Model-Based Enterprise and Standards
CIMdata PLM Leadership Webinar—April 2018

MBE and Standards
CIMdata PLM Leadership Webinar Series
12 April 2018
#cimdatawebinar

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Questions?
Please use the GoToWebinar Question panel

• Please enter questions in the GoToWebinar Question panel
• We will answer as many questions as time allows...
• Those that can’t be answered live will be answered by email
Presenter’s Profile

• John MacKrell, Chairman
  • More than 40 years of experience in the application of computer-based solutions to engineering & manufacturing; has held senior positions in product management, marketing, research & development, and consulting with companies that produce PLM solutions & services
  • B.S. in Naval Architecture & graduate-level studies in computer science

Our Mission...

CIMdata is the leading independent global strategic management consulting and research authority focused exclusively on PLM and the digital transformation it enables.

We are dedicated to maximizing our clients’ ability to design, deliver, and support innovative products and services through the application of PLM.
Our Services...

Creating, disseminating, and applying our intellectual capital in support of the digital transformation

Research
- Market research & analysis
- Technology research & analysis
- Reports & publications across multiple domains
- Market news
- Member services...

Education
- PLM Certificate Programs
- Executive seminars
- Technology seminars
- Educational webinars
- Int’l conferences & workshops
- Best practices training...

Consulting
- Strategy & vision
- Needs assessment
- Solution evaluation
- Best practices
- Quality assurance
- Program management
- Market planning...

Delivering strategic advice and counsel through a comprehensive, integrated set of research, education, and consulting services

Our PLM Transformation Clients...

A sampling of CIMdata’s international industrial clients (1 of 2)
Key Takeaways
What we will try to convey today...

• Without standards for MBE it is difficult to communicate design, build, maintenance, and other intent unambiguously across enterprises
• Standards for conveying rich product information vary by industrial segment
  • What is needed in automotive companies may be similar to, but not identical to what a shipbuilder needs
  • These will be vastly different from the needs of a petrochemical company
• Standards tend to evolve over time, so adoption is not a one-time event
• Companies will need to be very nimble and continue to expend resources to keep up with the latest trends
• This is a systems issue
Model Based Definitions

There is a lot of confusion around the various terms commonly used

- Model-Based Engineering (MBE) – Integrated use of models to define the system technical baseline across the full life cycle, across all disciplines, across all program members [models are the authoritative definition of the system]

- Model-Based Enterprise (MBE) – “a vision to transform an enterprise’s engineering, manufacturing, and aftermarket services through product data reuse and derived context, rather than interpreting inputs and recreating the models and drawings.”

- Model-Based Definition (MBD) – The practice of using 3D models (i.e., solid models, 3D PMI and associated metadata) within 3D CAD software to define (provide specifications for) individual components and product assemblies.

- Model-Based Design (MBD) – “A mathematical and visual method of addressing problems associated with designing complex control, signal processing and communication systems as applied in the design of embedded software”
Benefits of Using MBE Standards

Support the product lifecycle with high value information

- Better support all processes downstream from design (bidding, 3D TDP, manufacturing, MRO, owner/operator handover documentation, emergency response, ...) through end of life
- Foster data reuse from early design throughout the product lifecycle
  - Data becomes more valuable
  - Less time recreating what already exists—such as documenting via drawings...
- Problem is that even with all the standards that follow, we still do not have complete coverage for specialty areas
  - Evolving areas such as additive manufacturing may not be completely supported
  - You may need to develop “standard” ways to annotate things you need to share

Why You Need MBE Standards

Standards are necessary to overcome many of the issues with conveying data in an MBE

- Need a consistent way to communicate PMI and other information in the model throughout the lifecycle—without standards this will become (is) a free-for-all
- Drafting standards (ASME Y14.5M-1994) are not good enough—they don’t cover all PMI and how to attach information to the 3D model
- Understand what is required to assure comprehension
- Without standards everyone goes own way and we loose advantage

Source: PAS Technology
Model-Based Enterprise and Standards
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Model-Based Enables Systems Engineering

Digital collaboration enables high-value information continuity across lifecycle processes

Real world feedback

Cross domain system concept models

High fidelity virtual prototypes for product functional V&V

“Digital Twins”

Adapted from: US Federal Highway Administration:
http://ops.fhwa.dot.gov/publications/whiteguide/
“Systems Engineering for Intelligent Transportation Systems”

Business Value Comes with Adoption Maturity

It takes time, management commitment and cultural change

We are in the early stages of this journey

Adaptation
Trial Use
Understanding
Awareness
Contact

Business Value/ROI

Model Based Maturity

Institutionalization

CIMdata

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Barriers to Industry Implementation

What users cited as problems to overcome in adopting & using MBE/MBSE

- It’s about people & process—not just technology

<table>
<thead>
<tr>
<th>People</th>
<th>Technology</th>
<th>Process</th>
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</thead>
<tbody>
<tr>
<td>Culture</td>
<td>Education &amp; training</td>
<td>Organizational structure / boundaries</td>
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<tr>
<td>Talent availability</td>
<td>Tool fragmentation</td>
<td>Management support</td>
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<tr>
<td>Complexity of tools</td>
<td>Price / cost</td>
<td>IT / infrastructure</td>
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<tr>
<td>Data management</td>
<td>Licensing restrictions</td>
<td>Data translation</td>
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Source: CIMdata MBSE web survey conducted with ANSYS & INCOSE (2015)

Business Opportunity – Key Factors for Success

Driving the PLM/Model-Based digitalization strategy to realization

- Needs to be developed and supported in the context of an enterprise “platform of platforms” solution but...

- Implemented and promoted based on specific MBE business use case success and measurable ROI  **Crawl...Walk...Run!**
  - Define and pilot well-defined MBx processes in specific business focus areas—must account for cultural change and the people buy-in/training required

- Need to supply “integrated, yet open” solutions of software and services based on industry standards and best practices

- Industry & DoD need to support new contractual concepts AND accept electronic project deliverables/signoffs/TDPs
  - For digital information and models to replace paper and 2D drawings, OEMs need to understand what they are asking suppliers to do to change processes
Current & Evolving MBE Standards

Selected standards...

  - Defines how models are annotated (geometric features, datums, dimensions, tolerances, inspection data, finish, notes, etc.)
  - Primary basis for MBE

(Courtesy of Anark)

- ISO 10303 Part 242 ed1 & ed2 “Managed Model-based 3D Engineering”
  - Merges 2 most widely used STEP standards for 3D model geometry,
    - AP 203 (Configuration Controlled 3D Design)
    - AP 214 (Core Data for Automotive Mechanical Design Processes)
  - Defines STEP specification for 3D Model-Based PMI (Product and Manufacturing Information)
  - Not a lightweight CAD data format definition (see JT and 3D PDF on following slide)
  - Key support of Model-Based Definition (MBD)

(Image from AP242 Working Group)
## Current & Evolving MBE Standards

**Selected standards...**

- **ISO 14306 “Structure and Content of a Binary File with Extension .jt”**
  - JT standard is used to capture and repurpose 3D product definition data
  - Can contain multiple levels of geometric fidelity from precise to very lightweight
    - Supports CAD data exchange
  - Originally developed and sold by Siemens PLM Software as a lightweight 3D geometry format for visualization
  - Many CAD systems can read, write, and modify JT

- **ISO 14739-1 “3D use of Product Representation Compact (PRC) format”**
  - Aka “3D PDF”
  - Allows lightweight 3D geometry to be embedded & manipulated in PDF documents
  - Originally developed by Adobe, now managed by PDF3D

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### Current & Evolving MBE Standards

**Selected standards...**

- **MIL-STD-31000A—Technical Data Packages**
  - Prescribes the requirements for preparing a technical data package, including 3D TDPs
  - Critical for DoD
  - Problem for DoD suppliers since Armed Services don’t universally accept 3D TDPs
    - Loose the benefit, have to make drawings for delivery
Closely Related to MBE

To have a workable MBE you need to be cross functional

- Configuration management (many standards exist—next slide)
- Full systems definition—mechanical, electrical, software, processes, other physics
- Manufacturing support
- Inspection support

Source: Autodesk

Standards for PDM, DMU & Configuration Management

Many standards, many sources

- ISO 17599: General requirements of Digital mock-up for mechanical products
- ISO 10007: Quality management systems—Guidelines for configuration management
- EN 9223-100 to -105: Programme Management—Configuration Management
  - Part 100: A guide for the application of the principles of configuration management
  - Part 101: Configuration identification
  - Part 102: Configuration status accounting
  - Part 103: Configuration Verifications, Reviews & Audits
  - Part 104: Configuration Control
  - Part 105: Glossary
- MIL-HDBK-61A: Configuration Management Guidance
- ANSI/EIA 649B: Configuration Management
- GEIA-HB 649: Configuration Management Handbook
- EIA 836B: Configuration Management Data Exchange and Interoperability
Closely Related to MBE

Selected standards...

• ISO 10303 Part 238 “Application Interpreted for Computer Numeric Controllers”
  • Specifies an application interpreted model (AIM) for machining
  • Augmented with ISO 10303 product geometry, geometric dimensioning and tolerancing, and product data management information
  • Addresses new technologies for additive manufacturing and composites
  • Not yet adopted by industry nor supported by many solution suppliers
  • Similar capabilities to AP 238 are provided in solution suppliers’ COTS offerings

Closely Related to MBE

Selected standards...

• ISO 10303 Part 210 “Electronic Printed Circuit Assembly, Design, and Manufacturing” supports 3D models with electrical intelligence for:
  • Assemblies with electrical content at multiple levels of product hierarchy,
  • Assemblies being designed jointly by electrical and mechanical departments, and
  • Interconnections designed using layered abstraction, typically Printed Circuit Boards (PCBs)
  • Mature but not adopted by any major ECAD or PLM provider (e.g., Cadence, Mentor Graphics, PTC, Siemens PLM Software, or SolidWorks)
MBE Standards Players

Who is pushing for standards to be adopted

- Solution providers
  - Notably Siemens PLM Software (JT) and Adobe (3D PDF)
  - But many others as well
- Government agencies
  - EU, DoD, NASA, NIST, ASME
- Industrial companies and consortia tend to be domain specific
  - Automotive—AIAG and others
  - Aerospace—Aerospace & Defense PLM Action Group (see ad-pag.com)
  - Power & offshore—POSC & others

Concluding Remarks

Integration maximizes business value

- There are many definitions—use what works for you
- We need standards to support data for the full product lifecycle
- Many standards, not one comprehensive standard
- Participate in developing standards for your needs—to support your customers and supply chain
### PLM Certificate Program Outline

**5-day, 9-session outline for PLM Leadership offering**

- **Day 1:** Session 1: Introduction to PLM
- **Day 2:** Session 2: PLM Benefits & Potential Value  
  Session 3: PLM Strategy & Solution Definition
- **Day 3:** Session 4: PLM Solution Evaluation & Selection  
  Session 5: PLM Implementation, Monitoring & Continuous Improvement
- **Day 4:** Session 6: PLM Process Development & Testing  
  Session 7: Integrating PLM within the Enterprise
- **Day 5:** Session 8: Expanding PLM Across the Value Chain  
  Session 9: Configuration Management's Role in PLM
What Others Are Saying

Sample of feedback received from past certificate program participants

“A must attend program for anyone that is planning to participate in PLM selection or implementation activities at their organization.”
—Mr. Shinod Kumar, Edwards Lifesciences, USA

“An excellent overview of all PLM and it’s fit to companies. Good insights that can avoid many troubles in implementation.”
—Mr. Paulo C L Villaca, Embraer, Brazil

“I wish we had done this before we started our PLM effort...”
—Mr. Jeff Burk, Whirlpool, USA

“Hazy about PLM? Come to CIMdata and clarify.”
—Mrs. B. Uma Prasad, Bharat Heavy Electricals Ltd., India

2017-2018 PLM Certificate Class Schedule*

Join us, and learn more about PLM

• March 6-10, 2017 – Ann Arbor, MI USA (completed)
• June 12-16, 2017 – Amsterdam, The Netherlands (completed)
• October 2-6, 2017 – Boston, MA USA (completed)
• December 4-8, 2017 – Cypress, CA USA (completed)
• May 21-25, 2018 – Ann Arbor, MI USA
• June 11-15, 2018 – Amsterdam, The Netherlands
• October 1-5, 2018 – Boston, MA USA
• December 3-7, 2018 – Santa Clara, CA USA

15% Discount for any scheduled class:
Sign up and pay by May 1, 2018

* Dates are subject to change

Custom & on-site programs by request
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