

UNCLASSIFIED

# *2013 NIST MBE Summit*

Net-Centric Model Based Enterprise



**U.S. ARMY**  
**RDECOM<sup>®</sup>**

**TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.**

Armament Research Development & Engineering Center  
Picatinny Arsenal, NJ

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# Problem Statement

## Net-Centric Model Based Enterprise



- 2D drawings are the master product definition
  - 3D models are retained “For Reference Only”
  - Design details are easy to miss or misinterpret
- Product data is re-created many times
  - Data entry is costly and labor-intensive
  - Manufacturers build their own 3D models from supplied drawings
  - Opens processes up to errors and delays
- Lack of standards for model based product data
  - File formats are incompatible between organizations
  - Users have difficulty extracting information from models

All of these issues lead to higher product costs and longer schedules

# Definitions: 2D vs 3D Net-Centric Model Based Enterprise

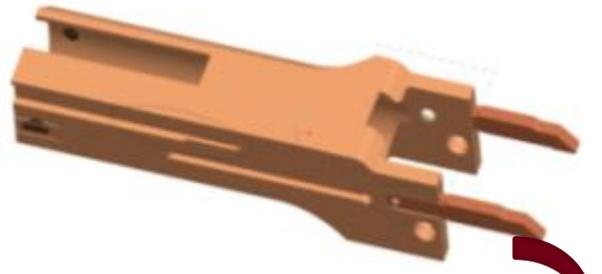


**Drawing Centric:** 2D PDF and C4 formats. Current Army Document of Record

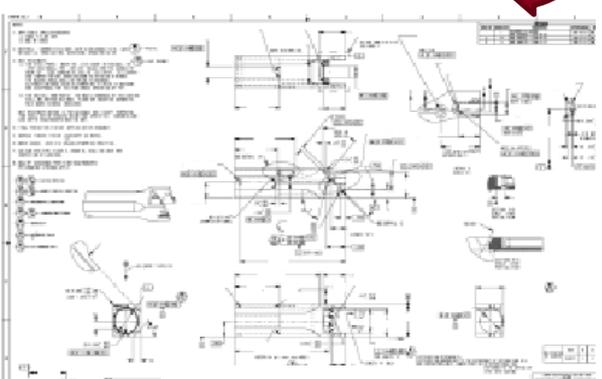
**Model Centric:** 3D model is official. 2D drawing driven by model

**Model Based Definition:** Complete Fully Annotated Model with supporting Lightweight viewable (i.e. Adobe Reader)

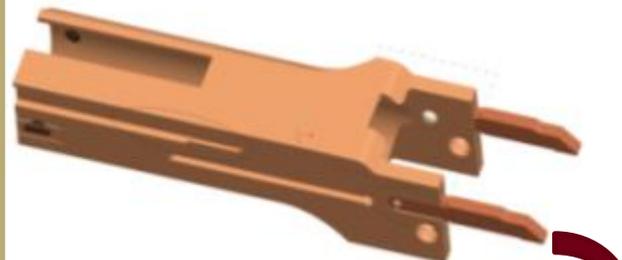
### Drawing Centric (Legacy Approach)



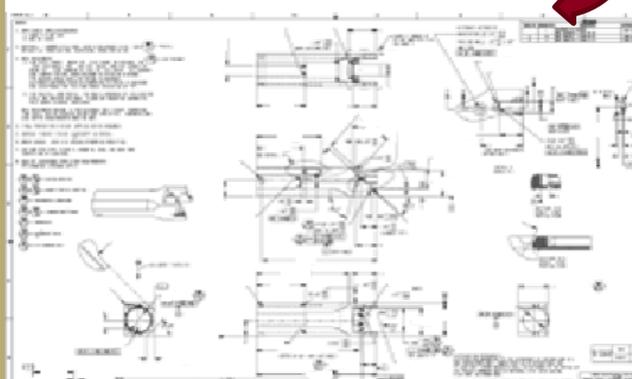
Drawing & model  
not linked



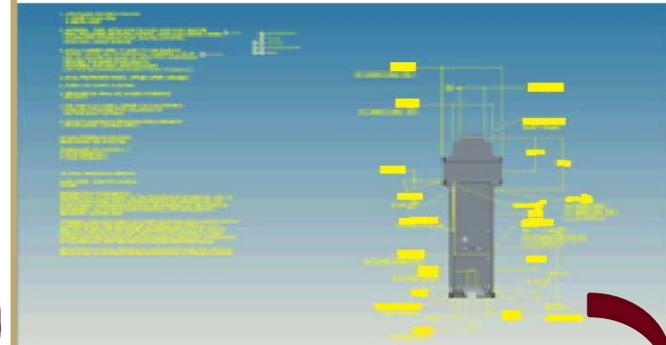
### Model Centric (Contemporary Approach)



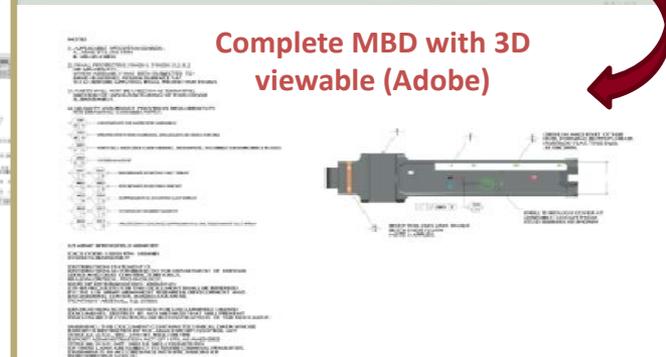
Drawing is driven  
by model



### Model Based Definition Net-Centric MBE ManTech



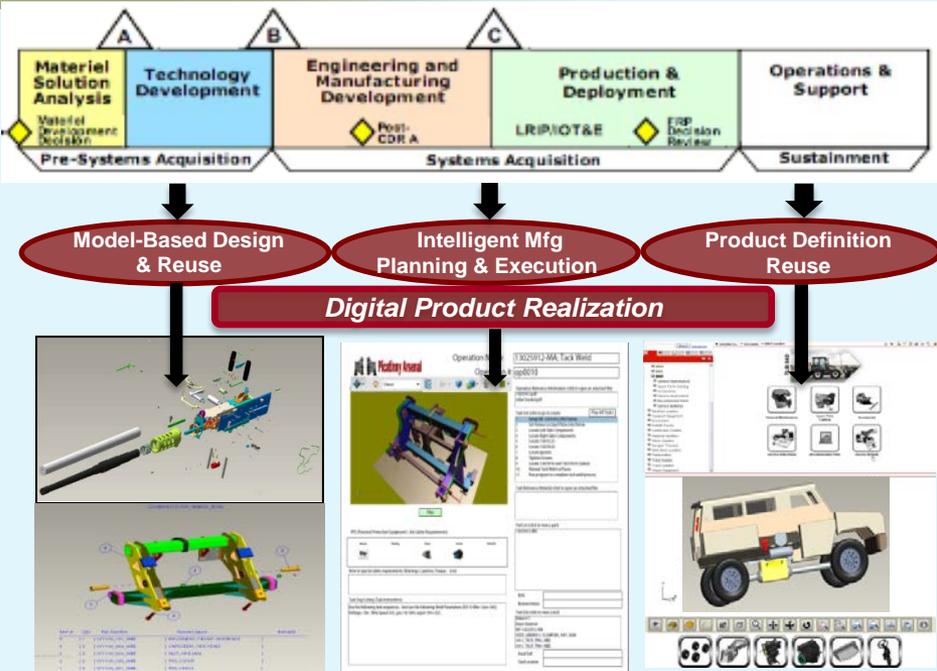
Complete MBD with 3D  
viewable (Adobe)



# Purpose, Product, Payoff



## Net-Centric Model Based Enterprise



### Schedule

MILESTONES	FY11	FY12	FY13	FY14
Configure and Deploy Product Data Management System		[Green bar with diamond]		
Develop 3D Product Data Packages for select systems	[Green bar with diamond]			
Compile MBE Process Library		[Green bar with diamond]		
Refine MBE processes, assess how reverse engineering tools can work with MBE			[Green bar]	

**Purpose:** This program seeks to define, develop, and demonstrate Model Based Enterprise (MBE) technologies and processes within the Army's organic base and private industry to reduce acquisition costs, risks and lead times by utilizing fully annotated models as the 3D product master and maximizing their use throughout the lifecycle.

**Products:**

- Processes for Windchill 10.1 baseline configuration and workflow editing
- Processes for creating fully annotated models in Pro-E, SolidWorks, Solid Edge, and CATIA CAD tools
- Processes for reusing 3D models in tech pubs tools Anark and Arbortext
- Published MBE schema in MIL-STD-31000

**Payoff:**

- Best practices available to tech data users
- Military and commercial standards in place
- Holders of tech data will have a tested set of processes to transmit data to others
- Increased reuse of model data throughout the lifecycle

- JPO MRAP: TOW-GPK Installation Instructions, 3Q FY12  
Developed SOP for Digital Work Instructions using Anark software
- PM-SW: CROWS -01 and -05 IETMs, 1Q FY13  
Developed SOP for IETMs using Right Hemisphere software
- PM-SW: M2A1 Quick Change Barrel 3DTDP, 2Q FY13  
Developed SOP for Model Based Definition in Pro-E
- PM-CCS: Service Information Center for Rhino, 2Q FY14  
Develop SOP for IETM using Arbortext, Develop SIC schema
- PM-GCV: Development of RFP language, 2Q FY13  
Develop boilerplate contract language for 3DTDP acquisition

- Aligns with PM-LMP goals for Engineering Product Data Systems
- Aligns with IBIF program

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# Capabilities

## Net-Centric Model Based Enterprise



Target: September 2014

1. Processes for building automated workflows in Product Data Management (PDM) systems – connecting users, data / metadata export, and data verification
2. Foundational processes and documentation requirements to enable 3D tech data to be used as the master product definition – Industry/DoD standards
3. The ability to quickly learn how to make and use MBD models with 3D tech data tools, so that 3D tech data may be reused throughout the lifecycle – Process manuals for MBE tools
4. Defined “Forensic Manufacturing” processes that yield MBD data

# Baseline MBE Metrics



## Net-Centric Model Based Enterprise

Capability	Value	Date	Origin
DLA annual savings when manufacturers use 3D TDPs	Up to \$14M with 100% of TDPs modernized	2007	DLA Technical Benefits Assessment – mathematical model
Reduction in bid prep time for complex assemblies	Up to 48%	2007	DLA Technical Benefits Assessment – mathematical model
Reduction in physical prototypes required by manufacturers	Up to 50%	2009	Aberdeen Group study
Reduction in Non-Conformance Issues	Up to 40%	2009	Aberdeen Group study

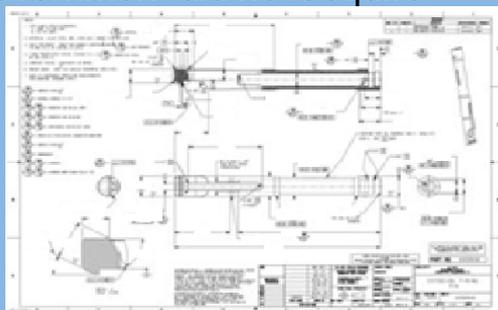
- Define processes for PDM systems
  - Currently tailoring Windchill 10.1 at the ARDEC PIF
  - Collaborating with ARDEC's Windchill configuration control board
  - Completed PLM-PLM interoperability study
- Mature and release standards for Model Based Definition
  - MIL-STD-31000A appendix B, published February 2013
  - Chartered new ASME standard Y14.41.1, October 2013
  - Provide inputs to ISO 10303 STEP APs, S1000D, etc.
- Develop and demonstrate MBE processes for commercial tools
  - 3D modeling – Pro/E, Creo, SolidWorks, Solid Edge, CATIA
  - Model Verification – CADIQ, ModelCheck
  - Digital Work Instructions – Anark
  - Interactive Electronic Tech Manuals - Arbortext

## Net-Centric Model Based Enterprise

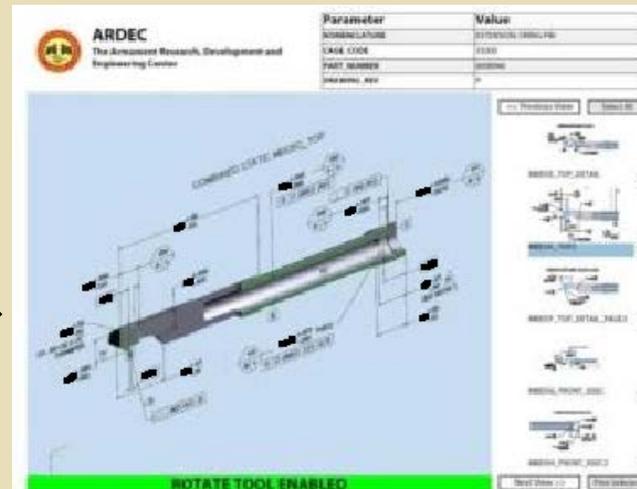
Customer: PM-Soldier Weapons

### Existing Practice

- 2D drawing as master document
- Saved as PDF or C4
- OEM controlled 3D models, government did not acquire



### 3D PDF from Fully-Annotated Model



### Deliverables Developed

- Fully-annotated 3D models
- 3D PDFs derived from the 3D models
- Validated our SOP for Pro-E
- Validated our MBD schema
- Validated our lightweight deliverable (3D PDF) template
- Lessons Learned document

### Benefits

- 3D master document
- Native CAD, neutral CAD and PDF format
- Suitable for reuse throughout lifecycle
- Reduced non-conforming or missing data
- Assured accuracy of file format translations
- Reduced time to quote, more accurate quoting
- Readable by all users of tech data

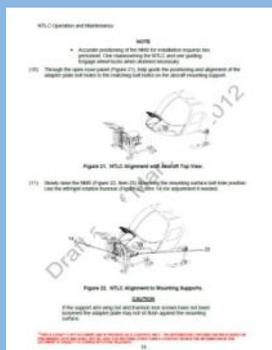
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## Net-Centric Model Based Enterprise

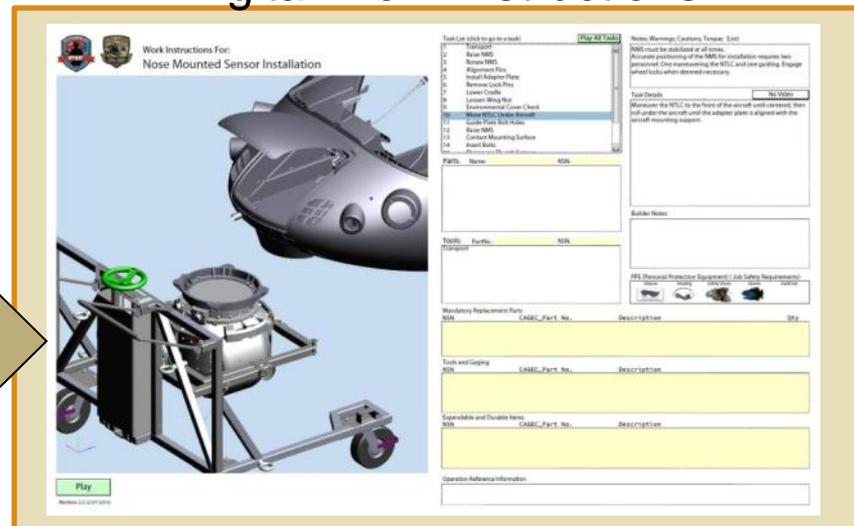
Customer: PM-Armed Scout Helicopter

## Existing Practice

- Depot Maintenance Work Requirements (DMWR's)
- Paper manuals or 2D PDF's



## Digital Work Instructions



## Deliverables Developed

- Set of 4 digital work instructions for the installation and removal of the sensor package
- Validated our SOP for Anark
- Validated our DWI schema
- Validated our lightweight deliverable (3D TDP) template
- Lessons Learned document

## Benefits

- Reused existing 3D product data instead of creating new illustrations
- Animations, interactive 3D models, and all data found in traditional work instructions
- Reduced time to update instructions
- Reduced mean time to repair
- Reduced training time for depot technicians

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- **Connect the Enterprise** *“Enable seamless interoperability of data and processes across organizational boundaries”*
  - Processes and technologies developed support transition to RDEC’s, Depots, and PEO/PM offices (i.e. PEO-Ammo, PM-SW, PM-ASH and PM-GCV)
  - Model Based Enterprise (MBE) tools empower disparate engineering functions to collaborate through the use of 3D virtual environments
  
- **Build the Digital Thread** *“Drive a continuous flow of integrated design, analysis, and manufacturing information throughout the product/system lifecycle”*
  - Integrate design and manufacturing processes to reduce costs
  - Shorten cycle-time for product improvement and product development

### Good news stories during FY14:

- ASME charters new standard to extract Appendix B from MIL-STD-31000A, Net Centric team member as chairperson

### Good news stories during FY13:

- Conversion of M320 Grenade launcher from 2D to 3D fully annotated models.
  - TDP was purchased by PM SW from OEM Heckler & Koch (Germany)
  - PM SW employed Tech data team from ARDEC PIF to build fully annotated 3D models and associated drawings
  - Tech data team from ARDEC PIF was trained by MBE team and given the SOP for Pro-E Wildfire 5.0
- Organizations are using the MBE Capability Index on model-based-enterprise.org to perform self-assessments. We have been in contact with a few to help them form an implementation plan.
  - Tobyhanna Army Depot
- Defense industry OEMs are incorporating the MBD schema from MIL-STD-31000 into their engineering and manufacturing processes.
  - BAE USCS, Boeing, Cubic Defense, GDLS, Honeywell, Raytheon, and Rolls Royce

# Next Steps

## Net-Centric Model Based Enterprise



- Collect metrics
  - Leveraging projects in the Industrial Base Innovation Fund (IBIF) portfolio
  - CH-47 mod E – completely MBD tech data
  - M320 tech data acquisition and conversion to MBD
  - M2 helicopter mount assembly with use of Digital Work Instructions
- Expand MBE awareness
  - [www.model-based-enterprise.org](http://www.model-based-enterprise.org) update coming soon
- Fill in gaps in the MBE Process Asset Library
  - Model verification – a standard Army process
- Develop framework for the new MBE standard at ASME

# Where to Learn More

## Net-Centric Model Based Enterprise



- [www.model-based-enterprise.org](http://www.model-based-enterprise.org)
  - Hosts distribution A content provided by NCMBE
  - Detailed definitions of MBE and its capabilities
  - Links to presentations, articles, and success stories



- MIL-STD-31000A
  - The DoD's standard for tech data packages
  - Appendix B – requirements for fully annotated models
  - Appendix C – 3D TDP Validation Guide

## Net-Centric Model Based Enterprise

Unrestricted\_Part.pdf - Adobe Acrobat Pro

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Tools Comment Share

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**ARDEC**  
The Armament Research,  
Development and Engineering Center

**See Sheet 2 for all Security Notices and all other related information.**

Title	
PART NO	123456
REVISION	A

Distribution Statement	
1.	APPLICABLE SPECS/STANDARDS: A. ASME Y14.5M 1994 B. MIL-W-13855 C. ASME Y14.41-2003 D. MBD SCHEMA, REV. C
2.	MATERIAL: STEEL, ASTM A322 OR A331, 4140, 4150, 6150.
3.	HEAT TREATMENT: LOCALLY HARDEN LENGTH "X" OIL QUENCH, TEMPER 1 HOUR MINIMUM TO HARDNESS RH A70.0-73.5
4.	FINAL PROTECTIVE FINISH: APPLIED AFTER ASSEMBLY.
5.	SURFACE FINISH: FINISH 125.
6.	BREAK EDGES .003 +.012 UNLESS OTHERWISE SPECIFIED.
7.	QUALITY ASSURANCE PROVISION REQUIREMENTS PER DRAWING 12993884 APPLY.

MBD4\_SET\_DATUMS

MBD5B\_AUX-A

MBD5C\_BOTTOM

MBD5D\_SECTION\_A

MBD5A\_TOP

Warning: This document may contain sensitive and/or proprietary information and must be treated as a confidential document

v1.16

**NCMBE goal for Organic and Commercial Defense Industrial base**

- Focus on data interoperability
- Reuse of models for technical documents
- Model Based Definition, 3D is master
- 3D models are associated to lightweight viewable (Adobe PDF)

**A3FABE goal for RDEC PIFs**

- Focus on shop-floor functionality
- Optimizing machine programming
- Model Centric, 2D drawing is master
- 3D models are associated to drawing

Where the RDECs and most of industry are now



FY17 Objective  
Threshold

MBE Capability Index

- DoD Strategic Plan - enabling goal 2.1

*Calls for "Innovative, enterprise-level Man Tech initiatives enabling collaborative and network centric manufacturing"*

- Heavy emphasis on modeling and simulation to deploy production ready product definitions to the manufacturing base

- DoD Strategic Plan - enabling goal 4.1

*Calls for "Active promotion of investment and innovation in manufacturing infrastructure and management systems"*

- Serves as an enabling program for A3FABE by providing the modern product data to drive the implementation of advanced digital manufacturing capabilities.

- DoD Strategic Plan - enabling goal 4.2

*Calls for "Effective ManTech contribution to a highly capable, well educated defense manufacturing workforce"*

- Takes up the learning curve of adopting MBE techniques by providing processes and best practices.

# Net-Centric Model Based Enterprise

