

Reuse of MBD Data

Transforming the Model Based Definition
Into the Model Based Enterprise



Presented by Walter Roy
Cont US Army Research Lab

MBE
Model Based Environment



The Next Generation of Business



MBD Is Only The Beginning



The Model Based Definition is created at the beginning of the lifecycle then reused throughout the enterprise, thus creating the Model Based Enterprise



MBD

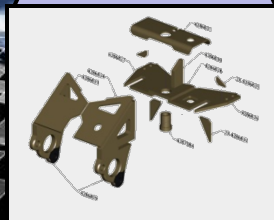
Concept

Design

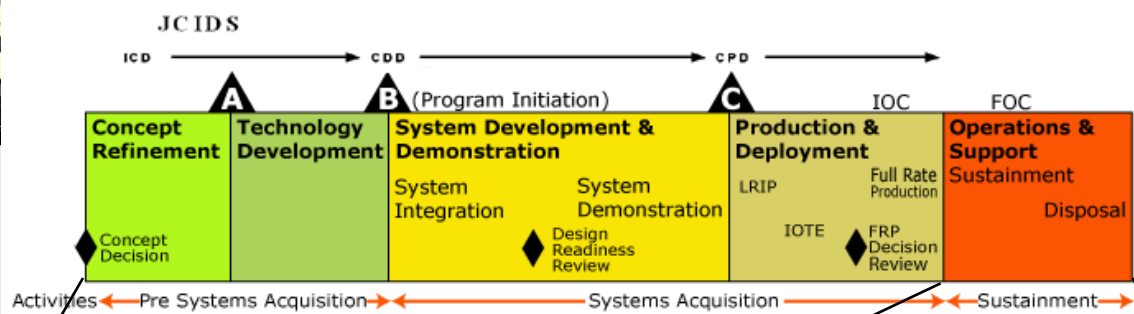
Production

Sustainment

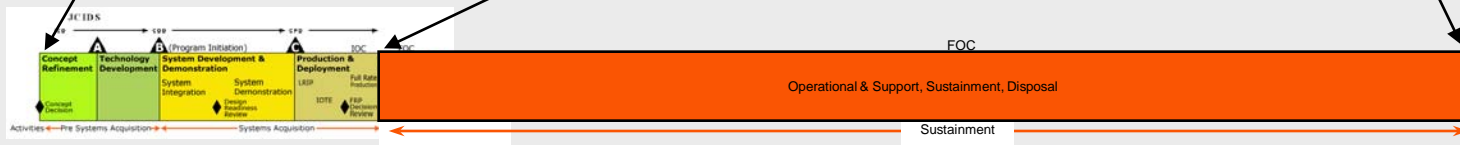
End
Of
Life



Usual Representation of DoD System Life-Cycle

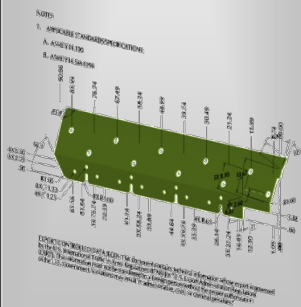
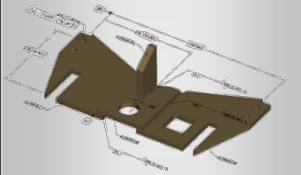
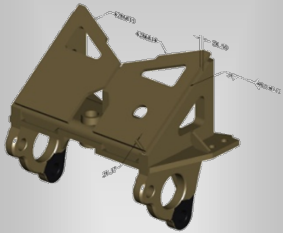


Scaled by \$
65%-80% of Life-Cycle Costs Occur in Sustainment



A Dollar That Reduces Sustainment Costs is 2x to 4x More Effective in Reducing Overall Cost than if Invested to Reduce Costs Elsewhere

GAO Reports on Data Rights



GAO Reports

- GAO-04-715
- GAO-06-839 DOD Should Strengthen Policies for Addressing Technical Data Needs to Support Weapon Systems
- Quotes
 - “The Air Force and Army have encountered limitations in their sustainment plans for some fielded weapon systems because they lacked needed technical data rights...C-17, F-22, C130J, Up-Armored HMMWV, Stryker, et al..” MRAP

OSD Team Members

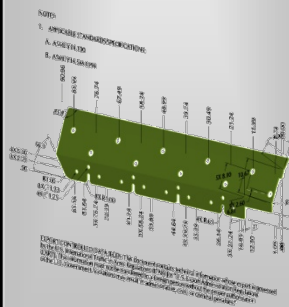
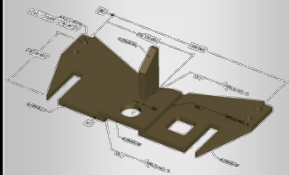
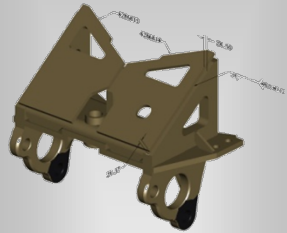


- DOD-Gov
- OSD- Adele Ratcliff

- **Army-** Paul Huang (ARL), Steve Luckowski(ARDEC), Steve McGlone(ARDEC/AMC), Jeff Windham(ARDEC/AMC), Mark Napolitano (ARDEC), Maj Scot Greig(ASAALT), James Colson(LOGSA), Kathy Rainbolt(LOGSA), Dayn Beam(Legal/AMCOM),Maj. Eric Burkeholder (LEAD), David Betts (RRAD), Walter Roy
- **Navy-** Ben Kassel (NavShips), Gary Sunderland (Navair)
- **AF-** David Crouse (AFRL), Henry Oates DLIS – Ric Norton
- **NIST-** Simon Frechette, Sharon Kemmer
- **Industry – Gov Primes**
 - BAE Rich Eckenrode, Roy Whittenburg, Curtis Toone
 - GDLS Carl Sens
 - Boeing Mike Clare
- **Industry – Technology Providers**

– PTC Mark Franci	Elysium Ken Tashiro
– Catia/Delmia Bob Brown	Adobe Jim Merry
– Siemens NX Fram Polad	EOS Tom Barth
– Vistagy John O'Connor	IMTI Richard Neal, Rob Steele

MBE for Design & Production



State of the Industry

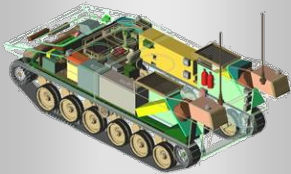
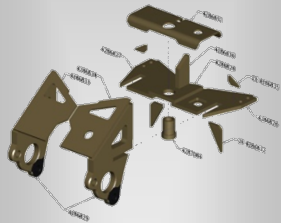
- Drawings are Model Centric (Driven by the Model but Still 2D)
- Drawings are Considered the Master
- Models are Recreated for Production

Currently Design Groups Are Not Generating Data For Easy Consumption By Production

Current MBE Projects

- Refinement of the 3D Annotated Model Schema(Army)
- X6 MBE Demonstrator (Army)
- Technical Data Package Definition (OSD)
 - **Co-chair Mil-DTL-31000 revision**
- Certification of MBD data and the Product Master (OSD)

MBE and Tech Pubs



State of the Industry

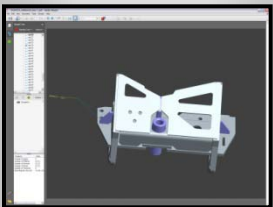
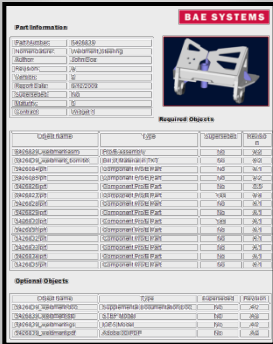
- Illustrations are Recreated Based off of Old Design Data or created from scratch
- Tech Manuals are 2D Based With Limited 3D Content
- Tech Manuals are a Serial Process Often Started Long After Delivery has Begun

Current MBE Projects

- Reuse MBE data for AVIs in technical pubs and manuals
- Gap Analysis and Roadmap for Implementing New Technology Based on the 3D Model
- Demo Pubs in compliance with S1000D

The Current Practices Limit The Reuse of MBE Data

MBE and Supply Chain



State of the Industry

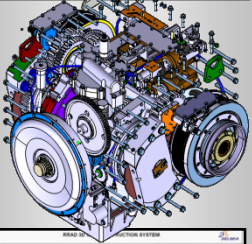
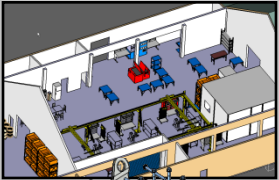
- Suppliers Receive TDPs in the Form of 2D Drawings and in Some Cases a Neutral File
- Delivery of the TDP is Typically by Fax or FTP Site With Little Control
- Most Small Companies Have Limited Exposure to High-End CAD or Native CAD Models

Current MBE Projects

- Survey of 1020 Supplier's Ability and Willingness to Use MBE Data (NIST MEP)
- Pilot Program With 10 Suppliers to Validate MBE Benefits
- Define the Basic MBE Delivery Package and Methodology for the Supply Chain
- Prototype a Full Function and Controlled Supplier Portal for MBE Data

The Key to Reuse of MBE Data in The Supply Chain is Effective Delivery

MBE in Depots



State of the Industry

- Typically the Depots Receive Only Limited 2D TDPs at Best. Many times nothing.
- Work Instructions are Paper Based with Pictures of Disassembled Hardware
- There is Typically no PLM and Limited ERP

Depots Have Are One Of The Biggest Potential Users Of MBE Data

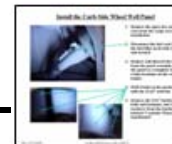
Current MBE Projects

- Digital Depot Activities are Currently Being piloted at:
 - RRAD, LEAD
- Currently Organizing a Depot Summit
- Establishing a Virtual Manufacturing Lab at NIST Gaithersburg (OSD)
- Working With Adobe and EOS to Perfect Lightweight PDF Work Instructions

Process Planning at the Depots



- Using outdated methods
- Same planning methods that were used 50 years ago
- Often TDP does not exist
- Disassemble and reassemble vehicles while documenting the processes
- Best guess efforts usually require re-thinking to implement best solution

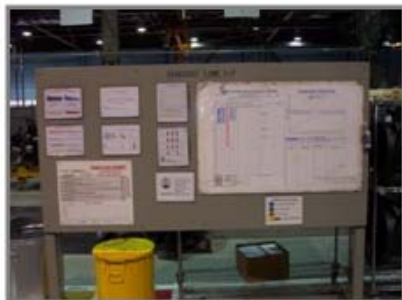


Photos courtesy of LEAD

Lean efforts applied to manufacturing



- After initial production start
- Improves Layout
- Improves factory flow
- Requires investment to implement
- Multiple Lean events require multiple investments
- Takes months or years to implement

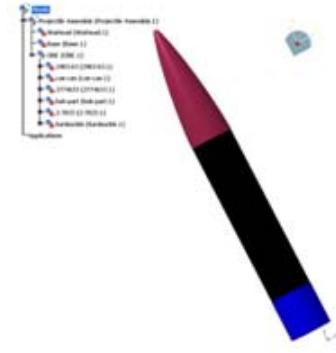


Photos courtesy of LEAD

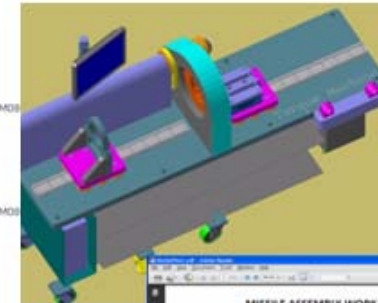
MBE Methods for Process Planning



- Prior to initial production start
 - Process plans without first article
 - Optimize layout
 - Optimize factory flow
 - Create work instructions
- Simulate and prove out in pixels rather than in brick and mortar
- Complete multiple simulation scenarios in order to determine best possible processes



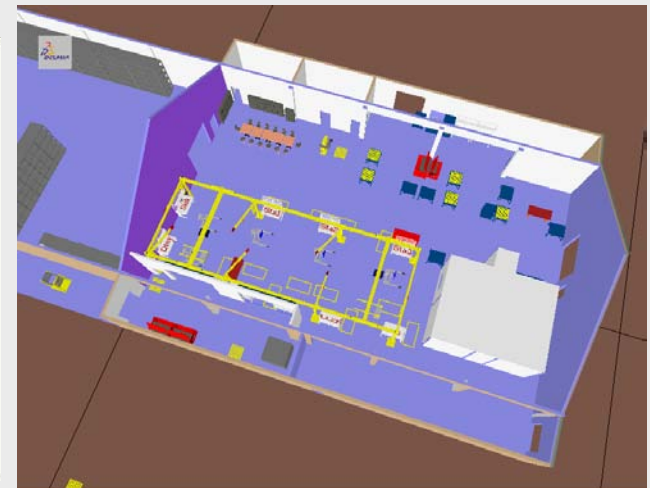
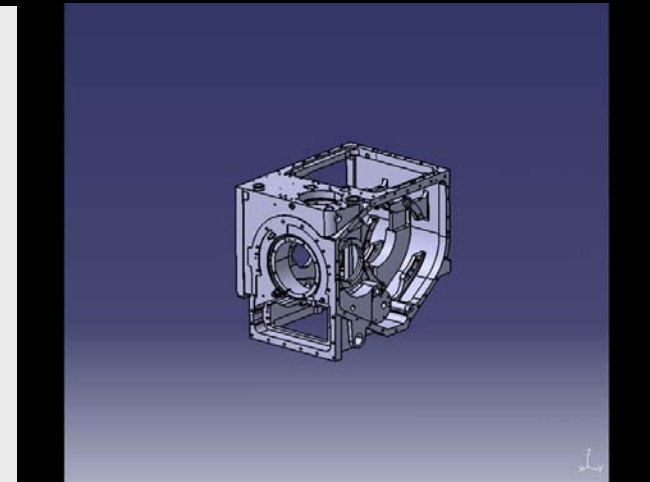
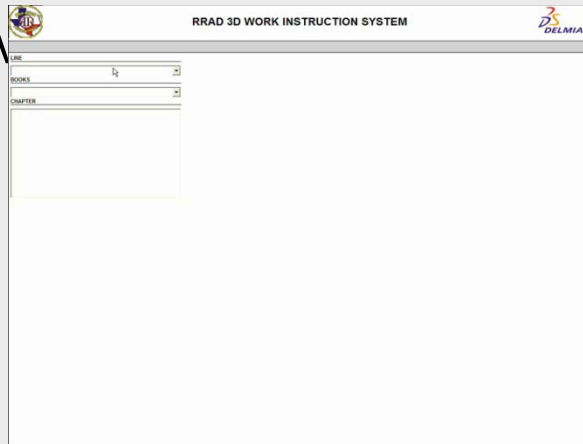
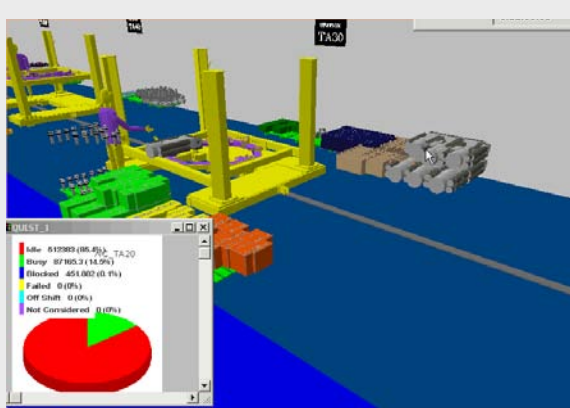
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N10 G00 G20 G40 G49 G80 G90 G98  
(1/4" SLOT DRILL)  
N12 T3 M06  
N14 S10000 M03  
N16 G00 G54 G43 X0.25 Y0.1 Z1. H03 M09  
N18 Z0.1  
N20 G99 G91 Z-1 R.05 F12.  
N22 T4 M06  
N28 S3761 M03  
N30 G00 G54 G43 X0.25 Y0.1 Z1. H04 M09  
N32 Z0.1  
N34 G99 G73 Z-1. R.05 Q.1 F18.  
N36 M97 P1000  
N38 M09  
(1/4-20unc TAP)  
N40 T3 M06  
N42 S10000 M03  
N44 G00 G54 G43 X0.25 Y0.1 Z1. H05 M09  
N46 Z0.1  
N50 M97 P1000  
N52 M09  
N54 G91 G28 Y0 Z0  
N56 G90  
N58 M30  
  
N1000 (P1000: HOLE PATTERN)  
N1002 X0.5 Y0.1  
N1004 X0.75 Y0.1  
N1006 X1.0 Y0.1  
N1008 X1.25 Y0.1  
N426 G80  
M99  
%
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Army Digital Depot MBE Transitioned to RRAD



- Digital Depot project started 2007
 - MBE basics (CAD modeling)
 - Mfg. Process definition
 - Factory flow simulation
 - Create Work Instructions

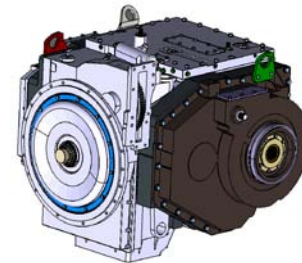


video courtesy of RRAD

Army Digital Depot Status at RRAD



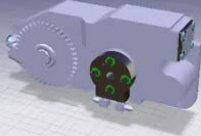
- Two teams trained and functioning
 - Methods and Standards (IE)
 - BFV Transmission Flow
 - Caterpillar engine rebuild
 - Production Documentation
 - BFV Transmission Work Instruction
 - On shop floor now
 - L3 Com wants the work instruction
 - BFV 25mm Gun rebuild
 - BFV Turret Servo Drives rebuild
- Support continues
 - Minimal mentoring
 - Maintain knowledge to pace of technology development



RRAD 3D WORK INSTRUCTION SYSTEM

Auxiliary MakeUp Pump

Select an object or a command
Product1



CHAPTER

Part Distribution Table
Inspection Criteria
Part
Modification
Other

PROCESSES

Process	Description
Identify Pump Elements	
Install Plugs and Passings	
Install Servos	
Install Inlets and Relieving Pipes	
Install Housing	
Install Seal	
Install Ring	
Assemble Valve	
Test Valve	
Install Valve into Make-Up Pump Body	
Install Servo to Drive and Relieving Output	

Part Distribution Table
Inspection Criteria
Part
Modification
Other

PARTS

Part	Description
AT2500-415-1	
AT2500-415-2	
AT2500-415-3	
AT2500-415-4	
AT2500-415-5	
AT2500-415-6	
AT2500-415-7	
AT2500-415-8	
AT2500-415-9	
AT2500-415-10	
AT2500-415-11	
AT2500-415-12	
AT2500-415-13	
AT2500-415-14	
AT2500-415-15	

TOOLS

SAFETY REQUIREMENTS

Install remaining housing using care to align dowel pins. Install screws and washers. Torque all screws to 100 to 120 lb-in (11 to 14 Nm). Verify that each shaft has some end play.

TORQUE: Screws 100 to 120 lb-in (11 to 14 Nm)
NOTE: ALL BOLTS REQUIRING TORQUE WILL BE MARKED WITH A FELT-TIP MARKER AFTER BEING TORQUED.

Photos courtesy of RRAD

Army Digital Depot Status at LEAD



- Hardware and software procure
- Training completed
 - CATIA CAD
 - DELMIA DPM (Manufacturing Analys
 - DELMIA DPE (Manufacturing Plannir
 - QUEST (statistical analysis of flow)
- Pilot project 2009
 - HMMWV GMV-S
 - Link to MRP (LMP) via output files
 - Work Instructions
 - Lean process by design
- Next projects
 - Patriot Missile



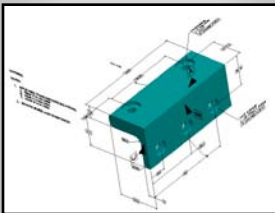
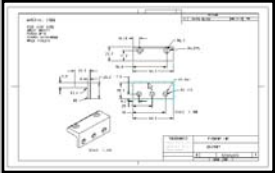


2009 OSD Digital Depot

- MBE Multi CAD Environment at NIST
 - Use Case Definition
 - Demonstration environment
 - Siemens
 - PTC
 - Dassault Systems
- Pilot Case (used to apply MBE at OSD depots)
 - Based on:
 - OSD depot site visits, assessments
 - MBE Multi CAD environments at NIST
 - Team objectives and evaluation
- Animation Tool
 - Adobe based low cost solution



MBE in DLA



State of DOD

- Typically DLA receives little to no product definition
 - **Type 2 NSNs only reference a part # MRAP**
- Many Legacy TDPs are 20, 30, or Even 40+ Years old
- No Process Definition is Received

Current MBE Projects

- Need to rework policies and practices so that DLA/DOD will get required data
- Long term data retention is a key factor for re-use of MBD Data
- Picatinny is Currently Prototyping a Re-mastering Process for Legacy Systems to produce required data

OSD Digital Depot Planned Activities 2010 and beyond



2010

- Choose and execute OSD depot project based on successes at RRAD, LEAD and pilot case defined in 2009.

Beyond 2010

- Provide capability to other OSD depots

MFG. Process Planning

Work Instructions

Tools & Tapes

Routings

MBOM's

Load LMP (MRP)

The collage features several screenshots of software interfaces. One screenshot shows a 'DRILL ASSEMBLY STATION 2' interface with a list of tasks and a 3D model of a drill. Another screenshot shows a 'Full Assembly' interface with a list of tasks and a 3D model of a machine. The collage also includes 3D models of various pieces of machinery, such as a drill press and a lathe.

Program Resource Opportunities/Requirements



Lead	Project	FY10/FY11/FY12 (\$K)
NIST Army Army/DOD Army/DLA	ONGOING Certification of 3D Model 3D Tech Data Package Digital Depot Reuse of MBE data by DLA for replacements parts	 1500K/depot
DOD/DLA Navy/DLA	Long-term Data Storage Automated Generation of Tech Data Requirements (SMART-T)	
TBD	DAU PM/Staff course for TDP/ Data Rights	
TBD	Data Rights DAU Course for DoD Legal staff	
Army	Data exchange pilot w/ Product Lifecycle Sustainment (PLCS)	

Program Resource Opportunities/Requirements Cont



- TBD Accelerate of STEP standards**
- DLA DLIS training module**
- DLA Investigate/study existing and cancelled DoD STD/DTL/PRF/DID**
- TBD File format for delivery to the supply chain**
- TBD MBE inspection/quality requirements**
- TBD Tools to better integrate routables (wiring harness hydraulic lines, etc)**
- TBD Reuse of MBE Models in Tech Pubs**
- TBD Digital Rights Mgmt of TDPs**