Smart Manufacturing
22nd Annual Conference on Quality in the Space and Defense Industries

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Continuing the discussion.....Smart Manufacturing

Talking points

- Summary of earlier remarks....
- Explore the process control direction that Alcoa is taking to enable full potential value from SMART manufacturing concepts
- Have a discussion on the essential future state Quality Assurance strategies required to fully leverage SMART manufacturing operating systems
Alcoa at a Glance

- 200+ locations
- 30 countries
- $24 billion 2014 revenue
- Global technology leader and supplier of Aerospace and Defense products
- Award-winning sustainability leadership
- 125+ years of aluminum technical leadership, including the original aluminum process
Our Values

We live our Values every day, everywhere, collaborating for the benefit of our customers, investors, employees, communities and partners:

**INTEGRITY**
We are open, honest, and accountable.

**ENVIRONMENT, HEALTH & SAFETY**
We work safely, promote wellness, and protect the environment.

**INNOVATION**
We creatively transform ideas into value.

**RESPECT**
We treat all people with dignity and provide a diverse, inclusive work environment.

**EXCELLENCE**
We relentlessly pursue outstanding and sustainable results.
Smart Manufacturing is …

Smart Manufacturing’s working definition and need for fundamental change

- **Smart Manufacturing** definition:

  An integrated, knowledge-enabled, model-rich enterprise in which all operating actions are determined and executed proactively applying the best possible information and a wide range of performance metrics.

- Focus on **Smart Manufacturing** is on the **need** for:

  … fundamental and broad transformation in thinking and approach. Incremental Improvements, while useful, will not achieve the full vision and do not lead to the breakthrough innovation and quantum capability shifts that are needed.

Source: Smart Process Manufacturing Steering Committee
Integrate globally distributed data and expertise to maximize the Alcoa Advantage.

Engage the right people with the right information at the right time to enable the right decisions.

Deploy standard systems, dashboards and metrics, to accelerate standard practice and innovation sharing.

Create an environment that enables broad use of models, and human expertise and creativity across the enterprise.

... for competitive advantage and leading to market-disruptive innovation.

Source: Smart Manufacturing Lead Team
What is Smart Manufacturing?

Profound transformations are coming within this decade in the way goods are manufactured — changes that will fundamentally alter the worldwide competitive marketplace.

Smart manufacturing technologies will drive these transformations in three rapid progressive phases:

**Phase 1**
- The integration of all manufacturing data throughout individual plants and across enterprises will facilitate significant, immediate improvements in costs, safety and environmental impacts.

**Phase 2**
- This data, paired with advanced computer simulation and modeling, will create robust "manufacturing intelligence" that will enable variable-speed, flexible manufacturing, optimal production rates, and faster product customization.

**Phase 3**
- As that manufacturing intelligence grows, it will inspire innovations in processes and products that comprise smart manufacturing's promise — a major market disruption such as a $3,000 automobile or a $300 personal computer.

The countries and companies that strategically start this journey toward smart manufacturing and are first to achieve "manufacturing knowledge" will earn long-term competitive advantages well into the coming decades.

Phase I Outcome

Example Outcome for Global Rolled Products Smart Manufacturing phase 1

- Data access for operators, maintenance, engineers, & leaders.
- Electronic Daily Management Boards (eDMB).
- KPI’s online in real-time.
- Remote, Web, Smart Devices (iPhone, iPad).

Source: GRP Smart Manufacturing Lead Team
Phase I Architecture

Current Condition - Phase 1 architecture

Level 0
- Diverse

Level 1-2
- Diverse

Level 3-5

Operations Management

Quality

Maintenance & Engineering

Production Operators

eDMB

Process Optimization

Repeat Interfaces for Each System

Source: GRP Smart Manufacturing Lead Team
Phase I Architecture

Target Condition - Phase 1 architecture

Level 0
- Diverse

Level 1
- 2
- Diverse

Level 3-5
- Smart Manufacturing Data Integration Layer
  - Time Series Data Historian + Relational Data as Primary Shop Floor Data Source

Operations
Management

Production
Operators

Quality

SM Phase 2 and 3

Maintenance & Engineering

Process Optimization

SM Phase 1

Standard

Level 1-2

Diverse

Level 0

Diverse

Source: GRP Smart Manufacturing Lead Team
SMART Analytics

Problem → Select Variables → Integrated data

Integrated data → Analysis Tools → Results

Results → Analyze → Integrated data

Integrated data → Data source 1 → Data source 2 → Data source 3 → Data source 4

Source: Alcoa Smart Manufacturing Strategy Team, ISA
Adopting ‘SMART’ within the Business Operating System

Introduction to the Concept…

An Enterprise Operating System delivers competitive advantage through:

- Improved People Engagement
- Adoption of Best Practices
- Common Process Measurement (KPI)
- Focus on Continuous Improvement

SMART Manufacturing serves as a key enabler for the operating system

Source: Alcoa Smart Manufacturing Strategy Team, ISA
Adopting ‘SMART’ within the Business Operating System

**People Engagement and Best Practice**

With common data, talent across the globe will engage in **collective innovation** and the pursuit and sharing of best practices.

The SMART architecture also allows for the rapid deployment of ‘Best Practices’ through leverage of a common computing infrastructure.

**Who Derives the Benefit:**
- **Operators** leverage critical information when and where it is needed
- **Process Engineers** develop ad-hoc analysis and ‘Best Practice’ process visualization standards to improve location production management and performance
- **Supervisors and Area Managers** review real time KPI and have drill down capability for root cause analysis and problem resolution
- **TICoE Resources** leverage ‘Best Practices’ visualization standards across the business for ‘Power of Comparison’, root cause analysis and improved performance
- **Business Leadership** is ensured of timely, accurate and consistent information for evaluating performance and driving decisions

**SMART:**
- Will reduce the impact of attrition
- Will reduce ramp-up time for new Talent
- Will increase people efficiency
- Will arm people with data
- Will allow users to create and share their own tools

Source: Alcoa Smart Manufacturing Strategy Team, ISA
Adopting ‘SMART’ within the Business Operating System

Process Measurement (KPI) – Site Perspective

In order to focus our best talent on management of the plant, our measurement data must meet the following criteria:

- **Accurate** (Representative)
- **Correlated**
- **Real Time**
- **Historized**

All measures convey actual physical conditions across the plant.

Measures are available for constant monitoring and immediate analysis; users can drill down from summary to true sources.

Known and newly discovered correlations between measures can be incorporated into reporting logic to allow for improved problem identification, modeling, and innovation for resolution or countermeasures.

Measures are stored to enable cycle time analysis, trending and root cause analysis.

Source: Alcoa Smart Manufacturing Strategy Team, ISA
Adopting ‘SMART’ within the Business Operating System

Process Measurement (KPI) – Enterprise Perspective

- Sharing a common language with other plants allows us to truly realize Enterprise Advantage.

- A discovery in one plant can result in procedure, training, and policy changes in the other plants.

- SMART measures are becoming *common* measures. They allow us to share best practices from one plant to another.

- Conventional manual data entry / transfers are being reduced.

Source: Alcoa Smart Manufacturing Strategy Team, ISA
Adopting ‘SMART’ within the Business Operating System

Production Management for Continuous Improvement

Targeted Training

SMART Measures

Managed Processes

Optimized Procedures

Better Results

Relevant Policies

The Deming Cycle

Source: Alcoa Smart Manufacturing Strategy Team, ISA
Committed to achieve Operational Excellence through SMART Manufacturing Technologies

New Technology Enables Improved Productivity by Engaging Employees and Further Leveraging the ABS Concepts

Traditional Manufacturing Processes

SMART Manufacturing Concepts

- Hidden information, problems
- Data in many locations & not easily accessible
- Multiple versions of the truth

- Common platform & tools
- Real-time data transparent, available to all
- Standardized Data Model

Manufacturing Excellence in the 21st Century

- Proactive problems solving to improve productivity and quality
- Process modeling & capability improvements
- Customer connections

Source: Alcoa Smart Manufacturing Strategy Team, ISA
About SMLC – Smart Manufacturing Leadership Coalition

- Non-profit industry-academia-government coalition
- Over 30 current members including Alcoa, and growing
- Mission: Development of the approaches, standards, platforms and shared infrastructure that facilitate the broad adoption of manufacturing intelligence
- Workgroups: Platform/Infrastructure, Test-Beds, Business development and Workforce development.
- SMLC is developing an open architecture platform – focus is on Phase II
- Alcoa is considering collaboration on Phase II test-beds

Source: Smart Manufacturing Leadership Coalition
About DMDI – Digital Manufacturing & Design Innovation


- One of several institutes announced by the President under the National Network of Manufacturing Institutes
- $70M over 5 years, matched by institute members
- DMDI mission is strongly aligned with Smart Manufacturing
  - Advanced manufacturing enterprise
  - Intelligent machines
  - Advanced analytics
  - Cyber physical systems security
- Alcoa has submitted letters of intent of participating in teams that have submitted proposals
- California and Illinois teams have strong proposals. Decisions expected soon