Building Blocks to a Connected Real-Time Digital Enterprise

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Agenda

- Goals of a Digital Thread for a Connected Real-Time Digital Enterprise
- Building Blocks for a Digital Thread – Connecting the Dots
- How does the Digital Thread look like?
  - Yesterday, Today, Tomorrow
We have made some progress… right?
Engineering has always been very supportive of Manufacturing
Especially when we needed changes…
Physical Flow through the Plant...
Business Processes supporting Production...
Most Information Flows on Paper between Departments
Automation and Integration began in 70's
But Email is not a Digital Thread

All day emails and phone calls to try to communicate changes accurately.
The Journey to the Model-Based Enterprise

From 2D to 3D
We are in the transition from MBD to MBE
DoD adds Digital Thread as Acquisition Requirement

Acquisition community can better support Agile Acquisition by leveraging advances in physics-based modeling to reduce development cycle time/costs.

More “Tails on the Ramp”

Agile Acquisition
Outcome Focused Development, Deployment, and Sustainment of Warfighting Capability

AF Engineering Revitalization
Governance, Roles/Responsibilities
Engineering Decisions
Technical Rigor
Engineering Workforce

Engineering Knowledge Management
Collaborative Environment and Repository for Engineering Knowledge in Support of Life Cycle

Digital Thread / OSD System Model
Instantiation of Model Based Engineering Over the Entire Life Cycle of a System

Engineering Resilient Systems
Collaborative, Cross-Domain, Model-Based Technologies

HPC, MBE, CREATE, ICME, Statistical Engineering
Enabling Technologies

Initiatives Underway

Integrity - Service - Excellence
Now on the Journey to a Digital Thread
## iBASEt is a Recognized MES/PLE Leader in Complex Discrete Manufacturing

<table>
<thead>
<tr>
<th>Airframe Assembly</th>
<th>Space Products</th>
<th>Defense Electronics</th>
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<tbody>
<tr>
<td>Gulfstream</td>
<td>Boeing</td>
<td>DRS Technologies</td>
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<td>Sikorsky</td>
<td>NASA</td>
<td>BAE Systems</td>
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<td>Northrop Grumman</td>
<td>EMS Technologies</td>
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<td>Saab Defence and Security</td>
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<td>Teledyne Technologies</td>
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<tr>
<th>Aircraft Components</th>
<th>Naval Components</th>
<th>Military &amp; Classified Weapons</th>
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<tr>
<td>UTC Aerospace</td>
<td>Airbus</td>
<td>Lockheed Martin</td>
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<td>Systems</td>
<td>Orbital</td>
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<td>Rolls Royce</td>
<td>Northrop Grumman</td>
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<td>NORDAM</td>
<td>ATK</td>
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<table>
<thead>
<tr>
<th>Industrial &amp; Fabricated Parts</th>
<th>Commercial and Military MRO</th>
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<tbody>
<tr>
<td>Honda Engines</td>
<td>Textron</td>
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<tr>
<td>Pratt &amp; Whitney</td>
<td>BWXT</td>
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<tr>
<td>Parker</td>
<td>ATK</td>
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<td>Curtiss Wright</td>
<td>Nammo</td>
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<td>L3</td>
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<td>Rockwell Collins</td>
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</table>

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iBASEt’s Solution = **Product Lifecycle Execution**

A key piece required for companies striving for …

**The Connected Real-time Digital Enterprise**
The Digital Thread for the entire Product Lifecycle

Product Realization Processes
The Digital Thread for the entire Product Lifecycle

SOLUMINA integrates to PLM and ERP to realize a fully integrated enterprise. SOLUMINA adds Execution...
The Digital Thread for the entire Product Lifecycle

SOLUMINA Product Lifecycle Execution = Process Control, Inspection, Deviation Handling, History, Corrective Action
The Digital Thread needs Product Lifecycle Execution

SOLUMINA Product Lifecycle Execution = Process Control, Inspection, Deviation Handling, History, Corrective Action
SOLUMINA supports your Digital Thread.. NOW!

PLM

SOLUMINA PLE
Goals of the Digital Thread

1. The Right Information at the Right Place at the Right Time
2. Data is only Entered Once!
   - Automatically distributed or linked to other systems as needed
3. Every Digital Handover is Structured, Parsable and Revision Controlled
4. Downstream processes Minimize Manual Translation or Transformation
5. Downstream systems Maintain Digital Associativity for Change Management of Derived Objects
Product Lifecycle Execution

For Manufacturing…
PLM: eBOM to mBOM to Process Plan

Associativity at the object level facilitates change management
PLM -> Solumina Execution

Process Plan

Work Plan

Work Order

Associativity at the object level is carried over to execution objects for work-in-process
Data Collection

• Inspection Data and Job Buyoff Signatures
Data Collection

- Measurement imported straight from Machines

Is this IIoT?

Data that matters!
Design engineers author 3D models and specifications which are published to manufacturing engineers for process planning in SOLUMINA and CMM programming in PC-DMIS.
Work Instructions explain how to set up part for measurement on CMM and start the data collection program.
Measurements are recorded and analyzed by Statistical Analysis software. Results are passed to Manufacturing Execution System.
Connecting the Manufacturing Digital Thread

Production Planning, Quality Management

Production Execution, Inspection, Data Collection

ACTING

SENSING

THINKING

Intelligence, Analytics
Enhanced Data Flow between PLM, MES

The Digital Thread is more than one threaded message!
Enhanced Data Flow between PLM, MES, ERP

PLM
- Product/Process Definition and Design
- Product/Process Change Management
- Problem Reporting

MES/MOM
- Process Change Management
- Process Execution
- Discrepancy Handling

ERP
- Parts, Production Routings
- Order Fulfillment & Scheduling
- Procurement, Inventory and Supplier Management

Digital Thread happening here

IloT happening here!
Product Lifecycle Execution

For Maintenance, Repair and Overhaul…
Enhanced Data Flow between PLM, MRO

- Ensure no requirement is missed.
- Identify all resource requirements.
- Ensure Revision Control through Service Bulletins
Service Plan

Instructions from Manuals

3D Illustrations

Parts from BOM for different product configurations
Select Task Groups required
Enhanced Data Flow between PLM, MRO

PLM / Tech Pubs

- Product Configuration Management
- Maintenance Manuals, Requirements
- Change Requests, Service Bulletins

MRO Task Mgt

- Service Task Planning
- Service Task Execution
- BOM, Configurations
- 3D Illustrations
- Maintenance Manuals
- Service Bulletins

Execute Service Tasks
Perform Service Task

Assign skilled personnel
Perform Service Task

Guide Technician with illustrated Work Instructions
Perform Service Task

Verify equipment
Perform Service Task

Collect data to verify unit is up to specifications
<table>
<thead>
<tr>
<th>End Unit No</th>
<th>Order Type</th>
<th>Order No</th>
<th>Oper No</th>
<th>Operation Title</th>
<th>Order Status</th>
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<tbody>
<tr>
<td>UA-77574</td>
<td>Maintenance</td>
<td>UA-R2944456</td>
<td>5050</td>
<td>Replace Rear Landing Gear Harness</td>
<td>ACTIVE</td>
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<tr>
<td>UA-77574</td>
<td>Maintenance</td>
<td>UA-R4778432</td>
<td>2010</td>
<td>Inspect Wing Surface</td>
<td>IN QUEUE</td>
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<tr>
<td>UA-77575</td>
<td>Maintenance</td>
<td>UA-R2944457</td>
<td>1001</td>
<td>Clean Weapon System</td>
<td>IN QUEUE</td>
</tr>
<tr>
<td>UA-77575</td>
<td>Maintenance</td>
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</table>

The image shows a production control interface with a list of work orders and a calendar for February 2017.
Enhanced Data Flow between PLM, MRO

- Over & Above Scope and Special Repairs require additional approvals
Enhanced Data Flow between PLM, MRO, ERP

PLM / Tech Pubs
- Product Configuration Management
- Maintenance Manuals, Requirements
- Change Requests, Service Bulletins
  - BOM, Configurations
  - 3D Illustrations
  - Maintenance Manuals
  - Service Bulletins
  - Special Repair Approval
  - Product/Parts Performance
  - Corrective Action Item to ECR

MRO Task Mgt
- Service Task Planning
- Service Task Execution
- Over & Above Scope Management
  - Service Sales Order
  - Work Order Release
  - Work Order Operation Status
  - Work Order Operation Schedule
  - Work Order Scope Revisions
  - Parts Requirement Revisions
  - Parts Issue to WO Operation

ERP
- Contracts, Service Orders
- Parts Management, Inventory
- Supplier Management
  - Tomorrow
  - Today
Enhanced Data Flow between PLM, MRO, ERP

Ensure parts are where needed. Not too many, not too few.
Enhanced Data Flow between PLM, MRO, ERP

**PLM / Tech Pubs**
- Product Configuration Management
- Maintenance Manuals, Requirements
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**MRO Task Mgt**
- Service Task Planning
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**ERP**
- Contracts, Service Orders
- Parts Management, Inventory
- Supplier Management

Feedback to Engineering for Product Performance Improvement
Update As-Maintained Data
The Digital Twin / Digital Thread Enabling the SCOR Model
Product Lifecycle **Execution**

For Supply Chain Quality Management…
The Digital Thread from Engineering, Planning to Suppliers
The Digital Thread with Suppliers
Taking Enterprise Quality Management to the Next Level…

1. Tactically Driven
   - Quality verified at receiving inspection
   - Ad hoc coordination via email and phone calls
   - Urgency culture expediting issue resolution
   - Suppliers are qualified, rated, and periodically audited
   - Penalties imposed on suppliers for poor performance
   - QA managed in multiple, not integrated applications

2. Efficiency Driven
   - Number of suppliers is reduced to focus on fewer key suppliers
   - Suppliers are given more integration responsibility for lower tier suppliers
   - Focus on obtaining better prices from suppliers
   - QA applications integrated across engineering, receiving, and operations
   - Lean applied to information value stream

3. Collaboration Driven
   - More inspection managed at the source versus receiving
   - Collaboration with suppliers via two-way postings on supplier portal
   - Helping supplier learn and implement Lean, Six Sigma processes
   - Rating suppliers on each product family and each capability instead of one global rating

4. Integration Driven
   - Orchestrated processes with suppliers for early detection of issues
   - Inspection requirements managed into the supply chain similarly to internal processes
   - Suppliers are part of the workflow for change control and problem resolution
   - Integration between suppliers and internal operation’s quality systems

Read iBASEt’s White Paper at www.iBASEt.com/Library
What is Your Digital Thread Adoption Score?
Where Are We Today on the Digital Thread?

- **Procurement**
  - **7%**
  - Only 7% of respondents use systems in which Engineering Change Notices flow to downstream systems with impacted and related objects defined.

- **Production**
  - **40%**
  - Nearly 40% are still using manual drawings and spreadsheets for interpolation definition.

- **Sustainment Services**
  - **16%**
  - However, only 16% include deviations and waivers as part of their as-built records.

- **Design**
  - Less than 20% are capturing data directly from 3D part or assembly based components or subassemblies.

- **Test & Evaluation**
  - Less than 30% have linked work instructions and UI of resources directly to 3D models.

- **Field Operation**
  - Less than 10% of respondents use 3D visuals for work steps based on 3D models in PLM with parts linked to a BOM.

*Source: State of the Digital Thread, iBASEt, 2017*
Questions?

www.iBASEt.com Resources

**eBOOKS**

*Calculate our Digital Thread Adoption Score*

Discover how well your manufacturing enterprise is performing with the adoption of new technologies by taking our quiz. Once all responses have been selected, your Digital Thread Adoption score will be instantly calculated.

*Enabling the Digital Thread*

Learn about unifying Design, Manufacturing and ERP in a Closed Loop Digital Thread.

**WHITEPAPERS**

*Six Innovation Areas in MRO Leading the Path to the Model Based MRO Enterprise*

In this paper, we discuss the convergence of technologies enabled by a new model-based enterprise philosophy that leverages the engineering 3D models and specifications throughout the product lifecycle including shop floor execution.

*Taking Enterprise Quality Management to the Next Level of Performance*

Can you remember headlines in the news related to product recalls and quality issues?
THANK YOU
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