Strategic View:
Delivering Product Standards Data in Multiple Forms to Multiple Platforms from a Single Source of Data

Ross Downing
Principal Engineer
PSDD Principal Technology Lead
The Boeing Company
October 14, 2010
Product Standards

- Standard parts (bolts, nuts, electrical connectors, Hydraulic fittings, etc.)
- Manufacturing processes (sealing, painting, heat treating, fastener installation, etc.)
- Materials (metal alloys, composite materials, sealants, insulation, etc.)
- Tooling
- Test methods
- Other categories that define products
Standards have been an integral part of our business for a long, long time.
Product Standards

Product Standards Data:
• used across Boeing products
• used across the product lifecycle
• used throughout the Supply Chain

Product Standards “in” Products:
• Parts
• Materials
• Processes

Defined by 10’s of thousands of documents.
Product Standards

• Authoritative Type Design product definition when invoked by a drawing or dataset
• Product standards lifecycle is independent of other product specific product definition data (CAD – Computer Aided Design, PDM – Product Data Manager, etc.)
• Product Standards provide standardized product definition across multiple products
• Product Standards comprise roughly 40% of the product definition data on Aerospace products
• Higher use of standards reduces product costs
• Product Standards data needs to be digital as is the CAD/PDM data and needs to be interoperable with it
Product Standards in a Product’s Lifecycle

**Product Standards Data Management**
- Supplier issues
- Obsolescence
- Hazardous materials
- Quality and reliability
- etc…

**Product Standards**
- Material specs
- Standard parts
- Process specs
- Design manuals
- etc…

**Support Product**
- Maintenance
- Spares
- Mod’s
- Investigation

**Design Product**
- Select standards
- Apply standards

Callouts to material specs, process specs & std parts

**Build Product**
- Tool setup
- Fabricate
- Assemble
- Inspect

**Manage Mfg Resources**
- Procure
- Manage inventory
- Distribute

**Mfg control, inspection reqs, facilities control, supersession, options**

**qualified sources, matls control, receiving inspection, supersession**

**subset of all info for other processes**

**Product Standards callouts**
Product Standards vs. Product Lifecycle

PSDD – Functional Architecture (with overlay of current & soon-to-be applications)

Define & Control
- Change Request Management
- Change Review / Coordination

Authoring
- Data-Centric Capable
- Document-Centric Only

Publishing
- Transform
  - Shape-Centric
  - Data-Centric
  - Document-Centric

Delivery
- View Product Standard Documents
- Select Product Standards for a Product Definition
- Apply Product Standards to Product Definition
- Get Relevant Manufacturing Data from Product Standards
- Get Relevant Customer Support data
- Data Access Infrastructure

Product Standard Lifecycle

Product Lifecycle
Product Standards

- Product standards are typically Paper documents
  - Some are being converted to digital files
- Authors of standards
  - The government
  - Industry “SDO” organizations (SAE, ASTM, etc.)
  - Companies (Boeing has ~114,000 in 17 collections)
- When invoked by a drawing or dataset
  - Only part of the standard is needed
  - Standards invoke other standards creating a chain or tree of standards information
- User Responsibilities for “Paper” Standards
  - Read and manually interpret ALL information in the invoked standards
  - Determine what part of a standard is needed for a specific application
Product Standards

A rivet isn’t just a piece of metal...

FAA requires that we can audit this web of product standards.
Current Situation

- Standards data comprises almost half of our product definition
- Standards are typically paper documents
  - Must be manually navigated and interpreted
  - Are not digitally interoperable with the product specific product definition data (CAD, PDM, etc.)
- Standards data cannot be managed in the product specific product definition tools (CAD, PDM, etc.) because it has a different lifecycle
- Navigation and interpretation of product standards and re-keying of standards data into other systems is expensive, error prone, and presents configuration management issues
Product Standards as Documents

Many document publishing systems

Documents are interpreted and re-keyed into different formats $\text{M/year}$

Several applications make data usable although 2nd source

Many different users, processes, & environments

Copyright © 2009 Boeing. All rights reserved.
Strategic Goals

Standards users will not need to access a PDF document for a standard. Instead, the optimum amount of specification information will be delivered in a role-based format to the point of use when needed with little or no manual intervention.

Government and industry wide common data model and hierarchical ontology for product standards.
Master Information Model

One Semantic Model for Product Standards Data
(wherever it is found)
Strategic Plan

• Raise product standards technology to the level of product design technology (CAD, PDM, etc.)
  • Author standards as digital files
  • Ensure that the data is interoperable with other product definition data and systems
• Manage and deliver product standards from single authoritative source
  • Standards are authored once and data is drawn from the single authoritative source (different standards may come from different single sources)
  • Never re-key data
  • Use a schema that allows multiple format publishing of standards data
    – PDF document views, CAD models, knowledge based interpretation and delivery systems, tools to feed data to design (CAD, PDM), procurement, manufacturing, and product support systems
  • Automatically feed data to all delivery systems on publishing
• Use SOA to facilitate data interoperability
Product Standards as Digital Data

Transformation at publish

Repository of Content Components

CAD

Databases

Internet and Intranet

Multimedia

Assembled Documents
Requirements

- Secure and reliable data management and configuration control system
- Software and schema that allows digital definition of standards data (numbers, formulas, conditions, logic, etc.)
- Software and schema that allows publishing of the standards data in all necessary formats (PDF documents, digital files, logical and conditional interpretations for “smart” systems, CAD models, etc.)
- Increased authoring resources dedicated to standards
- SOA architecture to facilitate system interface
- Robust data model and hierarchical ontology to facilitate data interoperability
## CAD Shape Data - Driven from Single Authoritative Source

### Part Number Details

<table>
<thead>
<tr>
<th>PartNumber</th>
<th>Length</th>
<th>Width</th>
<th>Height</th>
<th>Flange Thickness</th>
<th>Flange Corner</th>
<th>Shell Length</th>
<th>Shell Width</th>
<th>Shell Height</th>
<th>Insert CL</th>
<th>Block Length</th>
<th>Block Width</th>
</tr>
</thead>
<tbody>
<tr>
<td>BACC65AN2B10</td>
<td>1.323</td>
<td>2.165</td>
<td>0.92</td>
<td>0.433</td>
<td>0.119</td>
<td>1.215</td>
<td>0.549</td>
<td>-0.117</td>
<td>0.469</td>
<td>1.457</td>
<td></td>
</tr>
<tr>
<td>BACC65AP2B16</td>
<td>1.41</td>
<td>2.165</td>
<td>0.92</td>
<td>0.486</td>
<td>0.119</td>
<td>1.334</td>
<td>0.687</td>
<td>-0.117</td>
<td>0.471</td>
<td>1.457</td>
<td></td>
</tr>
<tr>
<td>BACC65AV2C10</td>
<td>0.975</td>
<td>2.165</td>
<td>0.92</td>
<td>0.522</td>
<td>0.119</td>
<td>1.334</td>
<td>0.687</td>
<td>-0.117</td>
<td>0.469</td>
<td>1.754</td>
<td></td>
</tr>
<tr>
<td>BACC65AW2C16</td>
<td>0.897</td>
<td>2.165</td>
<td>0.92</td>
<td>0.476</td>
<td>0.119</td>
<td>1.215</td>
<td>0.469</td>
<td>-0.117</td>
<td>0.471</td>
<td>1.754</td>
<td></td>
</tr>
</tbody>
</table>

---

**CAD Image:**

A 3D CAD model of a component, showcasing various dimensions and features.
Benefits

• Greatly reduced recurring manufacturing and product support costs (orders of magnitude greater than increased authoring costs)
  • Reduction in time needed to navigate and interpret standards
  • Elimination of data re-keying
  • Reduced rework due to interpretation errors
• Increased data quality
  • All standards data comes from the authoritative single source with no manual intervention
• Increased data interoperability
  • Easy and accurate analysis using standards data integrated with design, manufacturing, procurement, and product support data and systems
• Benefits extend across the supply chain
Current Situation at Boeing

• Everything described here is currently in production at Boeing
  • Digital authoring, content management, and delivery system (PSDD – Product Standards as Digital Data)
  • Knowledge based standards tools for design (ESDS KB – Engineering Standards Distribution System Knowledge Bases, iPSMG – integrated Product Standards Management Gateway, EGS – Enterprise Geometry Service)
  • Knowledge based tools to digitally interpret and deliver standards data for manufacturing (Wizards)
  • Various data feeds to PDM, Procurement, and Product Support systems
• Boeing has a long term strategic plan for standards that incorporates the elements described here
Manage Product Standards Within a Program
Product Definition Standards Tools

Customers (Design Engineering, Program M&P)

Manufacturing Engineer applies standards data
……..to production systems

Deliver Enterprise Product Standards
Produce & Support Standards Tools

Customers (Supplier Management, Manufacturing, Customer Support)

Design Engineer applies standards data
……..to drawing / PDM / dataset

Interpret and deliver standards data
……..via Wizard, manually, etc.

Standards Related Data
(Attributes not in the standard,
Connect points, Manufacturing aid data, Export control status, etc.)

PSDD Content Management
Single Source of Data

Product Standards
Corpus Families of Standards

Program Centric Data
(Program ASLs, Program Substitution Documents, etc.)

Standards Like Data
(Vendor Parts, SCDs, Models, etc.)

Infrastructure (MIM, Workflow, etc.)

Data Centric Authoring
(Wizardization, Rulesets, etc.)

PSDD Product Standards
User Interface

Product Definition Tools

SOA Interface

Produce and Support Tools

SOA Interface

PSDD Product Standards as Digital Data (PSDD)
iPSM Gateway

• Product Standards selection service draws data from single source (PSDD)
• Constrains selection to control proliferation
• Process notes can be linked directly to product standards Wizards to automatically interpret standards
• Produces CAD models of standard parts “on the fly” from the single source (PSDD)
• Automatically applies standards to the digital design dataset (CAD/PDM)
## iPSM Gateway

**Integrated Product Standards Management**

<table>
<thead>
<tr>
<th>Home</th>
<th>Contact Us</th>
<th>Help</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cart</td>
<td>Parts</td>
<td>Materials</td>
</tr>
</tbody>
</table>

### Material Change

- **Material** to **Chromium**. No further LCPT approval is required.
- **TI 6Al-4V, 150 KSI FTU, Aluminum Pigmented Coating Applied to Threads Only, 3/4” Dia. and Larger, Set ENOVIA part attribute “Hazardous Restricted Material” to “Chromium”. No further LCPT approval is required.**

### Bolt, 12 Point Tension Head, PD Shank Diameter

- **BACB30XL0B(_IH)0_**
- **Add to Cart**
- **Run KB**

### Bolt, 12 Point Tension Head, PD Shank Diameter

- **BACB30ZF0-0**
- **Add to Cart**
- **Run KB**
- Nickel Alloy 718, 185 KSI FSU, Bare

### Bolt, Hex Head, Shear, Short Thread

- **BACB30LJ12DEK0**
- **Add to Cart**
- **Run KB**
- **BACB30LJ0(DEUJDU)00**
- **Add to Cart**
- **Run KB**
- **BACB30LJ14K0**
- **Add to Cart**
- **Run KB**
- **BACB30LJ16C55**
- **Add to Cart**
- **Run KB**
- A286 CRES, 95 KSI FSU, Aluminum Pigmented Coating, **Set ENOVIA part attribute “Hazardous Restricted Material” to “Chromium”. No further LCPT approval is required.**
- A286 CRES, 95 KSI FSU, Passivated, Drilled Shank
- A286 CRES, 95 KSI FSU, Aluminum Pigmented Coating, Usage limited to 151Z6335-1. Set ENOVIA part attribute “Hazardous Restricted Material” to “Chromium”. No further LCPT approval is required
- A286 CRES, Chrome Plate, **Set ENOVIA part attribute “Hazardous Restricted Material” to “Chromium”**
## The Long Inputs Page

### Re-Answer

<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Select the functional use category for this part.</td>
<td>Category 1</td>
</tr>
<tr>
<td>Select the range which the maximum service temperature (F) of this part falls within.</td>
<td>-65 to 180</td>
</tr>
<tr>
<td>Is this a welded or brazed assembly?</td>
<td>No</td>
</tr>
<tr>
<td>Select the product form from which this part will be fabricated.</td>
<td>Sheet (Thickness &lt; .250)</td>
</tr>
<tr>
<td>Select one of the following joining methods, if required for this detail or for any other subsequent assembly using this detail.</td>
<td>None</td>
</tr>
<tr>
<td>Select the alloy desired for this Sheet (Thickness &lt; .250).</td>
<td>2024</td>
</tr>
<tr>
<td>Does this design require clad material?</td>
<td>No</td>
</tr>
<tr>
<td>Is this a standard part formed shape with a D-590 Standard Part number?</td>
<td>Yes</td>
</tr>
<tr>
<td>Select the Aircraft Model.</td>
<td>787</td>
</tr>
<tr>
<td>Select the condition of the material for forming.</td>
<td>Form in O-Condition</td>
</tr>
<tr>
<td>Enter the purchased Sheet stock thickness (in inches).</td>
<td>.1</td>
</tr>
<tr>
<td>Is this part located in a sonic fatigue environment, such as in the engine support area?</td>
<td>No</td>
</tr>
<tr>
<td>Select the applicable fatigue design criteria for this part.</td>
<td>Not Designed for Fatigue</td>
</tr>
</tbody>
</table>
# iPSM Gateway

**Cart Name:** New_32

## 787 Standard Parts

<table>
<thead>
<tr>
<th>Select</th>
<th>Instantiate if sent</th>
<th>Stackup Order</th>
<th>Part Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>BACB30US8K4</td>
<td>BOLT</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>BACN10HR8CS</td>
<td>NUT</td>
</tr>
</tbody>
</table>

## 787 Process Notes

<table>
<thead>
<tr>
<th>Select</th>
<th>Annotation</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>5PR0000003149</td>
</tr>
</tbody>
</table>

---

**BOEING** is a trademark of Boeing Management Company.
Wizards

• Web-based tools that use the digital standards structure to:
  • Interpret standards
  • Identify relevant information for a specific application
  • Provide the user with the optimum, sufficient data from the standard

• Capabilities:
  • Automatically generate authoritative, detailed, role based work instructions for the installation plans used by Manufacturing, Quality, Procurement, etc.
  • Automatically produce raw data from standards to be used directly by other systems or applications
Select the hole installation specification indicated on the Engineering dataset or drawing:

[BAC5009]

Enter the fastener part number:

[BACB30US8K12]

Is the hole in a fluid tight area as defined by the Engineering dataset or drawing?

[No]

Select all the materials in the stackup to be fastened:

- [ ] Aluminum
- [ ] Composite
- [ ] Magnesium
- [ ] Nickel Alloy
- [ ] Steel
- [ ] Titanium

Is the hole diameter called out on the Engineering dataset or drawing?

[Yes]
Wizards

For Commercial Use Only

Work Instructions: Critical Sequential Operations
All text in this font is product definition data from BAC specifications

Fastener = **BACB30US8K12**  Nominal diameter = **0.5000**

---

**HP Reference:** Class I, Refer 5009 AIM Table 2, Hole Preparation AIM Table 12, BAC5004-2 Table XIV

All linear dimensions in this specification are in inches.
Pilot holes for reamers can be made with any type of cutter.

Fillet relief is required for protruding head fasteners as shown in BAC5009 Figure 5. Head to shank fillet relief can be accomplished by one of the following three methods:

- Provide a radius around the hole.
- Add a 45 degree chamfer around the hole.
- Install the fastener with a countersunk washer under the head according to Section 8.1.4a.

Reference BAC5009 table 1 for surface quality.

BAC5009 - FIGURE 5

Inputs Selected:  Fastener=BACB30US8K12; Minimum diameter=0.5000; Maximum diameter=0.5050; Nominal diameter=0.5000; Head type=PROTRUDING; Washer on drawing=Illo; Lot size=Up to 17; Titanium or Steel=Illo; wzhm_specSelect=bac5009; wzhm_fluid_tightホール=Illo; wzhm_matl_stackup=Aluminum

SWI Number: SWI NOT AVAILABLE

Please click on the "Submit to CAPP" button to create a SWI and send it to CAPP.

Submit to CAPP  Note: Only authorized users can send SWIs to CAPP.
Boeing Enterprise

Boeing Product Standards
Long Range Strategic Plan

Boeing Product Standards Office
Revision C
June 2010
Questions?