MBE and MBD in Work Instructions
“Its all about reuse of CAD models”

Saving process development and operational dollars

Rich Eckenrode
RECON Services Incorporated
• RECON Services Incorporated

  – Small Engineering Consulting Corporation (3 engineers currently, combined 115 years of experience)

  – Expertise in:
    • Manufacturing Engineering (Certified Manufacturing Engineer, Certified GD&T (ASME Y14.5))
    • 3D CAD modeling (Multiple systems, Solidworks, Solid Edge, CATIA, NX, Wildfire/Creo)
    • Providing MBE/MBD training in multiple CAD systems
    • Membership on MIL-STD-31000 committee (co-chair of manufacturing sub-committee)

  – Provides advice to US Army/OSD regarding MBE/MBD

  – Providing direction/services with respect to 3D TDPs for two IBIF Projects

  – Providing CAD models with MBD to NIST for the “3D MBD PMI Validation” project (Creating CAD models with semantic 3D Annotations in multiple CAD systems.)

  – Research partner (sub-contractor) to the Applied Research Laboratory at Penn State University for the DARPA iFoundry program. (Providing Manufacturing Engineering expertise as well as MBE/MBD knowledge in the definition of 3D Technical Data Packages)
I believe that a Strong nation is dependent on a strong manufacturing base. If we continue to lose our manufacturing infrastructure to off-shore concerns we will go into a downward spiral that will be very difficult to recover from.

I also believe that by adopting a full spectrum of MBE/MBD process components in the everyday use at design and manufacturing companies in this nation, we can begin (in a small way) to improve our cost to produce products and subsequently to reduce off-shore sourcing of our manufacturing capabilities.

New processes are not the only thing that will save our manufacturing infrastructure. This in combination with good management policies and good work ethics can insure that the United States does not fall into an un-recoverable rut.

I can guarantee that the technology and processes will help, I cannot guarantee the policies and ethics will exist.

Only you can do that.
• MBE/MBD
  – Model Based Enterprise
    • A fully integrated and collaborative environment founded on 3D product definition detail and shared across the enterprise; to enable rapid, seamless, and affordable deployment of products from concept to disposal.
  – Model Based Definition
    • A 3D annotated CAD model and it’s associated data elements, that fully define the product definition in a manner that can be used effectively by all downstream customers in place of a traditional drawing.

Solidworks Drawing and MBD Models by Malkin Shaw, RECON Services Inc.
- Task Instructions
- Sequences of tasks
- Dimensions
- Tolerances
- Surface Finish requirements
- Weld Symbols
- Notes
- Specifications
- Representation of product
  - Illustrations
  - Photographs
  - Drawings
  - Models
- Safety Warnings
- Safety Equipment required

### Work Instruction Content

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### Terminology and Symbols

- **AT MAXIMUM MATERIAL CONDITION** (when applied to a tolerance value): \( \pm \) symbol
- **AT MAXIMUM MATERIAL BOUNDARY** (when applied to a datum reference): \( \pm \) symbol
- **AT LEAST MATERIAL CONDITION** (when applied to a tolerance value): \( - \) symbol
- **AT LEAST MATERIAL BOUNDARY** (when applied to a datum reference): \( - \) symbol

### Safety Warnings

- **Safety Equipment required**

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**P/N 500073**

**NOTES**

1. Interpret in accordance with ASME Y14.5-2009
2. All edges and corners to be free from burrs
3. 0.040 max. fillet radii unless otherwise specified
4. Material Steel Bar, 300 C, per ASTM A510-1010 - 1025

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**Doing Our Part In The Defense Of Our Nation**
3D WI History (Within ManTech)

Concept HTML (2005)

PDF 2007-2009

RRAD HTML 2007

LEAD HTML 2009

Doing Our Part In The Defense Of Our Nation
3D WI History (SW Industry)

- CAD Companies (DELMIA/3D Via (Dassault Systems); Tecnomatix (Siemens corporation) Creo view (PTC))
- Right Hemisphere
- Lattice technologies

- Adobe Acrobat 3D PDF (U3D and PRC formats)
  - Adobe divests of 3D product (2009-2010)
    - Techsoft (Hoops visual software libraries)
    - Prostep (Server based PDF solution)
    - Tetra 4D (Acrobat PRC converter, Reader components)
  - PDF Consortium (2012)
    - Members from above companies
    - Other Software companies
    - Building industry
    - Boeing
    - US Army / DoD

- ANARK
- EOS solutions
- Others...
Doing Our Part In The Defense Of Our Nation

3D Data is required for 3D data reuse

- Jana Tuck (RRAD) told me; “Rich, if we don’t receive 3D data we cannot realize the savings promised.”

Digital Depot 2007

- RRAD targeted as Pilot Project
How do we get 3D data?

- **New programs,**
  - Utilize MIL-STD-31000-A to acquire 3D data from OEM.
  - DoD designers create 3D data per MIL-STD-31000 requirements.

- **Legacy programs**
  - Engineering effort to re-master 2D into 3D.
  - Manufacturing/Sustainment activity to create 3D data.
    - All CNC Programmers already do this.
    - RRAD; production documentation did this.
  - Reverse Engineer existing products.
    - Measurement methods required.
    - Engineering effort required to determine certain things (tolerances)

In legacy data upgrade programs; Care must be exercised to insure that design intent and functional requirements are redefined properly.
How do we get 3D data?

2D Drawings to 3D MBD

2D Drawings and Model to 3D MBD

Reverse engineer to 3D MBD
Basic Search → Results → Document Details

Document ID: MIL-STD-31000A

Overview

Title: Technical Data Packages
Scope: This standard provides requirements for the deliverable data products associated with technical data package (TDP) and its related TDP data management products. A TDP contains a level and type, and may have associated metadata and supplementary technical data. Product data and product data is a sub-set of technical data. These relationships are shown in the hierarchical breakdown of data in Figure 1.

Document Status: Active Doc Date: 7 Dist Stmt: 3
FSC/Area: SESS Doc Category: Standard Practice

Responsibilities

Lead Standardization Activity: SE ODDR&E Systems Engineering
Preparing Activity: AR US Army Research Devlp & Engr Command, Armament Research
Army Custodian: AR US Army Research Devlp & Engr Command, Armament Research
Navy Custodian: OS Naval Surface Warfare Center (NAVSEA), Ordnance Systems
Air Force Custodian: 16 Air Force Product Data Systems Modernization Office
DLA Custodian: DH Defense Logistics Agency (DepSO)

Revision History

Changes to military standards or handbooks issued after August 1, 2003, are no longer published but are incorporated in the modified document.

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Please note that digital documents are available only in Portable Document Format (PDF) and accessing them requires using the free Adobe Reader plug-in.

http://www.assistdocs.com/search/search_basic.cfm
• TDPs incomplete
  – A10 wing replacement

• TDPs not able to satisfy modern manufacturing requirements.
  – 50 CAL Machine gun parts procurement.

Two DoD examples where new 3D data was required for sustainment activities.
In order to reverse engineer a legacy system, Measurement of that Legacy System is required.

• Michael Raphael, President at Direct Dimensions Inc.
  – DDI since 1995
  – Michael taught Rich FARO arm use around 1997
  – Michael is very active with Society of Manufacturing Engineers, Coordinate Metrology Society...
  – Uses his spare time to run Direct Dimensions Inc.
  – Expert in Coordinate Measurement equipment, software and processes.
  – DDI provider of hardware, software and services for all coordinate metrology processes.
    • All types of Scanner Technology.
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