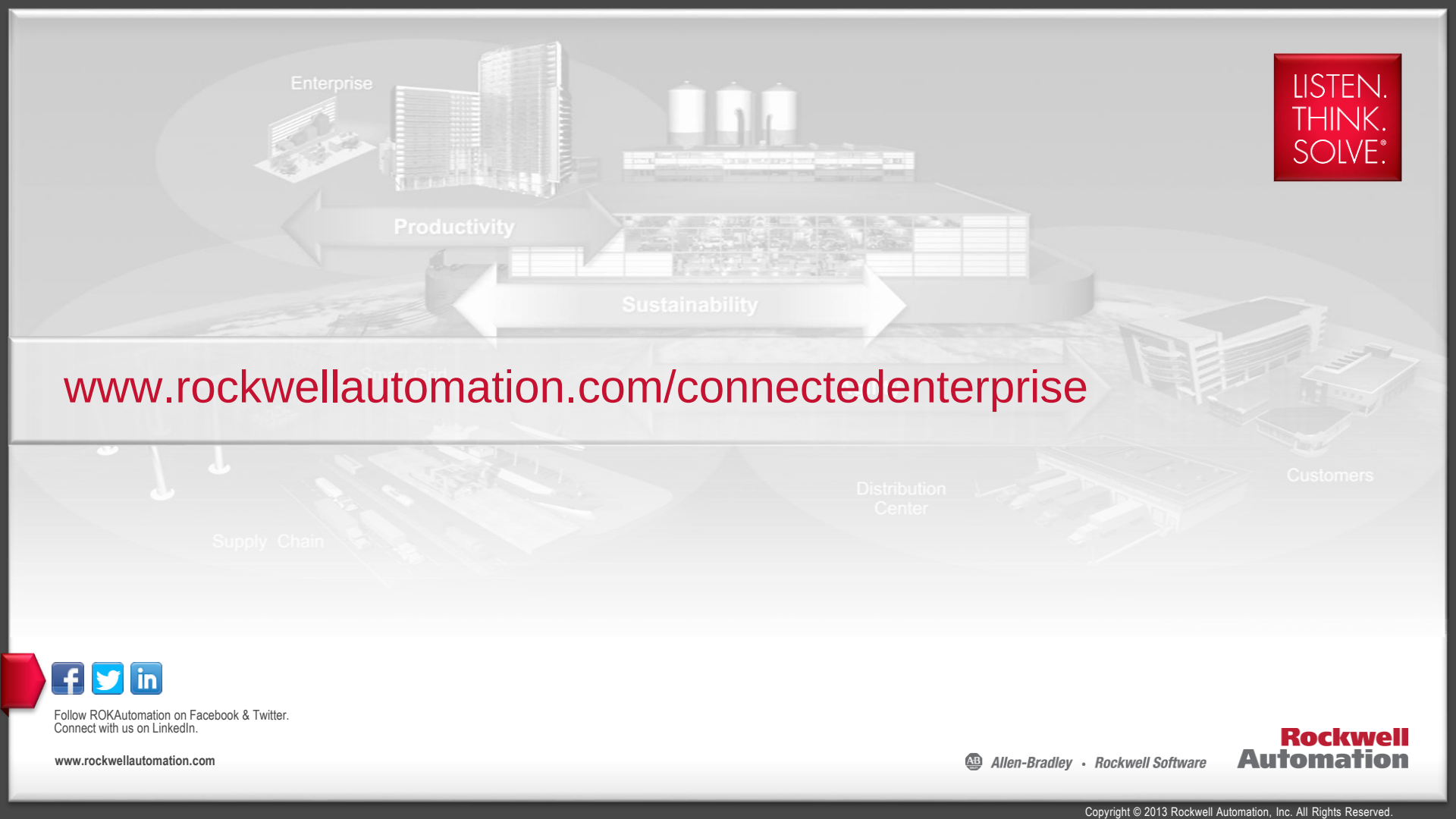
Customer Value

Faster Time to Market

Lower Total Cost of Ownership

Improved Asset Utilization

Enterprise Risk Management



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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

http://www.ism.uky.edu/2014/11/21/sustainable-manufacturing-roadmap-workshop-documents/

University of Kentucky Activities

http:\\digitallab.uilabs.org

DIGITAL MANUFACTURING and DESIGN INNOVATION INSTITUTE (DMDII)

The Industrial Internet Consortium®

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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

http://www.iiconsortium.org/January-2015-IIC-Progress-Report.pdf

NIST Cyber Physical Systems

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- 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.

NIST Cyber Physical Systems

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- 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)

Industry Driven Open Architecture

Shared Infrastructure

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

SMLC Partnerships

$10 Mil DOE Project: Prototype SM Platform with test beds @ General Dynamics & Praxair **Future Test Beds** - General Mills, General Motors, Corning, Pfizer, NETL, Alcoa, Center for Advanced Technology Systems/RPI **Design/Manufacturing Platform Providers** – JPL/NASA, UCLA, Rockwell Automation, Honeywell, Emerson, Invensys, Nimbis **Modeling & Simulation Materials, Design, Manufacturing** – Caltech/JPL, NETL, Argonne, UCLA, UT Austin, Tulane, NCSU, CMU, Penn, Purdue **Smart Grid** – EPRI **Global Metrics / Outreach** – AIChE, AMT, ASQ, ACEEE, NCMS, MESA, Sustainable Solutions, Spitzer & Boyes **Agency partners** – NIST, NSF **Regional Partners** - Center for Smart Manufacturing Innovation in California

Multi-Layered Smart Manufacturing Workflow Management

Time Managed as Workflow

Machines – People - Materials Dynamic Manufacturing Ecosystem

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Design Data

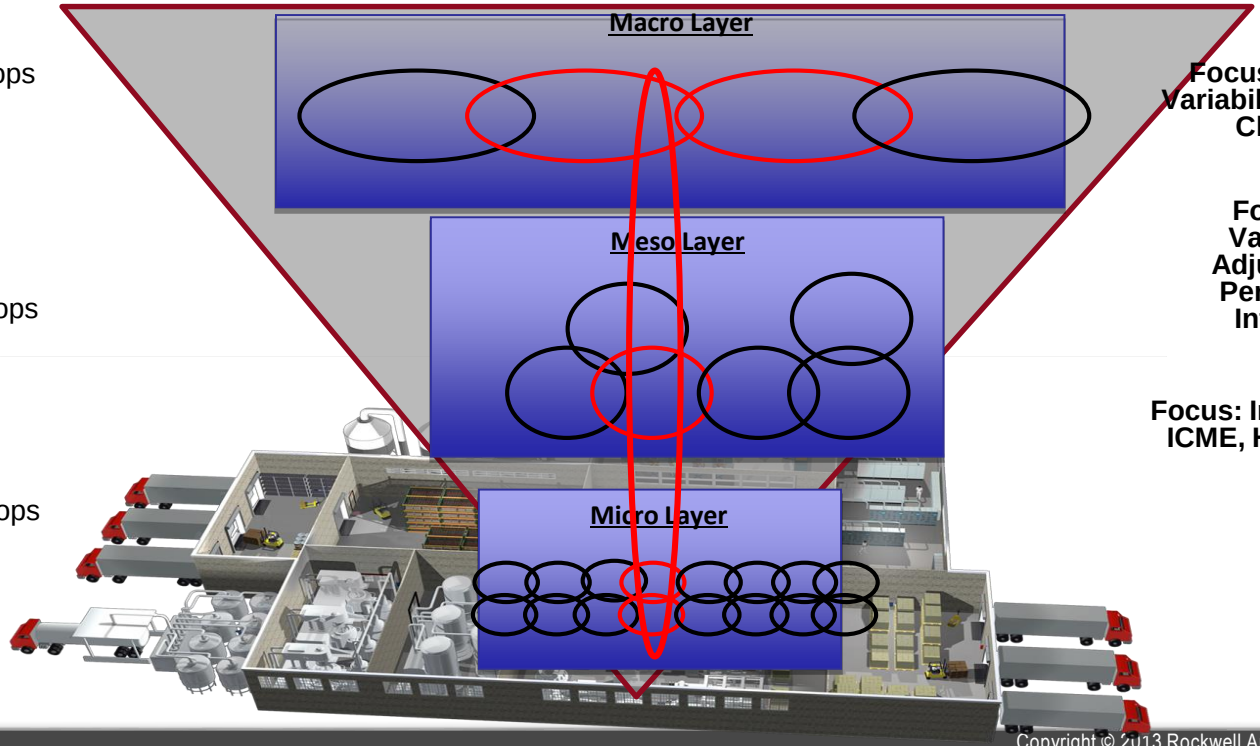
Prototype

Materials & Process Tech

Product Manufacturing

Qualification

In Service



10s of control loops
Time – days

Focus: 10x Multiple Pass Variability Reduction; Supply Chain Information

100s of control loops
Time -hours

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

1000s of control loops
Time - minutes

Focus: Insertion, Qualification, ICME, High Fidelity Dynamic Operations

SMLC
SMART MANUFACTURING LEADERSHIP COALITION

SMLC 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

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- **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

ABB EATON Powering Business Worldwide GE Rockwell Automation Schneider Electric SIEMENS

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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

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MIMOSA™

Current Situation - People, Processes and Systems in Silos

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marketing

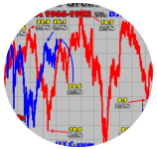
accounting

lab

planning

reliability

good enough in the past



trading

maintenance

control

Supply & distribution

management

ISO TC184 Task Force March 2009 Example

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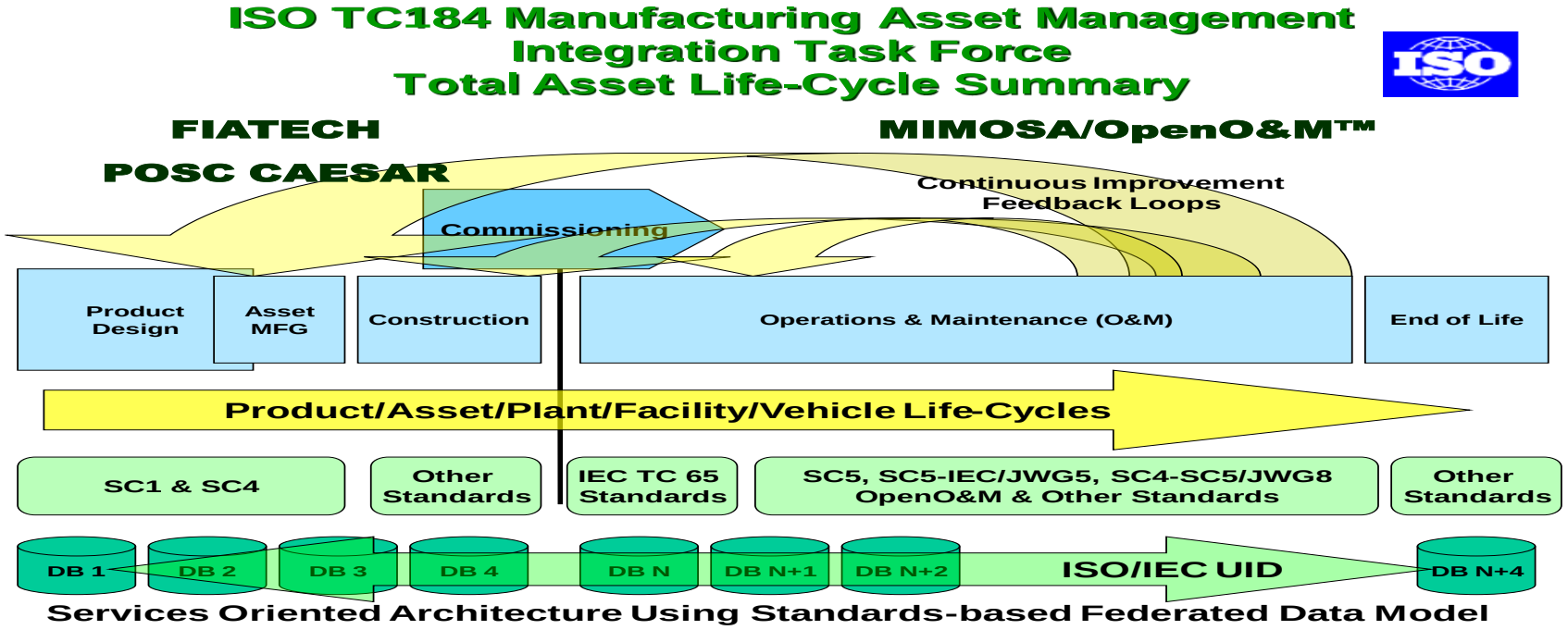

The OPEN O & M Initiative

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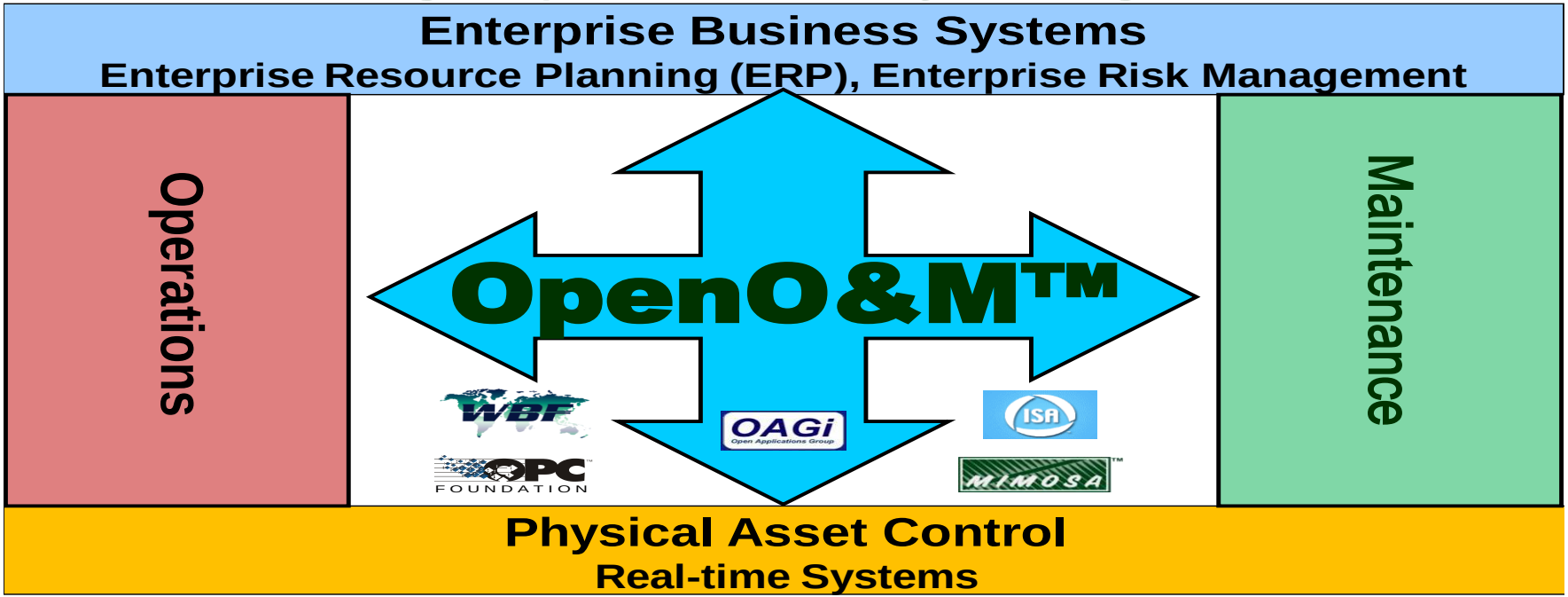
The OpenO&M™ Initiative

Brings People Processes and Systems Together



MIMOSA Consortium

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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

All IP is managed under the MIMOSA IP Policy, which is an adoption of the OASIS IP Policy.

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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

Oil and Gas Interoperability Project Scope

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Scope and Deliverables

- **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

ISO TC 184/WG 6

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Questions ?