



The SMART Manufacturing Business Case

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Session Agenda

- Alcoa at a Glance
- Establishing the SMART Vision
- Building the SMART Business Case
- Adopting SMART as part of the Business Operating System
- Where Are We Today? – SMART Manufacturing in Alcoa
- Questions?



Alcoa at a Glance

Alcoa at a Glance

- Founded in 1888
- 200+ locations
- 31 countries
- \$25.0 billion revenue in 2011
- 61,000 employees
- 10 times safer workplace than US average
- Award-winning sustainability leadership
- 120 years of patents, including the original aluminum process



Global Primary Products

Bauxite: 51 mmt | **Alumina:** 18 mmt | **Aluminum:** 4.2 mmt | **Energy:** 3.4 GW



Mining

#1 in Bauxite

Lowest cost producer of bauxite in the world with latest mine in Amazon jungle.



Smelting

Global Leader in smelting

Most efficient producer of smelter and chemical grade aluminum at 22 smelters worldwide



Refining

#1 in Alumina

World's leading producer of alumina, with global refinery capacity of 18 million metric tons per year, nearly a third of the international market.



Energy

2/3 of energy assets are renewable based energy

Dedicated to securing energy assets for our facilities by controlling more than 3 GW of generating capacity



Establishing the SMART Vision

Establishing the SMART Vision

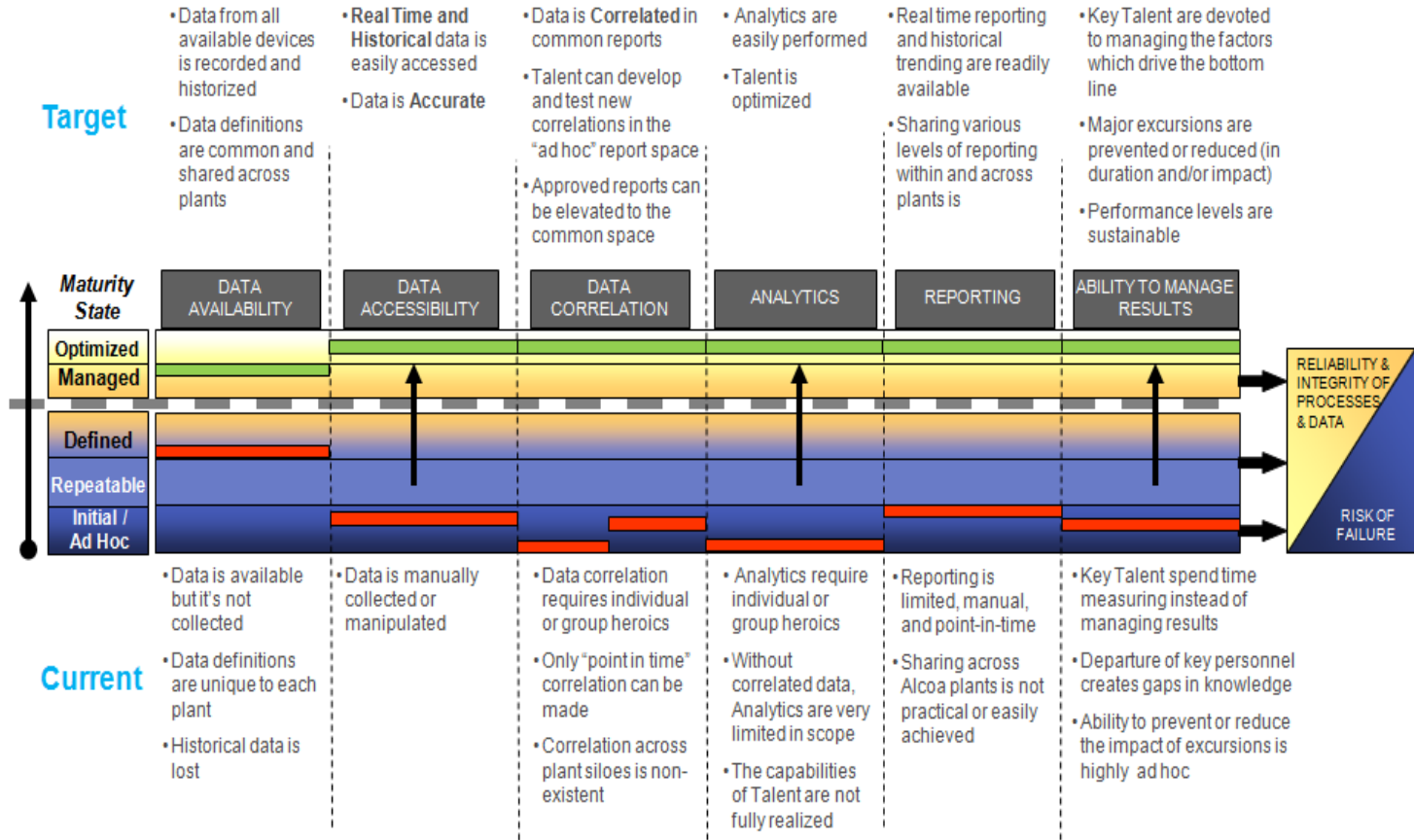
Why?

- Significant challenges in today's manufacturing environment
 - ✓ Sustainable Production
 - ✓ Agile Supply Chain
 - ✓ Plant / Enterprise Optimization
- Transition is needed to migrate from traditional strength in manufacturing to *manufacturing excellence* in the 21st Century
- Information is an expectation for continued success
 - ✓ SMART Grid
 - ✓ SMART Phones
 - ✓ SMART Applications
- Overcoming challenges means understanding the contributing factors

Let's review some information challenges in the current condition...

Establishing the SMART Vision

The Data Capability and Maturity Model

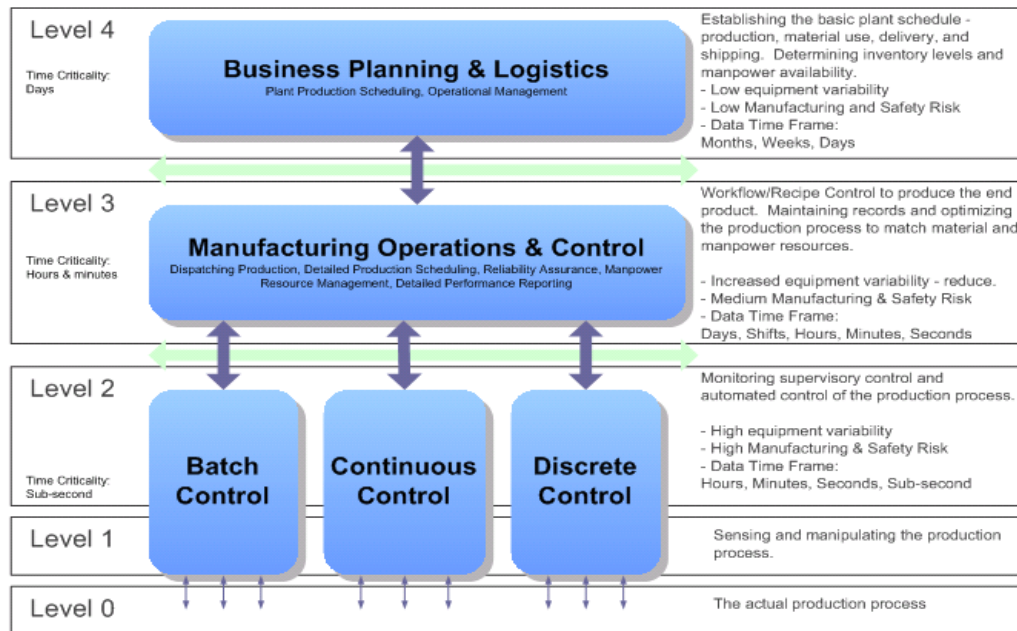


Establishing the SMART Vision

Contributing Factors in the Current Condition

1. Complexity of Information Sources

Architecture Reference Model - Functions



External Sources:

Web Services, Partners, Public Exchanges, etc.

Application / DB Examples:

Oracle, SAP, SQL Server, Proprietary Legacy, Access, Excel, etc.

Visual / Analytics Examples:

OSIsoft, Honeywell, SAS, etc.

HMI / SCADA Examples:

Factory Talk, Citect, Wonderware, Intellution, Schneider Electric, etc.

PLC / DCS Examples:

Rockwell Automation, Siemens, Honeywell, Square D, Emerson, GE Fanuc, etc.

Instrument Examples:

Yokogawa, Rosemont, ABB, etc.

Establishing the SMART Vision

Contributing Factors in the Current Condition

2. Manual Data Entry and Publication of Metrics

Human resources are being used for data collection and aggregation instead of analysis



21st Century technology solutions are not being leveraged to simplify shop floor operations and management



3. Actual Enterprise Performance is sometimes overshadowed...

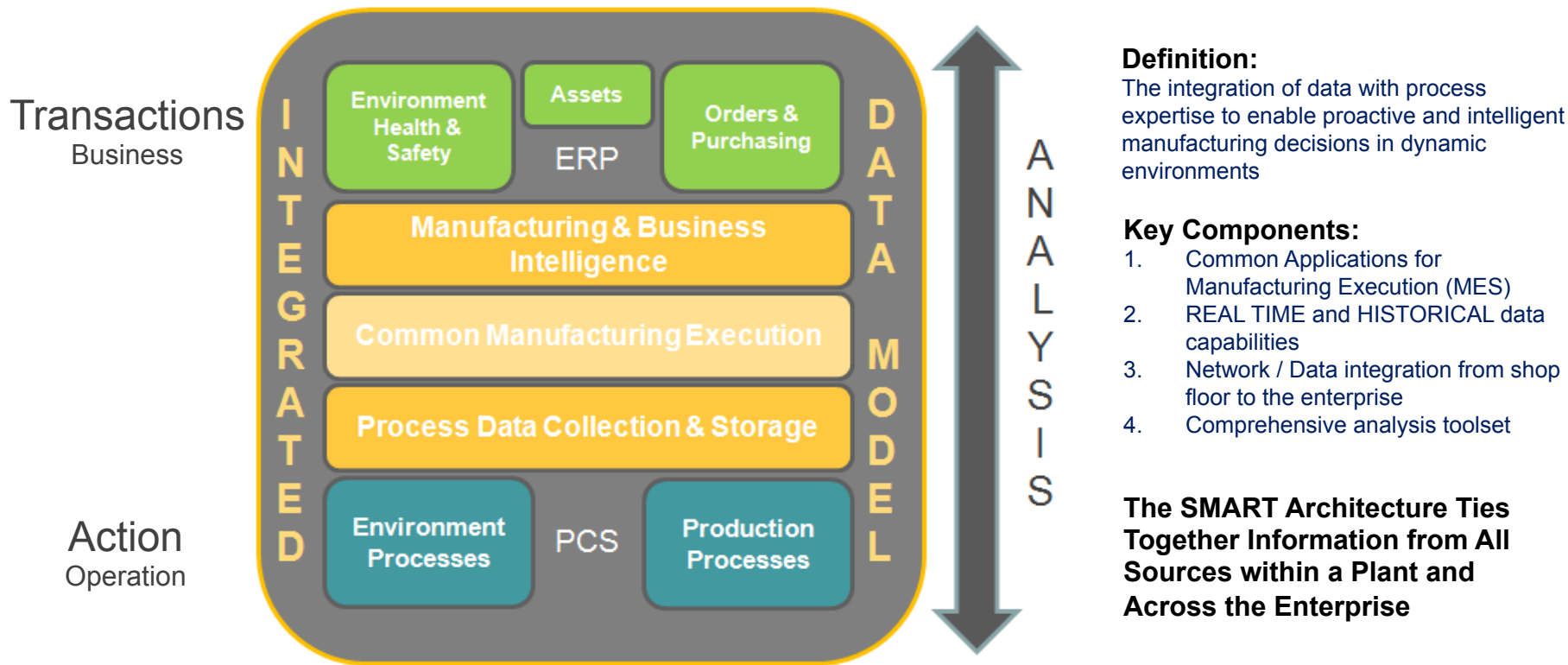
- *By site specific versions of the truth*



$$2 + 2 = 5$$

Establishing the SMART Vision

The SMART Manufacturing Architecture at Alcoa





Building the SMART Business Case

Building the SMART Business Case – Overview

‘Achieving Value from the Vision’

Seven (7) Steps for Building the SMART Enterprise Business Case

1. Select a Pilot Location within the Business – CoE Concept
2. Engage plant resources in **Value Brainstorming** and prioritization activities
3. Introduce plant leadership to prioritized opportunities and gain support to proceed to Pilot Phase
4. Develop detailed **use cases** for identified opportunities focusing on both process value financial benefit; gain Process and Finance support
5. Verify use cases with plant leadership; gain site support for the SMART manufacturing concept
6. Estimate **Value Potential of an enterprise-wide deployment**
7. Present enterprise-wide Value Potential; gain business support for SMART Manufacturing Concept

Building the SMART Business Case

Example – Value Brainstorming and Prioritization

Support the Process by Engaging People

- ✓ Onboard resources in the SMART Manufacturing vision
- ✓ Dedicate 'Brainstorming' sessions within each functional area
- ✓ Develop rough estimates of value, cost and ease of deployment for each identified opportunity
- ✓ Prioritize opportunities for initial Pilot focus

Massena West Smart Mfg Brainstorming Ideas

Dept	Opportunity Description	Priorit	Smart NOW	Data For	Potential Svgs	DI #	SPA
Energy	Overall Power data collection & Management systems 1) Improve Auxilliary Power Management: manage turning on/off equipment (Eg. furnaces) with peak hours to reduce power & gas bills (Eg. Scheduling OT in Rodding for pours) 2) Metering major power usage equipment to gain real time usage that effects power (Kath to develop list of existing metered equipment & equipment amperage Eg. fans)	H	Y-Q2		\$xxx,xxx		B. Murphy
Energy	Overall Natural Gas Data Collection & Management system to improve forecasting process (begin with making data available by area/dept to everyone/decision makers)	H	Y-Q2		\$xxx,xxx		B. Welsch
Environment	East FTC boreal Air monitoring (ADQ example), provide ability to react in FTC	H	Y-Q2		\$xxx,xxx		
Environment	Investigate solution for all remote outfall monitoring to improve collection and review of data (include WWT, Chem lab); process data first priority & flow data is second priority (this solution enables WWT checksheets to be eliminated and data go directly into a system to develop trends/dashboards)	H			\$xxx,xxx		D. Chin
Environment	East & West Parametric data access with Smart Dashboard (data resides in PLC-alumina feed, air flow, etc)	H	Y-Q2		\$xxx,xxx		J. Engstrom
Maint/Rel'y	Compressed Air Data collection & management system (generation distribution, leaks, equipment on/off, loaded/unloaded, dew point, flow meters)	H			\$xxx,xxx		R. O'Connell
Maint/Rel'y	Overall Asset Hierarchy system (one stop shop), asset health, failure modes, BOMs, WO's data, Top 5, etc.	H			\$xxx,xxx		Mike Tremper
Maint/Rel'y	Real-time PdM analysis data collection (vibration, IR, etc.)	H			\$xxx,xxx		Larry Fraser

Building the SMART Business Case

Example – Use Case with Process Detail

Initial Use Case Development is focused in Process Detail
Onboard Resources in the SMART Manufacturing Concept

- ✓ Development is completed with Area-Assigned Process Engineers
- ✓ General Approach is to focus on Production / Process Improvement

Case B: Auxiliary Energy & Gas Use

Tangible Benefits	Current Method	SMART Method	Objective Met	Est. Benefit
Reduce usage due to procedure and policy changes (see savings)	Ad Hoc	Real Time	Reduce Energy (20%) ¹	\$50,000 ¹
Auxiliary Energy Gas (see savings)	Ad Hoc	Real Time	Reduce Gas (20%)	\$50,000 ¹
Reduce compressed air use	Ad Hoc	Optimized	Reduce Energy	\$50,000 ¹
Automatically optimize heating based on personnel, material, and external temp rules	Not Possible	Real Time	Reduce Gas	\$50,000
Total Annual Benefit				\$200,000 – \$250,000

Footnotes

¹ The additional energy could be used to realize production gains of \$500,000.

¹ Alcoa's Energy Efficiency Group performed a study which indicates that, with the availability of real-time plantwide consumption of Energy and Gas, a 1-5% decrease in Auxiliary Energy Use and a 1-15% decrease in Gas use are typical.

² (See Practical Measurement and Verification, reproduced January 2011).

³ We conservatively estimate that Deschambault could realize a 2% savings in Energy.

⁴ Gas (boiler furnace) savings estimate is based on:

- Thermocouples drilled (1100 thermocouples @ \$100 - 250 each) = \$100,000
- Maintenance Complete Time (average) = 100,000
- Process/Production (average) = 100,000
- Process/Production (average) = 100,000
- Process/Production (average) = 100,000
- Miscellaneous (average) = 100,000
- Total** = \$500,000

⁵ A reduction of 500 scfm/year for a savings of \$500 for 1 scfm scf.

Case B: Auxiliary Energy & Gas Use

Measurement vs. Management

Q: How is energy measured now? How is it managed?
A: We have measures but do not correlate these to the hundreds of other factors (across sectors within the plant) which can affect overall usage. Today we only know the usage allocation between the Potroom and all other sectors. We cannot properly manage usage.

Q: Is instant data available? What is the cost / LOE to obtain the data?
A: For Potroom – yes, we have instant data. However, for Auxiliary, where waste occurs, we know what the plantwide consumption is but we cannot drill down to specific usage areas. It would be a time consuming and costly project to perform an auxiliary energy use analysis and impossible to perform a complete one. We might say that:

"Everybody takes from the buffet of auxiliary energy, but no one sees the impact of that."

Q: Are Alcoa Talent able to analyze the data in time (to make a difference)?
A: No.

Q: Are the factor measures even available? What key measure will be newly available with SMART Method?
A: We cannot maintain awareness of where auxiliary energy is used. With SMART Method, we will monitor usage, make adjustments, and apply lessons learned to the future of operations.

Q: Do Alcoa Talent get to focus on managing the various factors? Or is more time spent attempting to gather the measures (data)?
A: Since measures are not available at all, we are unable to manage auxiliary energy.

Our goal is to budget auxiliary energy use for each area within the plant and hold managers accountable for operating below that budget.

Case B: Auxiliary Energy & Gas Use

A Recent Example

In February of 2011, the shop room door breaks and will no longer close completely. An operator submits a Maintenance request. Operations resume.

Maintenance can only prioritize those requests for which they actually know the cost factors. Not knowing the energy costs, Maintenance fixes the door when they can.

34 days after the Maintenance request is made, the door is fixed.

This led to significant additional heating cost. February was a cold month.

Perhaps some of the other repairs could have waited.

The SMART Method will save us in Energy and Gas costs. In REAL TIME, we will:

- Correlate and trend energy usage data
- Respond to observations
- Develop procedures and training to manage those factors going forward

Building the SMART Business Case

Example – Use Cases with Finance Detail

Later Efforts are Focused on Re-Packaging for Finance Onboarding

- ✓ Aligned with Enterprise Level Objectives (ELOs)
- ✓ General Approach is on Value / Savings to the Bottom Line (\$\$\$)

ALCOA **A Summary of the Use Cases**

With readily available data measures, Alcoa Talent can focus on managing the factors which drive **value** for Alcoa instead of working just to gather measures.

Use Case	Reduce Energy & Gas Costs	Increase Production	Reduce Environmental Impact & Cost	Increase Maintenance Cost	Reduce Operations Process	Stability	Value
A: Metal Production Optimization	x	x					\$ xxx,xxx
B: Auxiliary Energy & Gas Use	x	x	x	x		x	xxx,xxx
C: HF Emissions	x	x	x		x	x	xxx,xxx
D: Anode Incidents & Tracking	x	x		x	x	x	xxx,xxx
E: Environmental Equipment	x		x			x	xxx,xxx
F: Maintenance			x		x	x	xxx,xxx

Grayed 'x' indicates another possible objective that is not detailed in this document.

These are just a few of the (possibly hundreds of) opportunities enabled by the SMART Method.

Building the SMART Business Case

Risks in Proceeding without the Vision

➤ Partial Solution / Partial Deployment

- ✓ Business Decides to Build Solution to Only Meet Specific Identified Opportunities
- ✓ Risk: SMART Architecture is Not Complete, Limits Future Value Potential

➤ Technical Solution is Deployed with Limited Resource Engagement

- ✓ Business Decision to Limit Resource Involvement or Inadequate Onboarding / Buy-In
- ✓ Risk: Value Realization Does Not Meet Business Expectations
- ✓ Risk: Solutions are Not Leveraged Across Enterprise

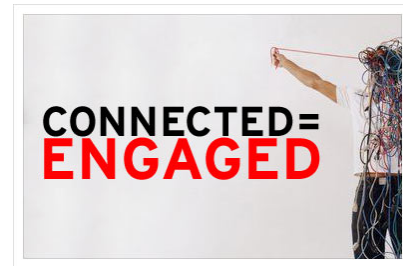
➤ Desired Outcome: SMART is adopted as part of the business operating system to continuously deliver value



Adopting SMART as Part of the Business Operating System

Adopting SMART as Part of the Business Operating System Introduction...

- An Enterprise Operating System delivers competitive advantage through:
 - ✓ Improved People Engagement
 - ✓ Adoption of Best Practices
 - ✓ Common Process Measurement (KPI)
 - ✓ Focus on Continuous Improvement
- The Alcoa Operating System is ABS (Alcoa Business System)
- SMART Manufacturing can be a key enabler for your operating system



Adopting SMART as Part of 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



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

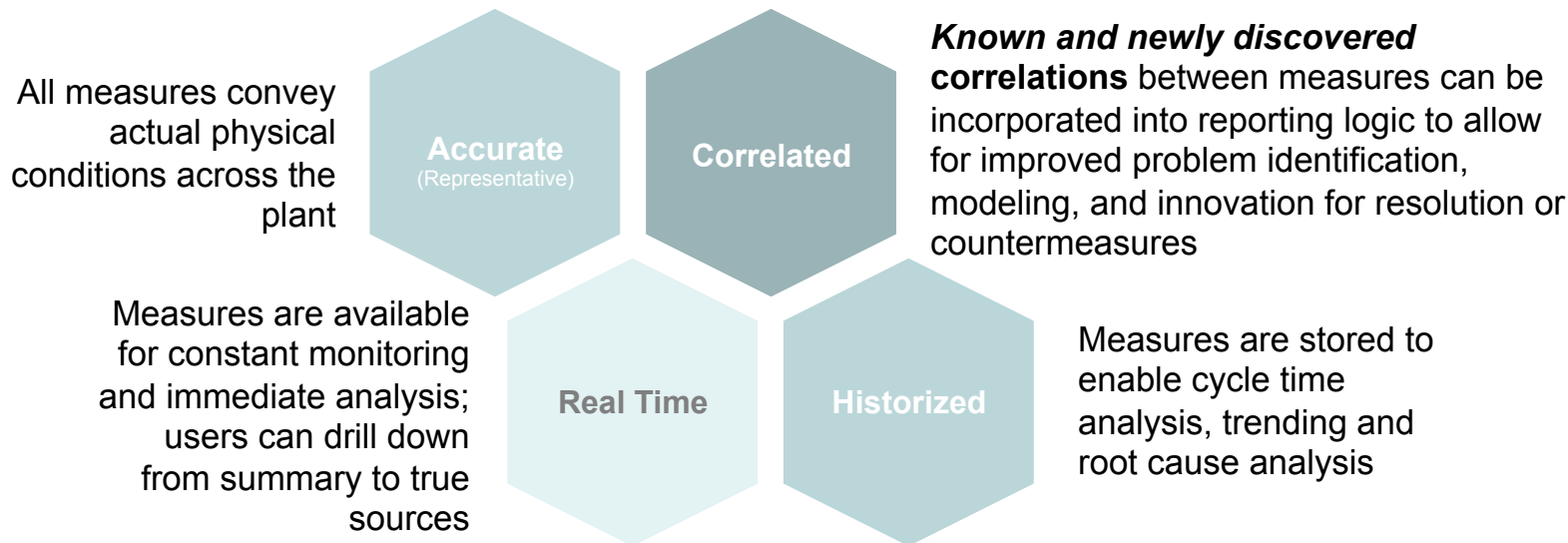
Who Derives the Benefit:

- 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

Adopting SMART as Part of the Business Operating System

Process Measurement (KPI) – Site Perspective

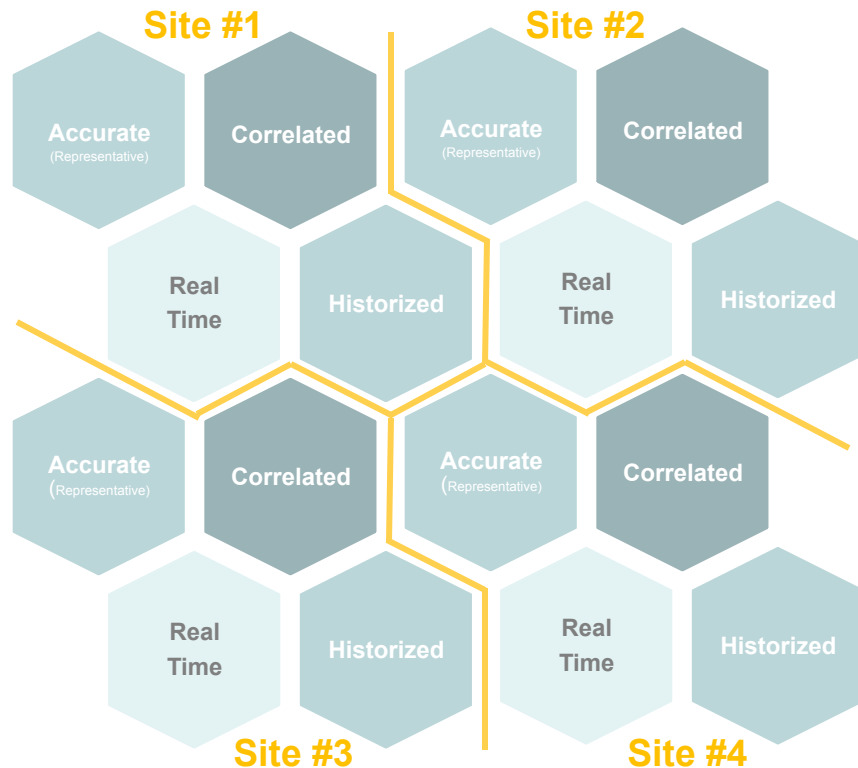
In order to focus our best talent on *management* of the plant, our measurement data must meet the following criteria:



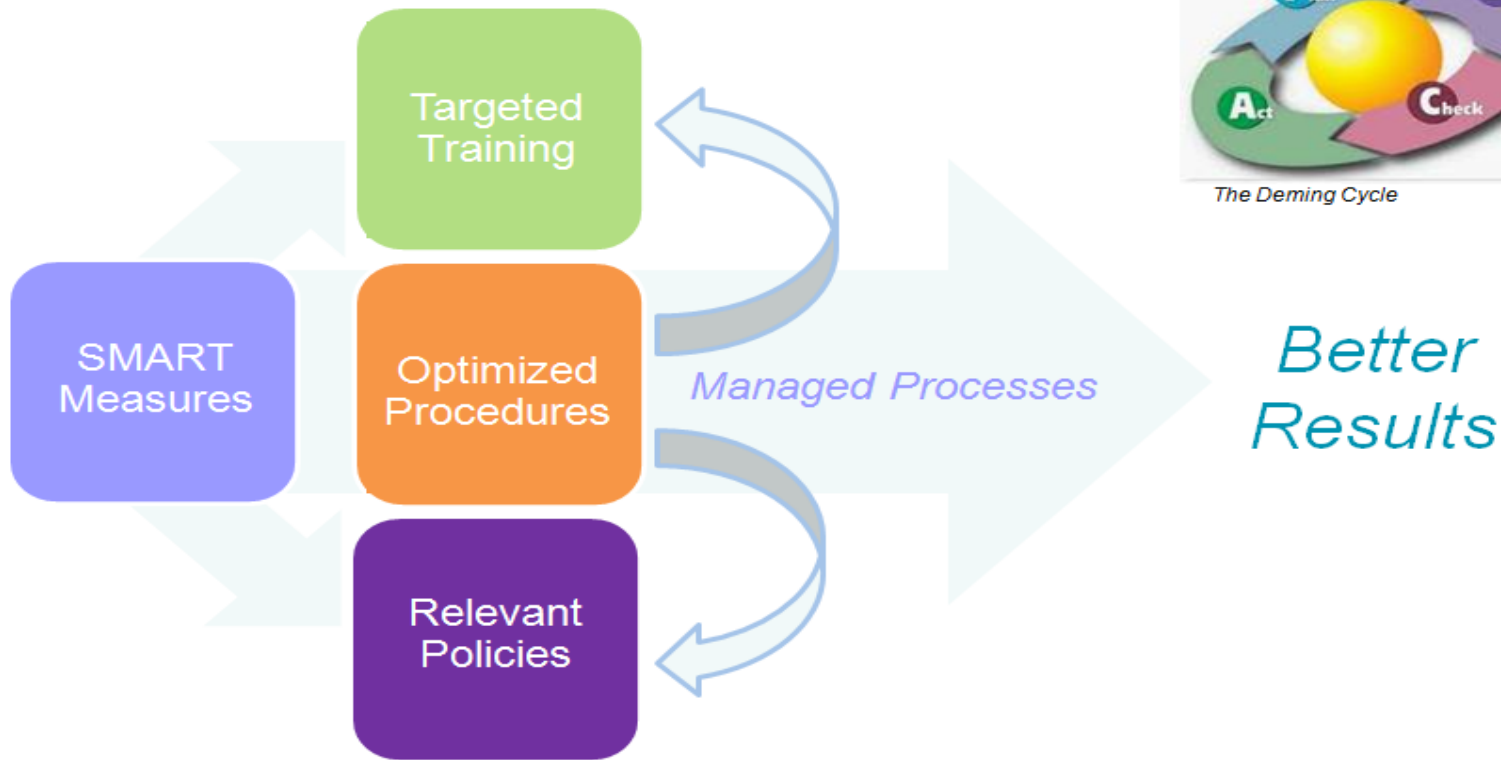
Adopting SMART as Part of the Business Operating System

Process Measurement (KPI) – Enterprise Perspective

- ✓ Sharing a common language with other plants will allow 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 will become **common** measures. They will allow us to share best practices from one plant to another.
- ✓ Conventional manual data entry / transfers will be reduced.



Adopting SMART as Part of the Business Operating System Production Management for Continuous Improvement



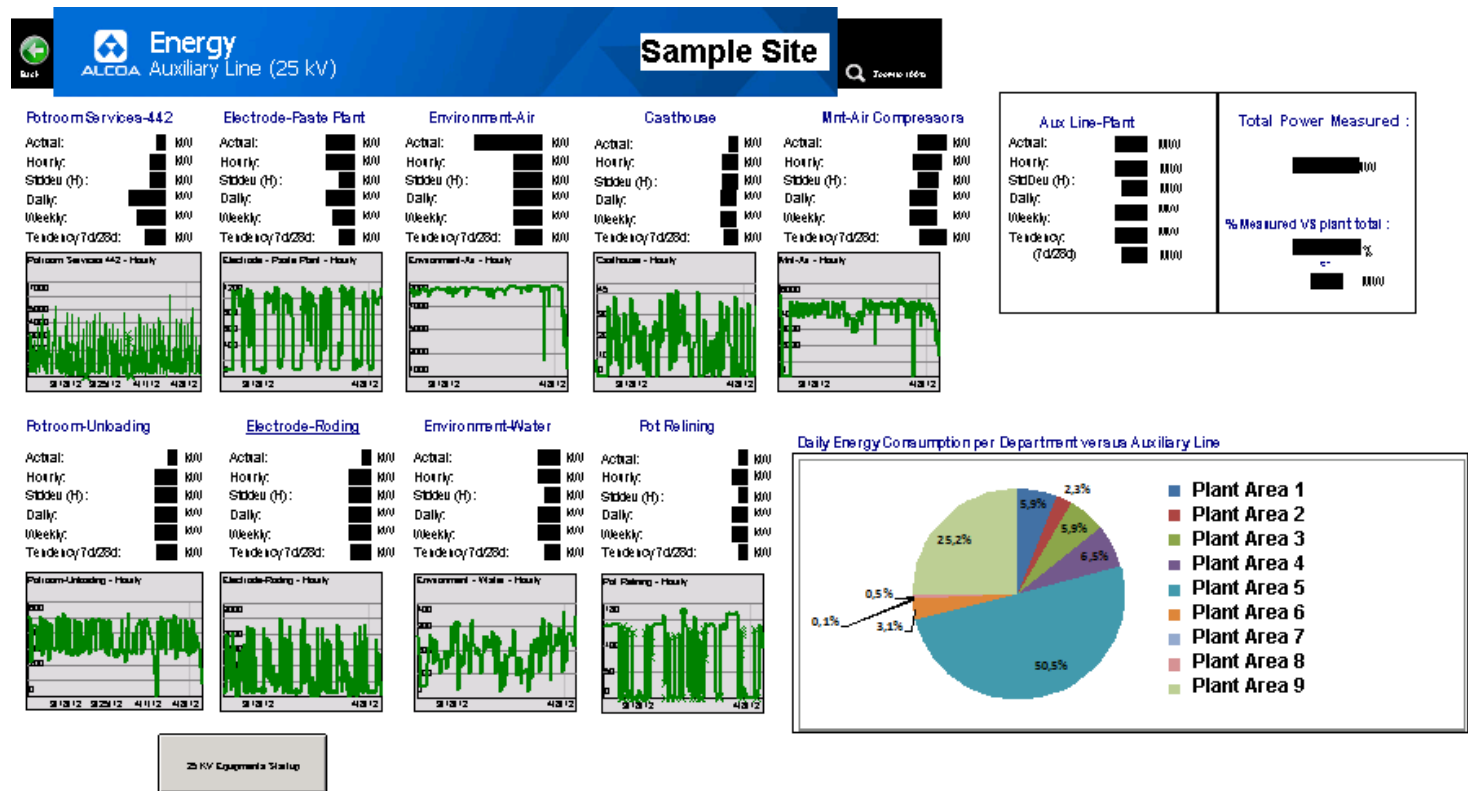
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Examples – Process Measurement / Production Management



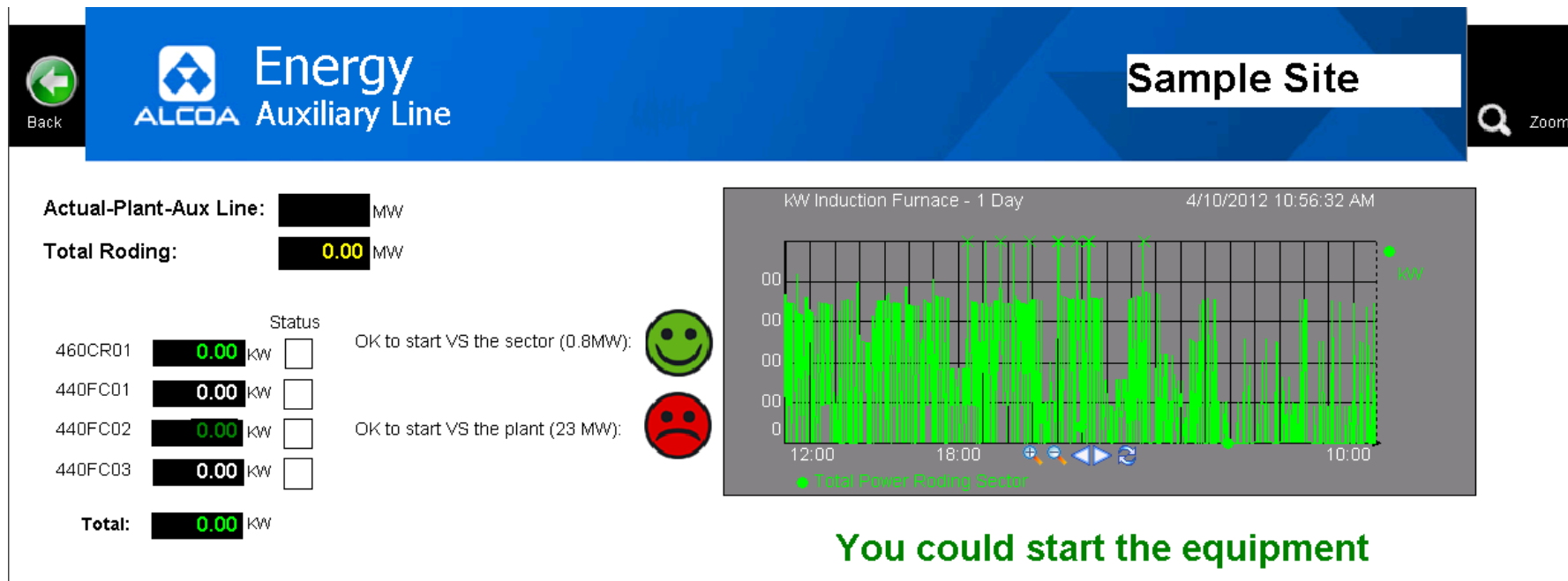
Adopting SMART as Part of the Business Operating System

Examples – Best Practice



Adopting SMART as Part of the Business Operating System

Examples – People Engagement (Operator Development)





Global Primary Metals Where Are We Today?

Alcoa – Where Are We Today?



Signed OSIsoft EA to support the SMART Manufacturing architecture – December 2011



Sites targeted for SMART Deployment in 2012-2013



SMART Deployment Completed at One (1) Location – Pilot Site



SMART Deployment In-Progress at Three (3) Additional Sites



Project Success Pending – Based on documented “Delivery of Value” to the Business from 2012-2014

to be continued

at the 2013 OSIsoft UC...



Questions?

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THANK YOU

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