Update of MIL-STD-31000

Jeff Windham

US Army ARDEC

James.j.Windham.civ@mail.mil

Update of MIL-STD-31000.

- Incorporate the concept of 3Di models in MIL-STD-31000.
- Ensure -31000 works for the anticipated use cases.
- Make other updates as needed.
  - Removing Appendix B: *Organizational Schema Standard for Model Base Definition (MBD) and Appendix C: 3D TDP Validation Guide. (this info moving to ASME Y14.41.1)*
  - *Updating and clarifying the TDP Option Selection Worksheet.*
  - *Adding TDP List (TDPL) as a TDP Data management product.*
- Other misc. corrections and clarifications.

MIL-STD-31000B Draft

- Document has been drafted and thru 2 internal DOD review cycles.
- SAE G-33 Committee offered to serve as industry liaison in the review of -31000.
- Comments received via the SAE G-33 Committee website.
- Document was formally staffed via ASSIST website. Comments closed 2 Dec 2017. 90 comments received and adjudicated.

MIL-STD-31000

- MIL-STD-31000 is a high level document which defines what a TDP is suppose to be.
- Detailed information (e.g. drawing format, revision information, GD&T, etc.) generally left to other standards.
- Working with Defense Acquisition University (DAU) on a new TDP course – goal better written contracts asking for TDP.

MIL-STD-31000 – New Terminology

- 3Di pdf: 3-Dimensional Intelligent pdf
- Engineering design data: (drawings/models/viewable)
- Technical Data: Format, Origin & Validation Status

The terminology

FORMAT

Native
-CREO
-CATIA
-SolidWorks
-NX
-Solid Edge
-AutoCAD Inventor

-Authoring software.
-Can generate Neutral and Viewable (directly or via third party software.)

or

Neutral
-STEP
-IGES
-STL

-High fidelity model.
-Typically non-annotated.
-Can be imported into Native.
-Typically intended for Machine-Machine transfer.

or

Viewable
-3Di pdf
-JT
-X3D

-Lightweight.
-Fully annotated.
-Widely available and/or free viewer.
-Typically intended for human readable.

ORIGIN

Master

-Source for all other data.
-File from which all changes must originate.
-Almost always Native format.

or

Derivative

-Generated from Master.
-Cannot be directly changed.

VALIDATION STATUS

Authoritative

-Validated to be correct.
-Can “build to” and ”Inspect to”.
-Implied warranty as good data.

or

Reference

-For Information only.
-Can not ”Inspect to”.
-No Implied warranty.

TDP Definition Current published version and recommended B-rev version.

- Technical Data Package (TDP). A technical description of an item adequate for supporting an acquisition, production, engineering, and logistics support (e.g. Engineering Data for Provisioning, Training, and Technical Manuals). The description defines the required design configuration or performance requirements, and procedures required to ensure adequacy of item performance. It consists of applicable technical data such as models, drawings, associated lists, specifications, standards, performance requirements, QAP, software documentation and packaging details.

- Technical Data Package (TDP). The authoritative technical description of an item. This technical description supports the acquisition, production, inspection, engineering, and logistics support of the item. The description defines the required design configuration and/or performance requirements, and procedures required to ensure adequacy of item performance. It consists of applicable technical data such as models, engineering design data, associated lists, specifications, standards, performance requirements, quality assurance provisions, software documentation and packaging details.

TDP Definition Current published version and recommended B-rev version.

- Technical Data Package (TDP). **A technical description of an item adequate for supporting an acquisition, production, engineering, and logistics support (e.g. Engineering Data for Provisioning, Training, and Technical Manuals).** The description defines the required design configuration or performance requirements, and procedures required to ensure adequacy of item performance. It consists of applicable technical data such as models, drawings, associated lists, specifications, standards, performance requirements, QAP, software documentation and packaging details.

- Technical Data Package (TDP). **The authoritative technical description of an item.** This technical description supports the acquisition, production, inspection, engineering, and logistics support of the item. The description defines the required design configuration and/or performance requirements, and procedures required to ensure adequacy of item performance. It consists of applicable technical data such as models, engineering design data, associated lists, specifications, standards, performance requirements, quality assurance provisions, software documentation and packaging details.

TDP Definition Current published version and recommended B-rev version.

- Technical Data Package (TDP). A technical description of an item adequate for supporting an acquisition, production, engineering, and logistics support (e.g. Engineering Data for Provisioning, Training, and Technical Manuals). The description defines the required design configuration or performance requirements, and procedures required to ensure adequacy of item performance. It consists of applicable technical data such as models, drawings, associated lists, specifications, standards, performance requirements, QAP, software documentation and packaging details.

- Technical Data Package (TDP). The authoritative technical description of an item. **This technical description supports the acquisition, production, inspection, engineering, and logistics support of the item.** The description defines the required design configuration and/or performance requirements, and procedures required to ensure adequacy of item performance. It consists of applicable technical data such as models, engineering design data, associated lists, specifications, standards, performance requirements, quality assurance provisions, software documentation and packaging details.

MIL-STD-31000 – Option Selection Worksheet

- Option Selection Worksheet revised to match changes and try to make it a more usable document.

- TDP types.
  - Type 2D: 2-Dimensional (2D) Technical Data Package.
  - Type 3D: 3-Dimensional (3D) Technical Data Package. Type 3D will include one or more:
    - (1) 3D native models.
    - (2) 2D drawings derived from the 3D native models.
    - (3) 3Di pdf viewable data derived from the 3D native models.
    - (4) Neutral files derived from the 3D native models.

TDP Option Selection Worksheet

- Intended as the starting point for planning for TDP.
- Becomes a contractual document supporting the SOW.
- When ordering 3D TDP, the Option Selection Worksheet must be supported by additional explanation, instruction, SOW verbiage, etc.

TDP OPTION SELECTION WORKSHEET

SYSTEM:		DATE PREPARED:	
A. CONTRACT NO.	B. EXHIBIT/ATTACHMENT NO.	C. CLIN	D. CDRL DATA ITEM NO.

1. TDP LEVEL (CHOOSE ONLY ONE PER WORKSHEET). Note: The level selected must coincide with the requirements of the elements selected in block 5.

A. ☐ CONCEPTUAL LEVEL
☐ DEVELOPMENTAL LEVEL
☐ PRODUCT LEVEL

B. REMARKS:

2. TYPE AND FORMAT (X all that apply and complete as applicable.)

A. ☐ TYPE 2D: 2D DRAWINGS(describe in detail in remarks below or in block 11):

☐ NATIVE 2D CAD (SPECIFY TYPE): _____
☐ ISO 32000 PDF
☐ HARD COPY
☐ OTHER FORMAT (SPECIFY TYPE): _____

REMARKS :

B. ☐ TYPE 3D: 3D MODEL BASED (describe in detail in remarks below or in block 11):

☐ NATIVE 3D CAD (SPECIFY TYPE): _____
☐ 3Di VIEWABLE* FORMAT DERIVED FROM 3D NATIVE MODELS (Specify type, i.e. ISO 32000 PDF etc.).
☐ NEUTRAL FORMAT DERIVED FROM 3D NATIVE MODELS (Specify type, i.e. STEP AP203, AP 214 etc.).
☐ 2D DRAWINGS DERIVED FROM 3D NATIVE MODELS (Specify type, i.e. ISO 32000 PDF etc.).
☐ OTHER FORMAT (SPECIFY TYPE): _____

**NOTE: 3Di viewable will be in ISO 32000 pdf format unless otherwise specified.*

REMARKS :

3. CAGE CODE AND DOCUMENT NUMBERS	A. ☐ CONTRACTOR CAGE & DOCUMENT NUMBERS ☐ GOVERNMENT CAGE & DOCUMENT NO. (COMPLETE 3B, 3C, AND 3D)	
B. USE CAGE CODE:	C. USE DOCUMENT NUMBERS:	D. TO BE ASSIGNED BY:

4. DRAWING FORMATS AND/OR 3Di PDF FORMAT (X one and complete as applicable)

☐ CONTRACTOR FORMAT ☐ GOVERNMENT FORMAT
REMARKS:

5. TDP ELEMENTS REQUIRED (X all that apply)

☐ ELEMENTS REQUIRED TO BE DETERMINED BY CONTRACTOR

OR THE FOLLOWING ARE REQUIRED:

☐ CONCEPTUAL ENGINEERING DESIGN DATA
☐ DEVELOPMENTAL ENGINEERING DESIGN DATA AND ASSOCIATED LISTS
☐ PRODUCT ENGINEERING DESIGN DATA AND ASSOCIATED LISTS
☐ COMMERCIAL ENGINEERING DESIGN DATA AND ASSOCIATED LISTS
☐ SPECIAL INSPECTION EQUIPMENT (SIE) ENGINEERING DESIGN DATA AND ASSOCIATED LISTS
☐ SPECIAL TOOLING ENGINEERING DESIGN DATA AND ASSOCIATED LISTS
☐ SPECIFICATIONS
☐ SOFTWARE DOCUMENTATION
☐ SPECIAL PACKAGING INSTRUCTIONS (SPI) ENGINEERING DESIGN DATA AND ASSOCIATED LISTS
☐ QUALITY ASSURANCE PROVISIONS (QAPs)

6. APPLICABILITY OF STANDARDS. The following Standards apply: (X as applicable)

☐ ASME Y14.100 ENGINEERING DRAWING PRACTICES WITH APPENDICES: ☐ B ☐ C ☐ D ☐ E Company stds permitted? Y/N	☐ ASME Y14.24 TYPES AND APPLICATIONS OF ENGINEERING DRAWINGS ☐ ASME Y14.34 ASSOCIATED LISTS ☐ ASME Y14.35 REVISION OF ENGINEERING DRAWINGS AND ASSOCIATED DOCUMENTS ☐ ASME Y14.41 DIGITAL PRODUCT DEFINITION DATA PRACTICES ☐ ASME Y14.5 DIMENSIONING AND TOLERANCING	☐ OTHER STANDARDS APPLY AS DESCRIBED:

TDP OPTION SELECTION WORKSHEET
PAGE 2

A. CONTRACT NO.	B. EXHIBIT/ATTACHMENT NO.	C. CLIN	D. CDRL DATA ITEM NO.

7. ASSOCIATED LISTS (X all that apply and complete as applicable.)

A. ☐ PARTS LISTS (X ONE)*	☐ (1) INTEGRAL	☐ (2) SEPARATE		☐ (3) CONTRACTOR SELECT
B. ☐ DATA LISTS	☐ REQUIRED (Specify Levels of ASSY) _____			
C. ☐ INDEX LISTS	☐ REQUIRED (Specify Levels of ASSY) _____			
D. ☐ WIRING LISTS	☐ (1) INTEGRAL	☐ (2) SEPARATE		☐ (3) CONTRACTOR SELECT
E. ☐ APPLICATION LISTS	☐ (1) INTEGRAL	☐ (2) SEPARATE	☐ (3) PLM MAINTAINED	☐ (4) CONTRACTOR SELECT
F. ☐ OTHER	☐ REQUIRED(Specify Levels of ASSY) _____			

**NOTE: USE OF SEPARATE PARTS OR WIRING LISTS ARE NOT RECOMMENDED ESPECIALLY WITH TYPE 3D TDPS.*

8. TDP DATA MANAGEMENT PRODUCTS

A.
- ☐ TECHNICAL DATA PACKAGE LIST (TDPL)
- ☐ SOURCE CONTROL APPROVAL REQUEST
- ☐ DOCUMENT NUMBER ASSIGNMENT REPORT
- ☐ PROPOSED CRITICAL MANUFACTURING PROCESS DESCRIPTION
- ☐ ENGINEERING DRAWING TREE
  - ☐ TO LOWEST REPAIRABLE UNIT (LRU) LEVEL
  - ☐ TO LOWEST COMPONENT LEVEL
- ☐ OTHER (DESCRIBE): _____

B. REMARKS:

9. TDP METADATA

☐ TDP METADATA REQUIRED (describe requirements):

10. TDP SUPPLEMENTARY DATA

☐ TDP SUPPLEMENTARY DATA REQUIRED (describe requirements):

11. OTHER TAILORING (Attach additional sheets as necessary

12. PROCURING ACTIVITY TITLE, SIGNATURE AND DATE

TITLE:	SIGNATURE:	DATE:

MIL-STD-31000 Summary

- New version should be published in the next few weeks.
- Incorporates 3Di pdfs as an option.
- Govt/Industry teams need to engage early and often on best TDP solution for their programs.
- Be advised, requirement to deliver 3Di pdf based TDP may be coming soon to a contract near you.

BACKUP SLIDES

Guidelines in preparing – MIL-STD-31000

- **What's the purpose of a Standard?**

  1. To provide a common language.

  2. To establish uniform engineering or technical criteria, methods, processes, and practices.

  3. To provide a standard of reference or widely recognized model of authority.

- **What's <u>NOT</u> the purpose of a Standard:**

  1. To be a cost driver.

  2. To constrain a program unnecessarily.

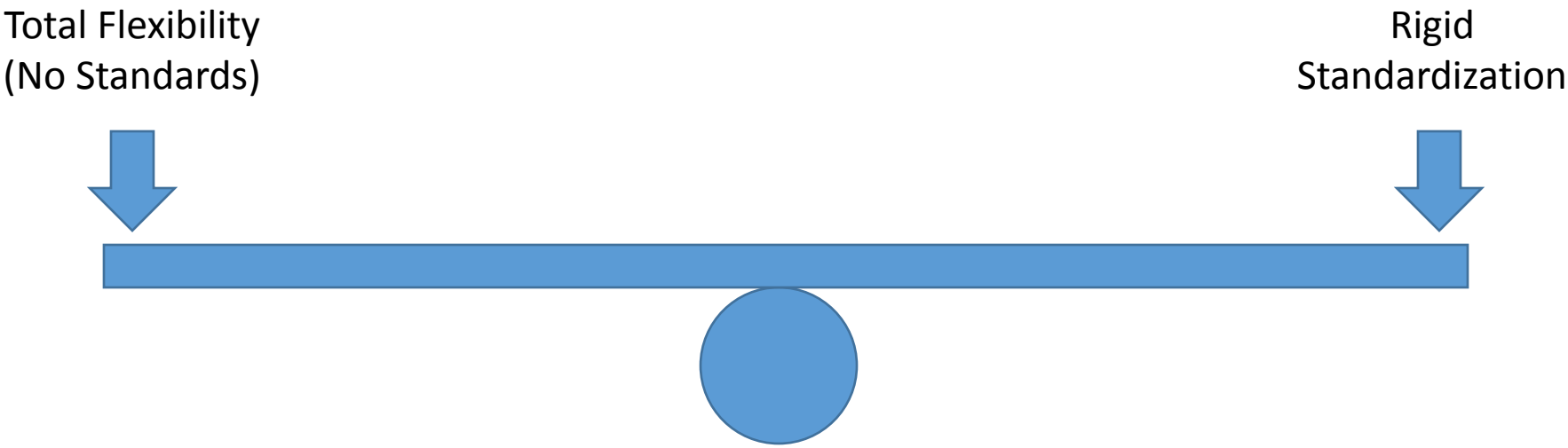
  3. To impose the standard writers judgment in place of the program of record's judgment.

  4. To anticipate every eventuality.

Guidelines in preparing Standards

- When writing a standard, assume the person using the standard is reasonably knowledgeable, and has the best interest of the program in mind.
- View the standard as a tool for the program manager to use, not a club to beat him with.
- Make it easy to read… short words better than long words, short sentences better than long sentences, short para better than long para.
- KISS philosophy applies – Keep It Simple Stupid. (example: Goal of <50 page document)

Achieve the right balance



Anark Platform Overview

Connecting the Digital Thread

Jim Merry | Senior Director, Enterprise Sales | jim.merry@anark.com | 240 674 5547

Agenda

- Company Overview
- Partnerships
- Anark Platform Overview
- Challenges with adopting MBD/MBE
- Lessons Learned
- Customers: DoD, Industry
- Beyond 3D PDF: MBEWeb

Anark Corporation

Leading provider of visual collaboration software and solutions to industry leaders since 2000

Empowering Model Based Enterprise & Digital Thread revolutions within Aerospace, Defense, Automotive, Energy, Industrial, Electronics, and Medical Equipment Sector

Most capable, production-proven **automated data transformation and publishing platform** on market today.

Founding member of the **3D PDF Consortium**

Growing, profitable company, with world-wide network of technology, integration, and channel partners

Anark Corporation HQ in Boulder, Colorado

Offices, Dev & Integration Partners in multiple locations in North America, EU, and India

Anark Technology, Integration, Reseller Partners

Implementation & Integration

Geometric
An HCL Technologies Company

TATA
TATA CONSULTANCY SERVICES

QUEST
BORN TO ENGINEER

ITC INFOTECH
Business-friendly Solutions

SARATECH
Engineering and Management Solutions Provider

CAD, PLM, ERP Technology Integration

SIEMENS PLM SOFTWARE
SIEMENS

DASSAULT SYSTEMES

PTC

SolidWorks

AUTODESK.

ORACLE

Software Development

AUTODESK.

SolidWorks

Geometric
An HCL Technologies Company

Reseller-Commercial

Geometric
An HCL Technologies Company

CADD EDGE
Engineering Simplified

ITI
International TechneGroup

PLM GROUP
Experience 3D

Digital Thread / Model Based Enterprise Key Terms

- **Digital Thread**

  Communication framework that allows a connected data flow and integrated view of the asset's data throughout its lifecycle across traditionally siloed functional perspectives.

  The digital thread concept raises the bar for delivering *"the right information to the right place at the right time."* – Industry Week

- **3D MBE – Model Based Enterprise**

  Reuse of 3D engineering (MBD) outside of 3D CAD systems, including dimensions, tolerances, annotations, views for more effective communication and collaboration, including

  3D model-based assets, TDPs, inspection plans/reports, RFQs, manufacturing process, field service

  "A fully integrated and collaborative environment founded on 3D product definition detailed and shared across the enterprise; to enable rapid, seamless, and affordable deployment of products from concept to disposal." – Model-Based-Enterprise – Powered by UILABS

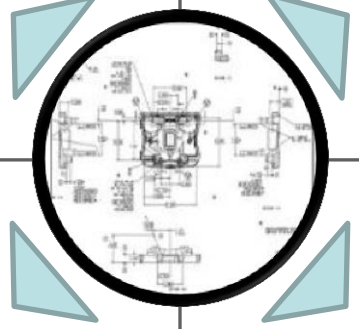
Why the Digital Thread? - Extended Enterprise Challenges w Data Exchange & Collaboration

Engineering

- Significant rework in creating 2D design deliverables
- Supplier data package is not in sync with the Engineering release data
- Protecting intellectual property across global supply chains

Manufacturing

- Difficult to understand instructions
- Instructions are not up-to-date and incomplete



Supply-Chain Collaboration

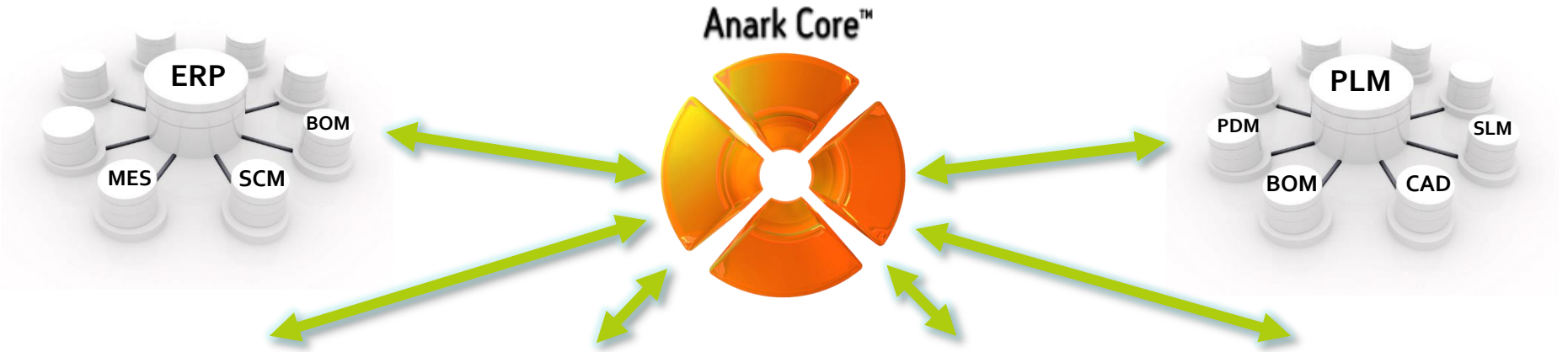
- Incomplete and out-of-date data to supplier
- Ad-Hoc, Mostly Manual Supplier Collaboration Practices
- Longer Supplier Turnaround time

Quality Process

- Key Characteristics not readily identifiable
- Hard to incorporate data manually

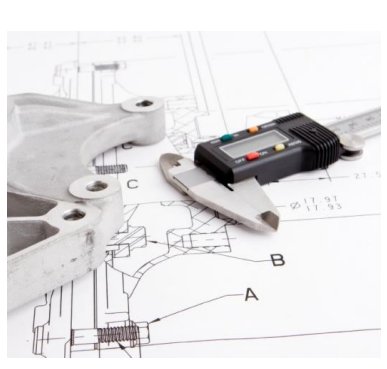
Anark Core: Generate Technical Content for the Extended Enterprise

Provide the right data, in the right form, to the right people, at the right time

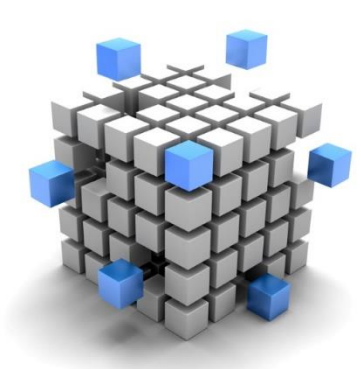


Engineering Release

Supply Chain



Quality Inspection



Manufacturing

Field Service

Anark MBEWeb: Digital Thread Across the Extended Enterprise

Extension Of Anark Core Technology Platform

Visual Collaboration for the Knowledge Worker

- Allows siloed knowledge workers across the extended enterprise to communicate and collaborate with fit-for-purpose, authoritative technical web content from any device.
- Publish content with Anark Core into MBEWeb with up-to-date content derived from PLM, ERP, and other critical data sources.
- Built with scalable cloud technologies that can be installed on-premise, with access control established from PLM, ERP, or independently from MBEWeb, insuring the protection of authoritative technical content.

Challenges/Lessons Learned – Questions Posed?

- What is the impact on industry to replace traditional 2D drawings with 3D PDF's?
  - Implementing 3D PDF's on the shop floor, increase/decrease in time to bid on a contract, interpretation of technical data, demand for paper printouts still?
- What investment is needed to implement 3D PDF's into industrial facilities?
  - Laptop computers on the shop floor, training, increase server capacity, etc?
- Are there savings in time and/or cost associated with implementing 3D PDF's?
  - If so, what are these and can examples be provided.
- What is industry saying are the pro's and con's of 3D PDF's?
  - No sugar coating 3D PDF's, what are the real challenges industry is having?

Challenges and Lesson Learned – Anark's experience

- Exec Sponsorship critical to successful MBE process change
- Upfront investment includes Software, Infrastructure, Process & Culture Change.
  - Use "Crawl, Walk, Run" phased approach
- Engineering MBD best-practices must be designed with downstream MBE requirements in mind, constraining the use of available CAD MBD modeling features
- People still want to be able to print.
- Specific 3D PDF challenges
  - Mobile Platform Support Lacking
  - Large Assembly performance Limitations
  - Markup and Collaboration Tools Difficult to Use
  - Limited Acrobat Forms UX toolset constrains UX design

3D MBE & Digital Thread Performance Benefits

ANARK

***Sources**: Benchmark & research studies presented by LNS Research, US Navy Naval Air Command, and National Institute of Standards & Technology (NIST)*

3D Model Based Enterprise Process Benefits

	Performance Benefits	MBE Contributors to Savings
1	**Easier to Accurately Interpret Information**	• Accelerates execution of process steps and overall pace of assembly. • Eliminates costly errors caused by misinterpretation.
2	**30% Reduction in Tooling Design & Fabrication Costs**	• There is no need to remodel the original design (typically from 2D Drawings) around which the Tooling/fabrication processes will be designed • 'Original engineering design intent' is more easily and quickly understood by the tooling designer
3	**10% Reduction in Overall Assembly Time**	• Complete Assembly process can all be seen within 1 - 3D PDF MBE document. • The exact assembly process, animated in 3D leaves less room for shop floor confusion or delays
4	**20% Reduction in Manufacturing and Supplier Scrap and Rework**	• Manufacturing and Supplier process documents automatically updated when an Engineering change or new version occurs • Both Manufacturing and Quality gain a much clearer idea of the Engineering Designers Key Characteristics, Important Assembly Datums and Sequence

***Source**: US Dept. of Defense, Analyst reports & studies presented at conferences*

Anark DoD Customers

- US Army – ARDEC – Creo, Windchill
  - Rock Island Arsenal - Technical Data Packages (TDPs)
  - Picatinny – TDPs, Work Instructions
  - Benet Labs – Model Based Work Instructions (MBWI)
- US Navy
  - NAVAIR Lakehurst - TDPs; Creo, NX and Windchill. Adding SolidWorks, CATIA, ENOVIA and Teamcenter
  - NAVAIR PMA 261 - ENOVIA + CATIA
  - NAVAIR FRCE - TDPs, Work Instructions (pilot) – Teamcenter, NX, Creo
- US Air Force –
  - Hill – Parts Provisioning Reports, TDPs
  - Robins - TDPs
  - Yulista - TDPs, MBWI

Select Anark Deployments – Non DoD

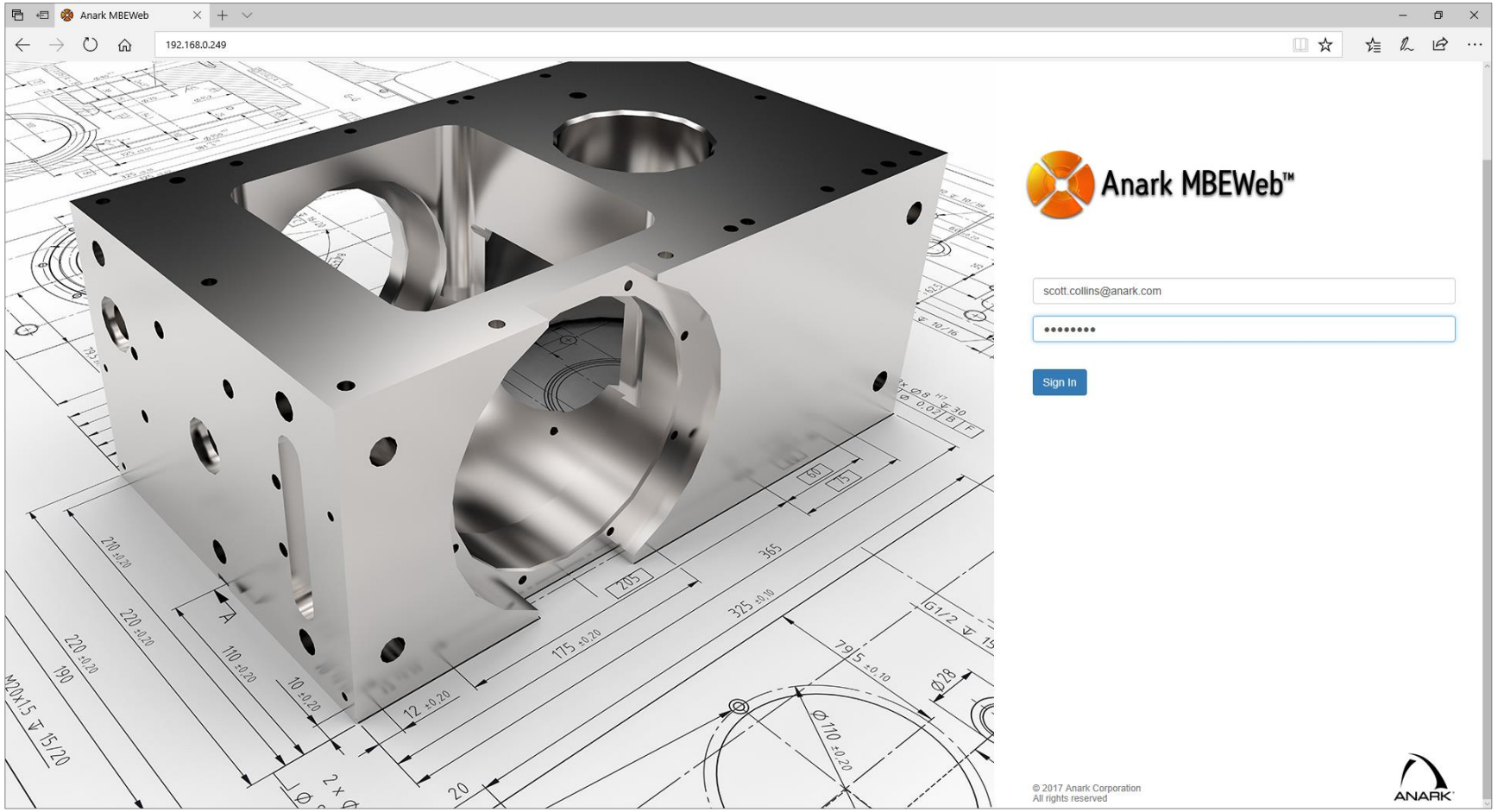
Aerospace & Defense Manufacturing:

- Raytheon – TDPs, Quality Inspection Plans, First Article Inspection documents, MBWI
  - RMS, SAS, IDS, IIS Divisions
- Boeing – A10 Wing Replacement Program
  - 3D PDF Parts Provisioning Reports, TDPs delivered to DoD DLA and used by Hill AFB
- Lockheed-Martin
- Honeywell – TDPs, MBWI
- General Dynamics – TDPs
- Cubic Defense – MBWI
- Ball Aerospace – TDPs

Commercial Manufacturing:

- General Electric –TDPs, Supply Chain Collaboration - 3D PDF and MBEWeb
  - Power, Aviation, Oil & Gas, Healthcare, Transportation
- Boeing Commercial – TDPs
- Rolls-Royce – TDPs, MBWI upcoming
- Navistar - TDPs
- CSR-Sifang – MBWI, TDP
- TE Connectivity (Tyco) – TDPs
- Cisco – TDPs
- Ericsson – TDPs
- Allison Transmission – Engineering Release

DEMO --- MBEWeb: Technical Collaboration for the Extended Enterprise



Thank You!

Jim Merry | Senior Director, Enterprise Sales | jim.merry@anark.com | 240 674 5547

Anark Product Line

Anark Core Server: Automated publishing server software with SOA for recipe-based transformation and publishing. Combine authoritative enterprise data from PLM and ERP, with advanced CAD integrations for NX, Creo, CATIA, SolidWorks, and Inventor.

Anark Core Workstation: Desktop software for defining server-side publishing “recipes”, as well as SME authoring for manual content generation. Combine enterprise data from PLM and ERP, with advanced CAD integrations for NX, Creo, CATIA, SolidWorks, and Inventor.

Anark Core SDK: Integration software development kit for connecting Anark Core software to other enterprise data sources and workflow engines.

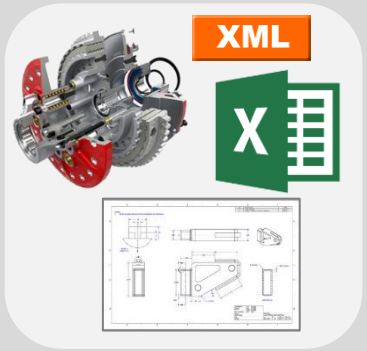
Anark Core Integrations for PDM: Reference integration code for **Teamcenter**, **Windchill PDMLink**, **ENOVIA**, and **SolidWorks EPDM** for workflow-driven, recipe-based publishing automation.

Anark MBEWeb: Cloud-based software that hosts template-driven, technical HTML5 content inside the firewall for all supported downstream use cases, with search and collaboration capabilities for knowledge workers throughout the extended enterprise.

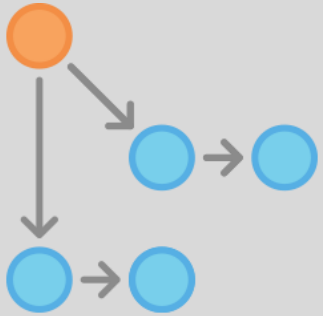
Anark Recipe Based Publishing for the Digital Thread

Anark Core™

Technical Data

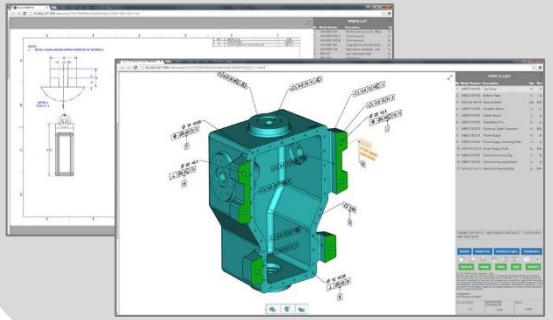


Recipe Actions



Anark MBEWeb™

HTML5: Use-Case-Specific Technical Content



Consume & Collaborate

PLM, ERP

PDF

PLM, ERP, MES, SLM, IOT

Advanced PLM and Systems Integration with Anark Platform

Automation Workflow:

1. Anark Core automation recipe is authored with Anark Core Workstation, deployed to Anark Core Server.

---

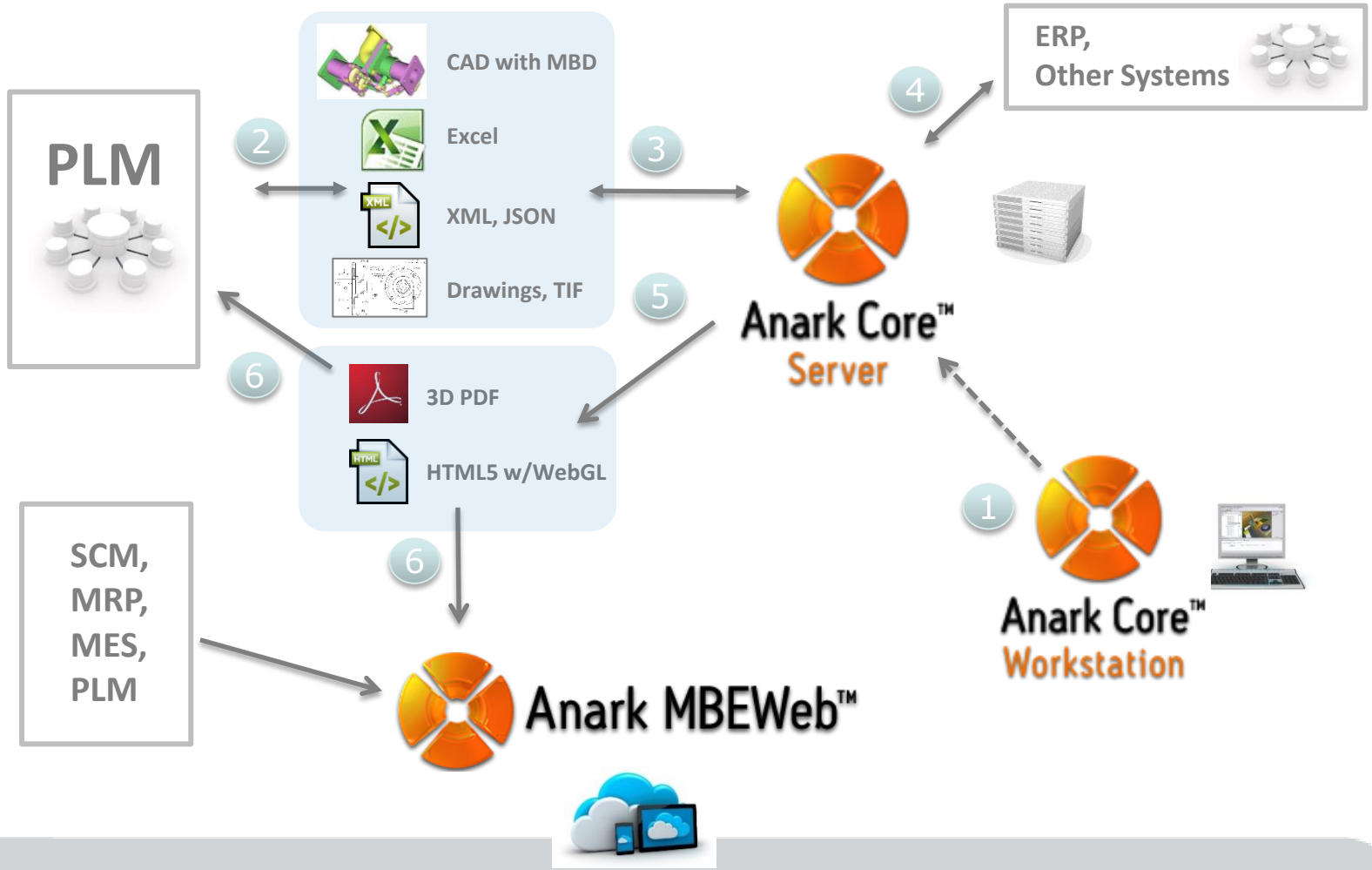
2. PLM workflow triggers Anark Core Integration for PLM, extracts PLM files and data.

3. PLM integration requests that automation recipe is run, typically using a designated recipe and template.

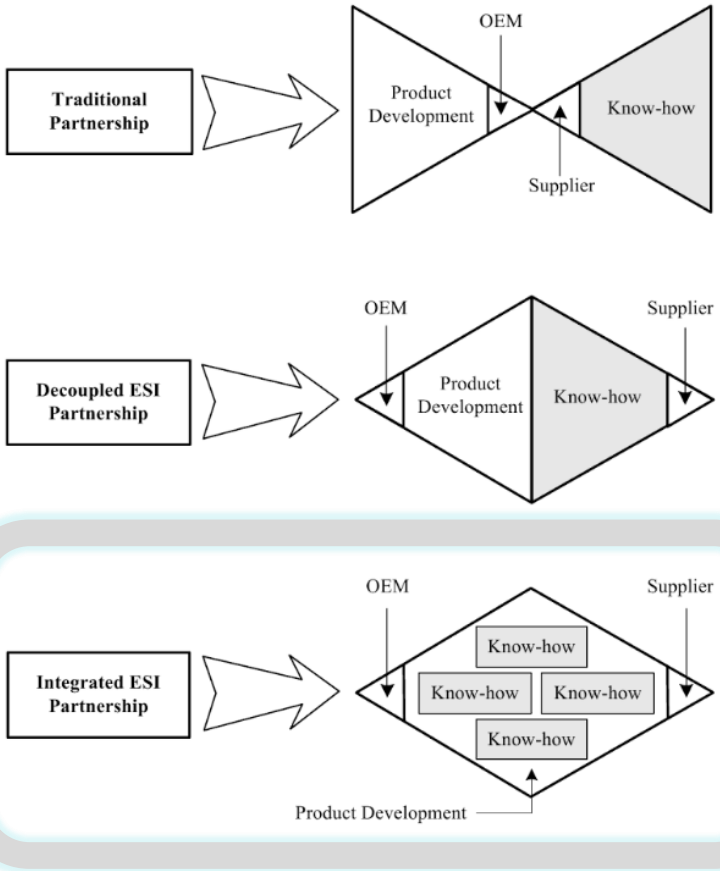
4. Exogenous data may be incorporated during publishing.

5. HTML or PDF content is published from Anark Core Server.

6. HTML content is hosted by Anark MBEWeb with downstream collaboration. PDFs are imported into PLM system for access and release control.



MBEWeb for Supplier Integration

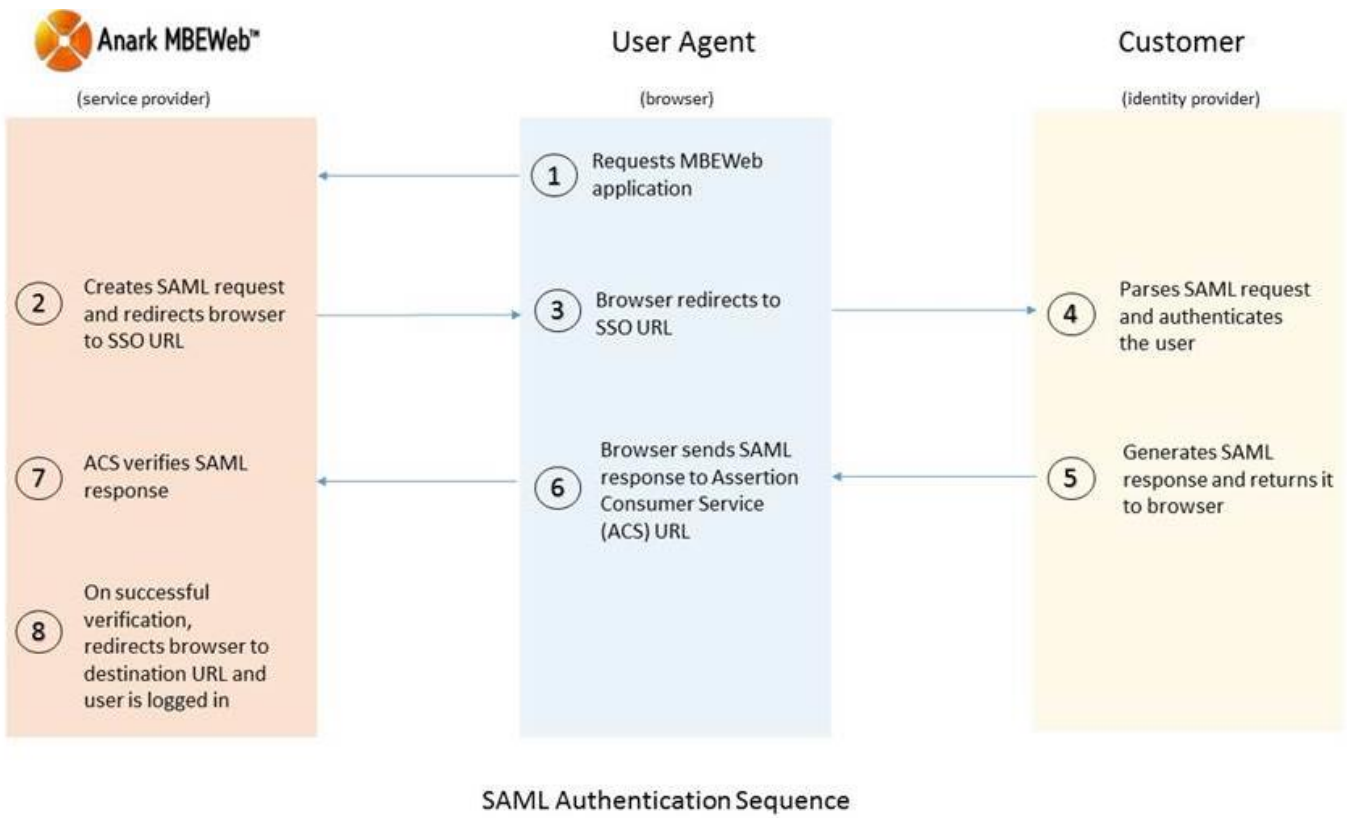


Anark MBEWeb™

- **OEM-to-supplier integration can significantly drive down product costs by**:
  - Increasing knowledge share,
  - Solving technical problems more quickly,
  - Increasing bid participation,
  - Identifying and reducing supplier capability risks, and
  - Reducing product delay risks.

Collaborative Design and Planning for Digital Manufacturing, Lihui Wang, Andrew Yeh Ching Nee, Springer, 2009

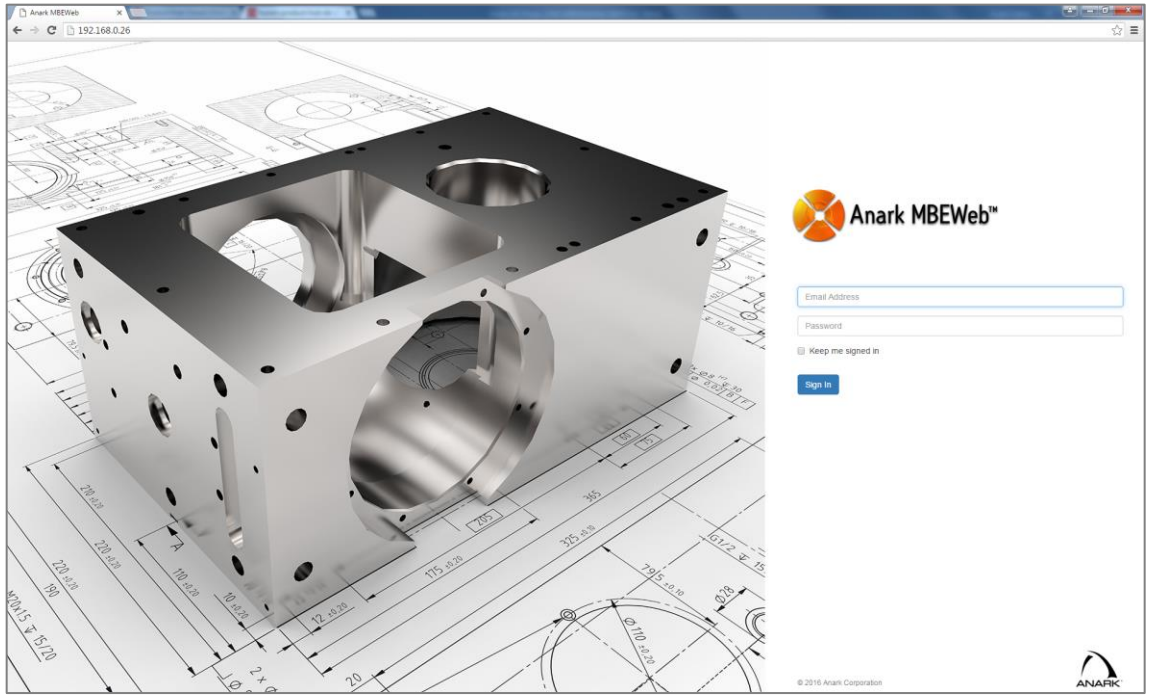
MBEWeb Security and Authentication



SAML Authentication Sequence

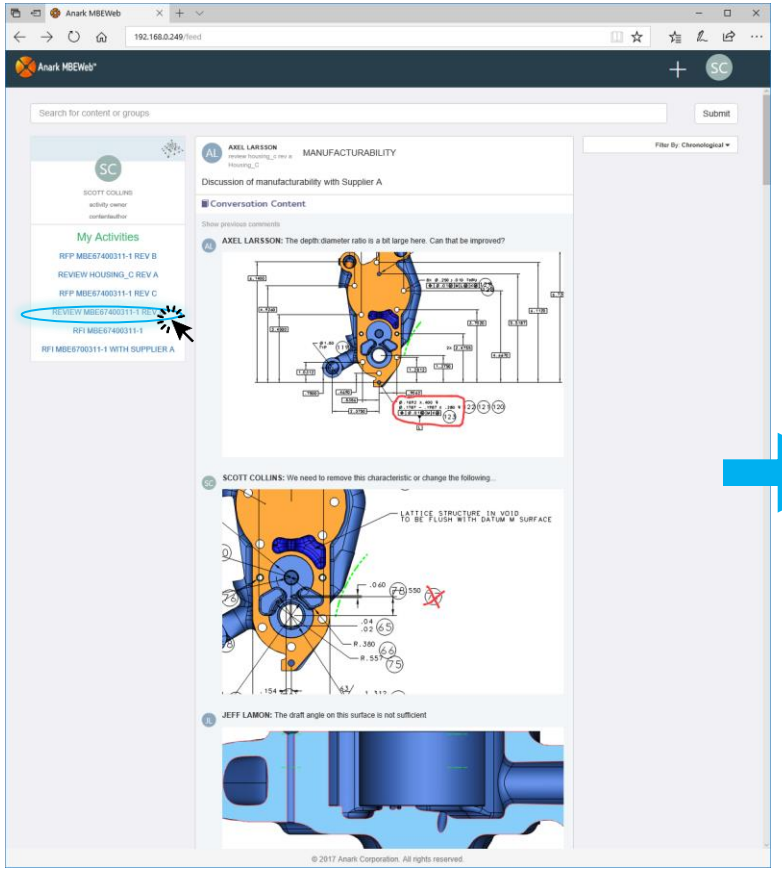
- Anark MBEWeb uses a flexible cloud technology stack operating on Linux:
  - MongoDB (database),
  - Node.js (application server), and
  - NGINX (web server).
- Supports authentication integration via SAML, LDAP, Local Account, and WAM (Siteminder, etc.)
- MBEWeb content is published with privileges integrally defined by publishing workflow.

MBEWeb Differences from PLM, Custom Portals, SharePoint

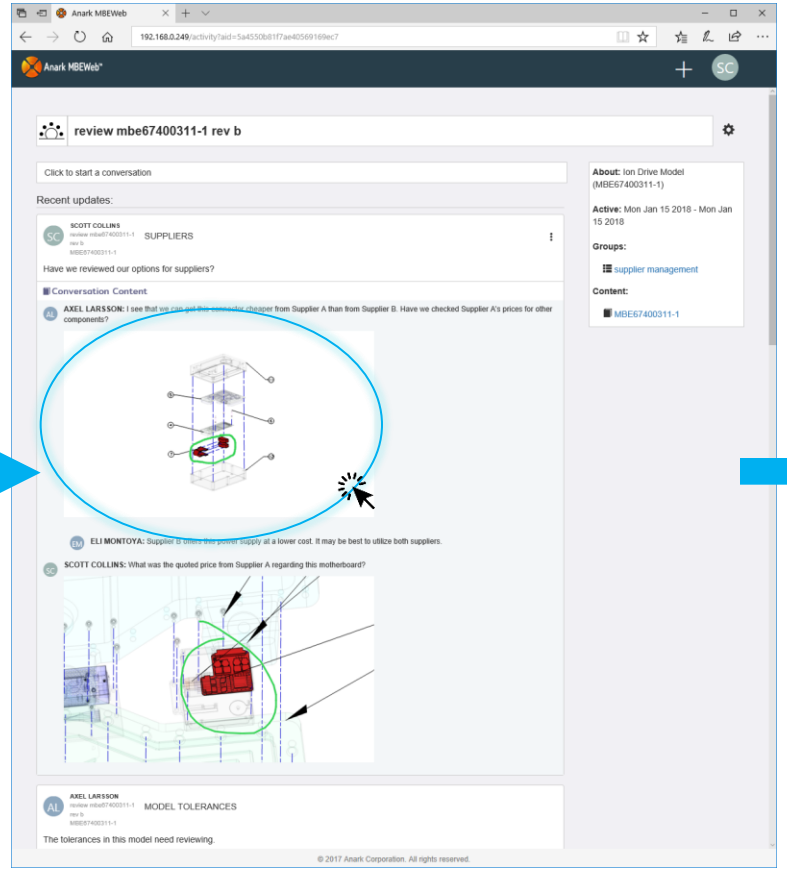


- **Inexpensive compared to PLM licenses and custom portals**. Allows the system to be used widely across the extended enterprise.
- **Easy to deploy, easy to use system** does not require specialized user training, with substantially reduced IT and user-support costs.
- **Generate role-and-use-case-specific content** such as TDPs from PLM for supplier integration, instead of hunt and peck for documents. More efficient access to critical data.
- **Content can be accessed from virtually any device**, anywhere in the enterprise: supply chain, manufacturing, field service. Allows flexibility with paperless access.
- **Integrated content-centric collaboration** supports critical technical conversations within the extended enterprise. More efficient than document, email, and web conferencing collaboration.

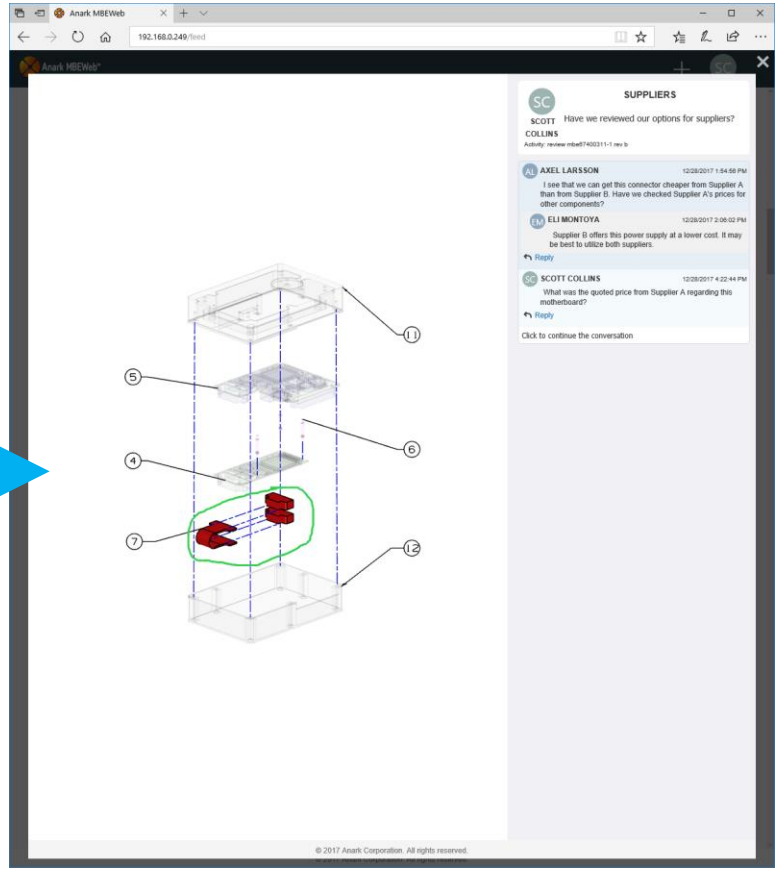
MBEWeb: Technical Collaboration for the Extended Enterprise



From the News Feed, select an Activity on which to focus.



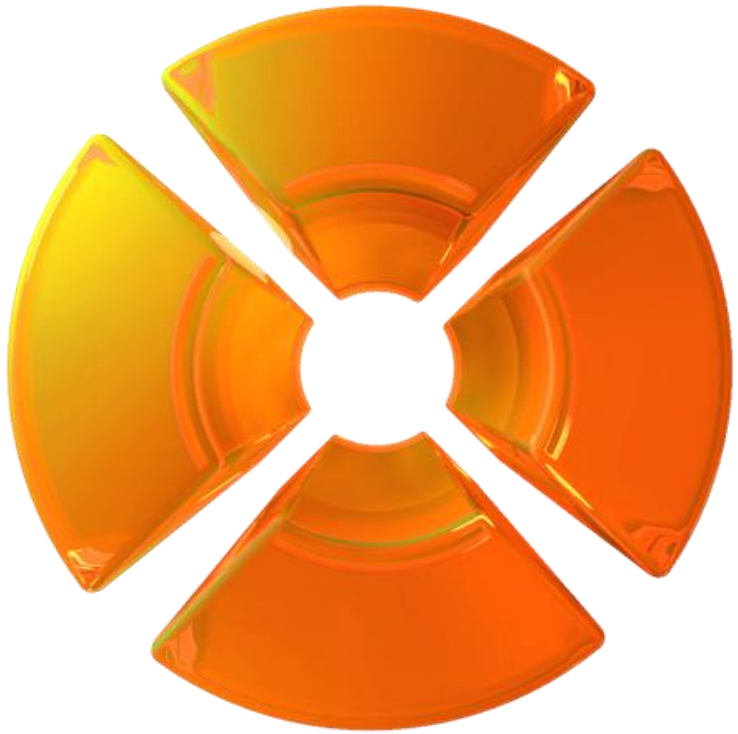
Click on the Activity News Feed to take a closer look.



Review comments and markup, reply, or add a new comment.

Publishing Automation and Collaboration Capabilities

- Recipe-based publishing automation, with multi-data support for 2D and 3D content, including support for advanced 3D MBD
- Packaging of MBEWeb HTML or PDF technical data packages (TDP) for downstream consumption in supply chain
- Web-based technical content management and collaboration with MBEWeb, with secure access and support for mobile
- Management of MBEWeb HTML or PDF dynamic data markings such as distribution notices and watermarks
- Control of custom attribute schemas for MBEWeb HTML or PDF content, without republishing content
- Extraction of PDF comments and form-fields data to databases
- Integrations for all major PLM systems supporting automated publishing



3D MBE & Digital Thread Performance Benefits – References

	Performance Benefits	MBE Contributors to Savings
1	**Easier to Accurately Interpret Information**	• Accelerates execution of process steps and overall pace of assembly. • Eliminates costly errors caused by misinterpretation.
2	**30% Reduction in Tooling Design & Fabrication Costs**	• There is no need to remodel the original design (typically from 2D Drawings) around which the Tooling/fabrication processes will be designed • 'Original engineering design intent' is more easily and quickly understood by the tooling designer
3	**10% Reduction in Overall Assembly Time**	• Complete Assembly process can all be seen within 1 - 3D PDF MBE document. • The exact assembly process, animated in 3D leaves less room for shop floor confusion or delays
4	**20% Reduction in Manufacturing and Supplier Scrap and Rework**	• Manufacturing and Supplier process documents automatically updated when an Engineering change or new version occurs • Both Manufacturing and Quality gain a much clearer idea of the Engineering Designers Key Characteristics, Important Assembly Datums and Sequence

John Schmelzle – NAVAIR – 2013 NIST MBEsummit
https://www.nist.gov/sites/default/files/documents/el/msid/2Schmelzle_MBD.pdf

LNS Research – December 2014
Understanding the Digital Thread in Aerospace & Defense
http://blog.lnsresearch.com/blog/bid/203158/Understanding-the-Digital-Thread-in-Aerospace-Defense-INFOGRAPHIC

ASME Publication – March 2016
Testing the Digital Thread in Support of Model-Based Manufacturing and Inspection
http://ws680.nist.gov/publication/get_pdf.cfm?pub_id=919497

USAF 3D Intelligent PDF Status

24 Jan 18

Chad Berdon
AFLCMC/LZPP
Comm: 478-327-2668
chad.berdon@us.af.mil

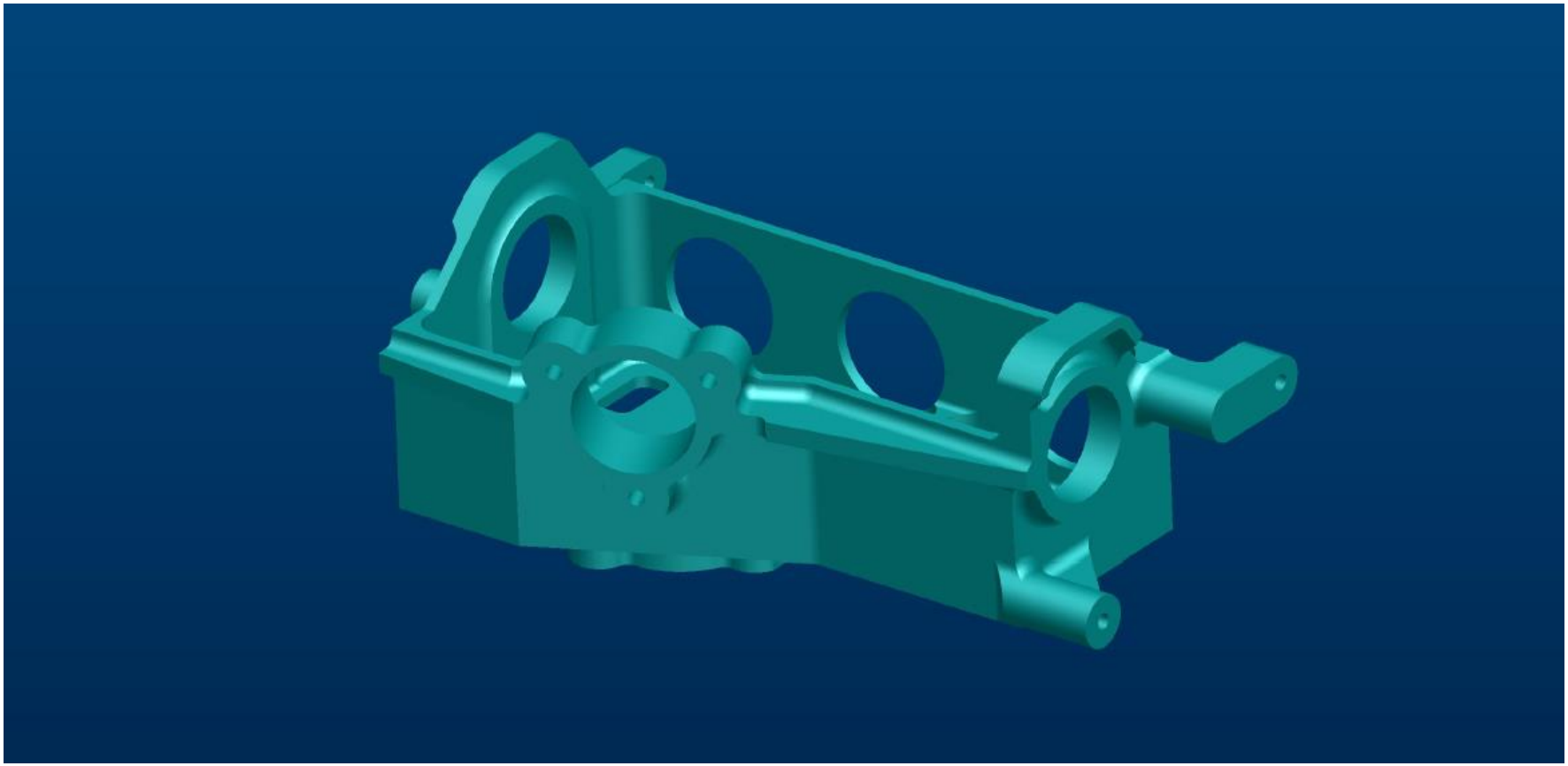
TDP Modernization Timeline

AFLCMC… Providing the Warfighter's Edge

- **2010: MERC modernizes MAU-12 2D TDPs**
- **2011: GD begins modernizing 20mm Gun TDPs**
- **2012: 3D iPDFs investigated**
  - **Anark software chosen for 3D iPDF generation**
- **2013: GD begins modernizing all Aircraft Gun systems to include 3D iPDFs**
- **2015: Yulista/MERC begin modernizing all Bomb Rack systems to include 3D iPDFs**
- **2016: Yulista develops USAF 3D iPDF Template**
- **2017: Anark produces integration for Teamcenter**

Conventional 3D PDF

AFLCMC… Providing the Warfighter's Edge



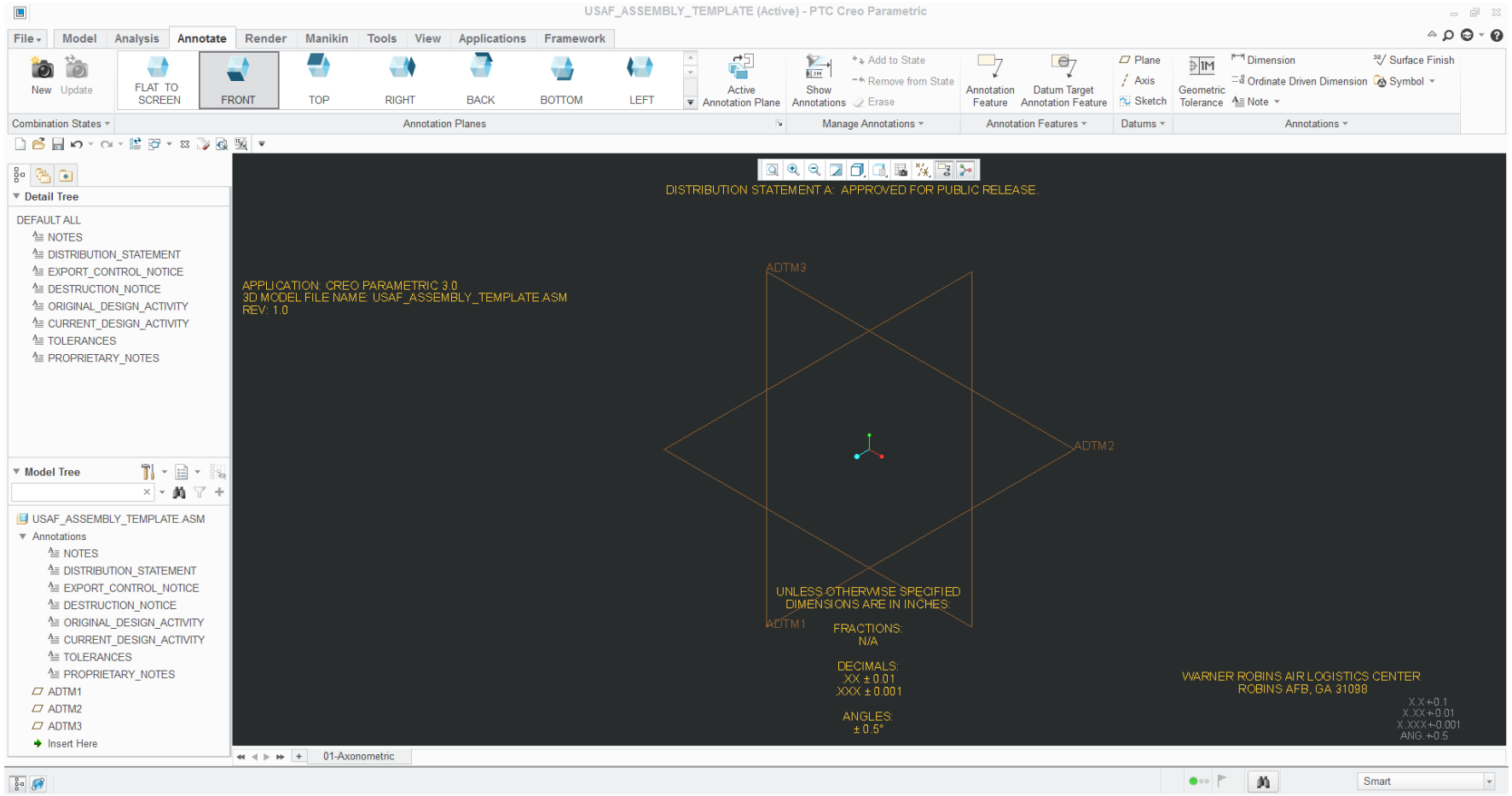
3D Intelligent PDF

201646967

201646968

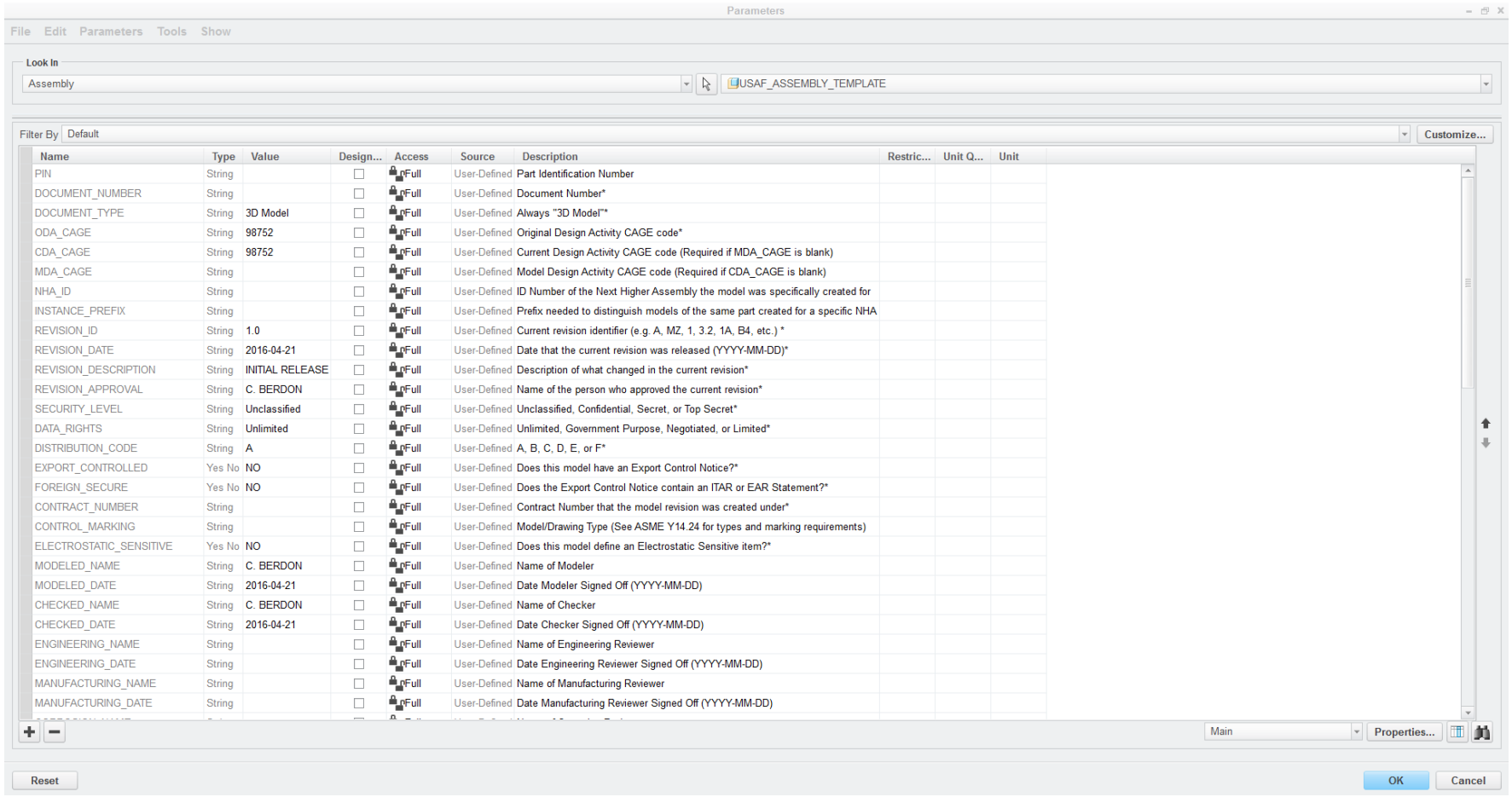
Creo Start File Annotations & Views

AFLCMC… Providing the Warfighter's Edge



Creo Start File Parameters

AFLCMC… Providing the Warfighter's Edge



2018 Efforts

- **Integrate Anark with Armament Teamcenter**
- **Update 3D iPDF Template and Creo Start Files**
  - **Add special item/process parameters**
  - **Redesign approvals section**
  - **Remove pop-up window**
  - **Reconcile with ASME Y14.47**
- **Draft/Release USAF MTDP Requirements**
- **Implement automated 3D review tools (CADIQ)**
- **Release updated version of MIL-STD-31000**

Future Efforts

- **Test HTML5 3D format and templates**
  - **Preliminary investigation completed in 2017 was inconclusive**
- **Create USAF 3D iPDF templates & recipes for:**
  - **CATIA**
  - **Inventor**
  - **NX**
  - **SolidWorks**


AIR FORCE LCMC

3Di TDP Workshop

Presented To:
AMMO

7– Feb – 2018

Presented by:
John Schmelzle
NAVAIR 4.8 Additive Manufacturing and
Model Based Definition Initiative Lead

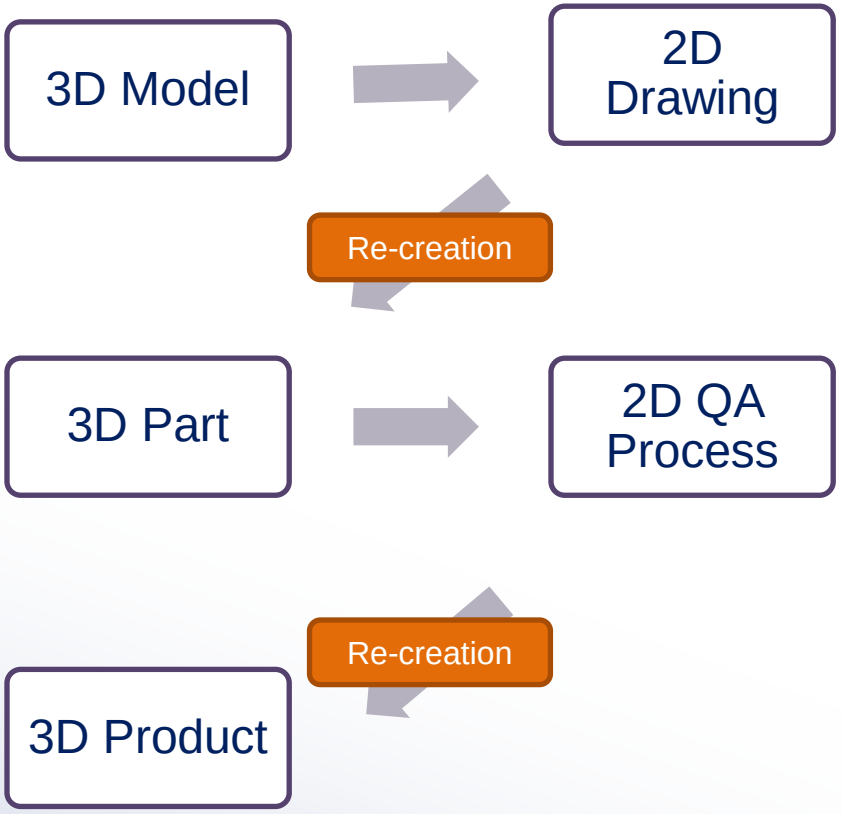
NAVAIR

Agenda

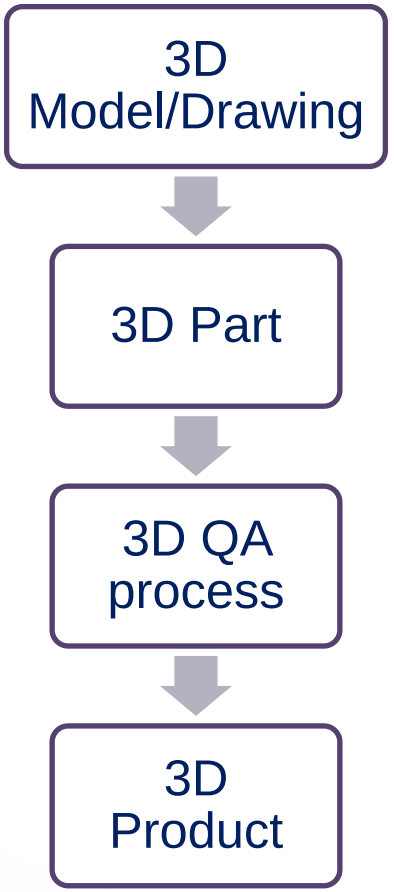
- Why a 3D TDP
- Why 3D PDF
- **Components of the TDP**
- Part Criticality
- **Components of the AM TDP**
- **AM TDP DID**
- **The NAVAIR TDP Standard**
- **CDRL Requirements**
- **Intellectual Property (IP)**
- Plan to expand the 3D TDP

Why a 3D TDP

Current design process:



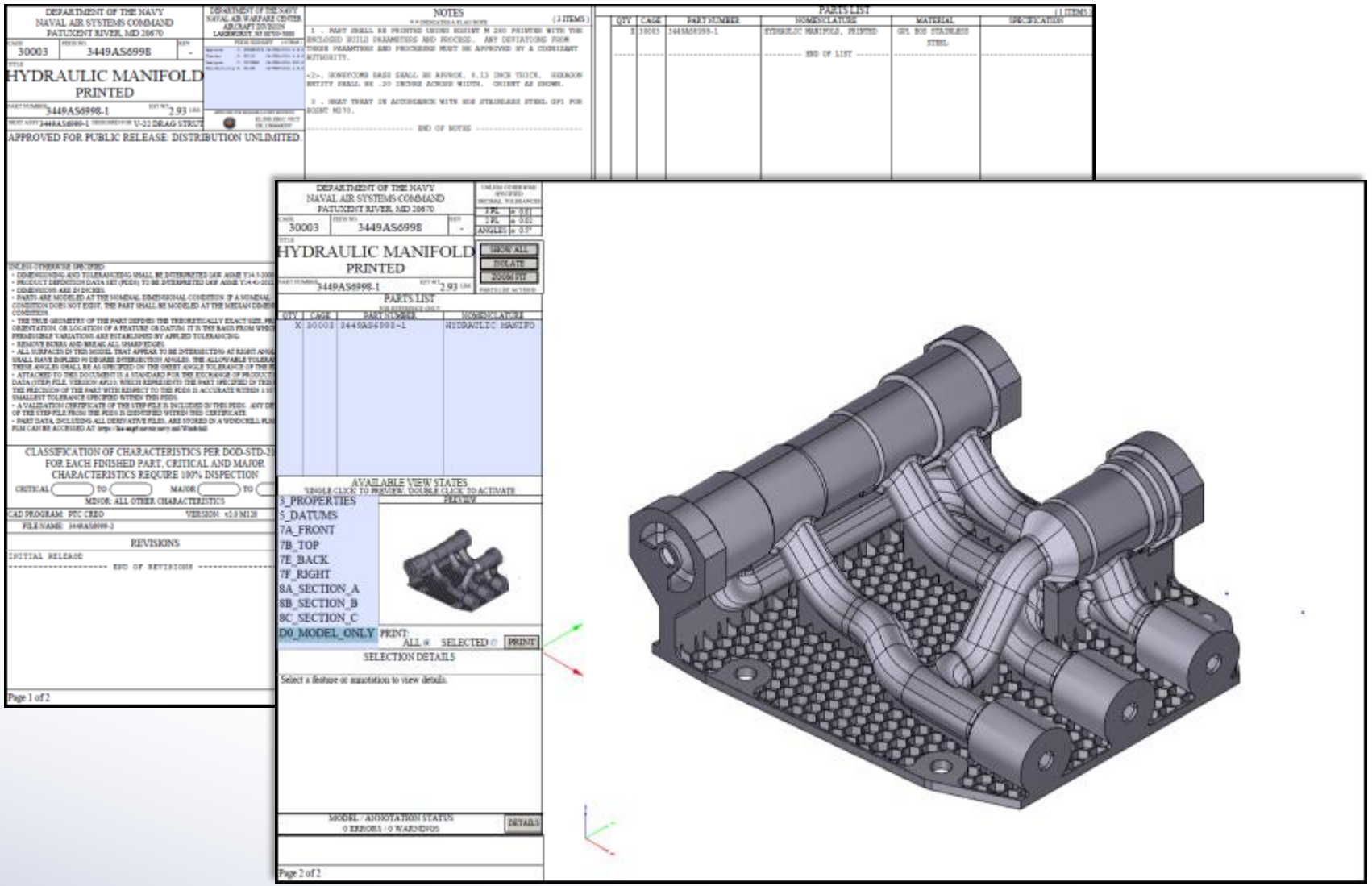
3D Drawing design process:



Why 3D PDF

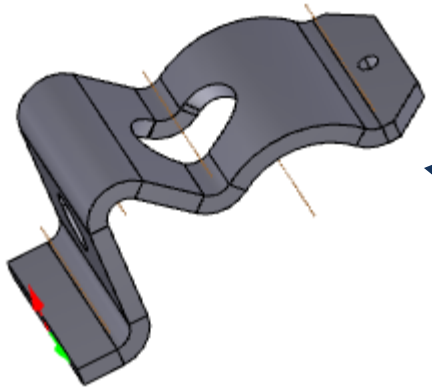
- Neutral File Format
- In Accordance with ASME Y14.41
  - Need to Publish/Approve
- Readily Readable Format
- Compatible with JEDMICS
- Long Term Archiving and CAM compatibility
  - Embedded STEP

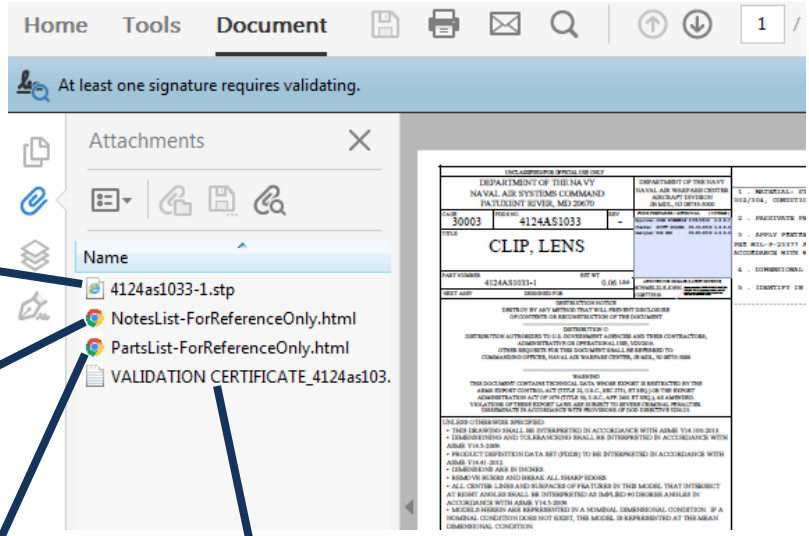
3D PDF


DEPARTMENT OF THE NAVY
NAVAL AIR SYSTEMS COMMAND
PATUXENT RIVER, MD 20670
30003
3449AS6998
HYDRAULIC MANIFOLD
PRINTED
3449AS6998-1
2.93 LBS
APPROVED FOR PUBLIC RELEASE. DISTRIBUTION UNLIMITED.
NOTES
PARTS LIST
QTY
CAGE
PART NUMBER
NOMENCLATURE
MATERIAL
SPECIFICATION
HYDRAULIC MANIFOLD, PRINTED
END OF LIST
CLASSIFICATION OF CHARACTERISTICS PER DOD-STD-1
FOR EACH FINISHED PART, CRITICAL AND MAJOR
CHARACTERISTICS REQUIRE 100% INSPECTION
MINOR: ALL OTHER CHARACTERISTICS
REVISIONS
INITIAL RELEASE
END OF REVISIONS
Page 1 of 2
SHOW ALL
ISOLATE
ZOOM FIT
AVAILABLE VIEW STATES
3_PROPERTIES
5_DATUMS
7A_FRONT
7B_TOP
7E_BACK
7F_RIGHT
8A_SECTION_A
8B_SECTION_B
8C_SECTION_C
D0_MODEL_ONLY
PRINT
SELECTION DETAILS
Select a feature or annotation to view details.
MODEL ANNOTATION STATUS
0 ERRORS / 0 WARNINGS
DETAILS
Page 2 of 2

Components of the TDP

STEP





file:///C:/Users/john.SCHMELZLE/Documents/DLA/NotesList-ForReferenceOnly.html

NOTES (FOR REFERENCE ONLY):
< > INDICATES A FLAG NOTE
1 . MATERIAL: STEEL, CORROSION-RESISTANT, QQ-S-766, TYPE 302/304, CONDITION A, FINISH 2.

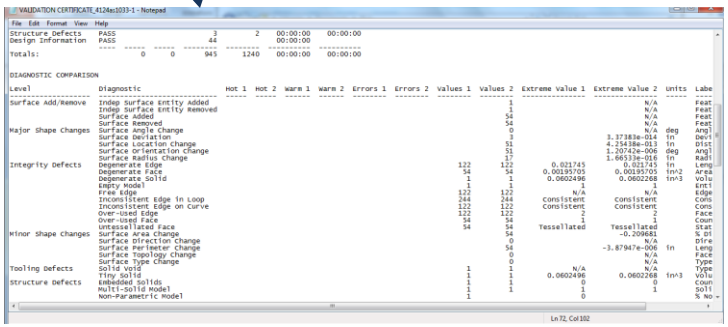
2 . PASSIVATE PER QQ-P-35

3 . APPLY PRETREATMENT COATING PER MIL-C-8514, PRIMER M23377-1 PER MIL-P-23377 AND COATING MIL-C-22750, TYPE I, CLR 26270 IN ACCORDANCE WITH MIL-C-8507 AND MIL-C-22751

4 . DIMENSIONAL LIMITS APPLY AFTER FINISH.

5 . IDENTIFY IN ACCORDANCE WITH MIL-STD-130, BAG OR TAG.

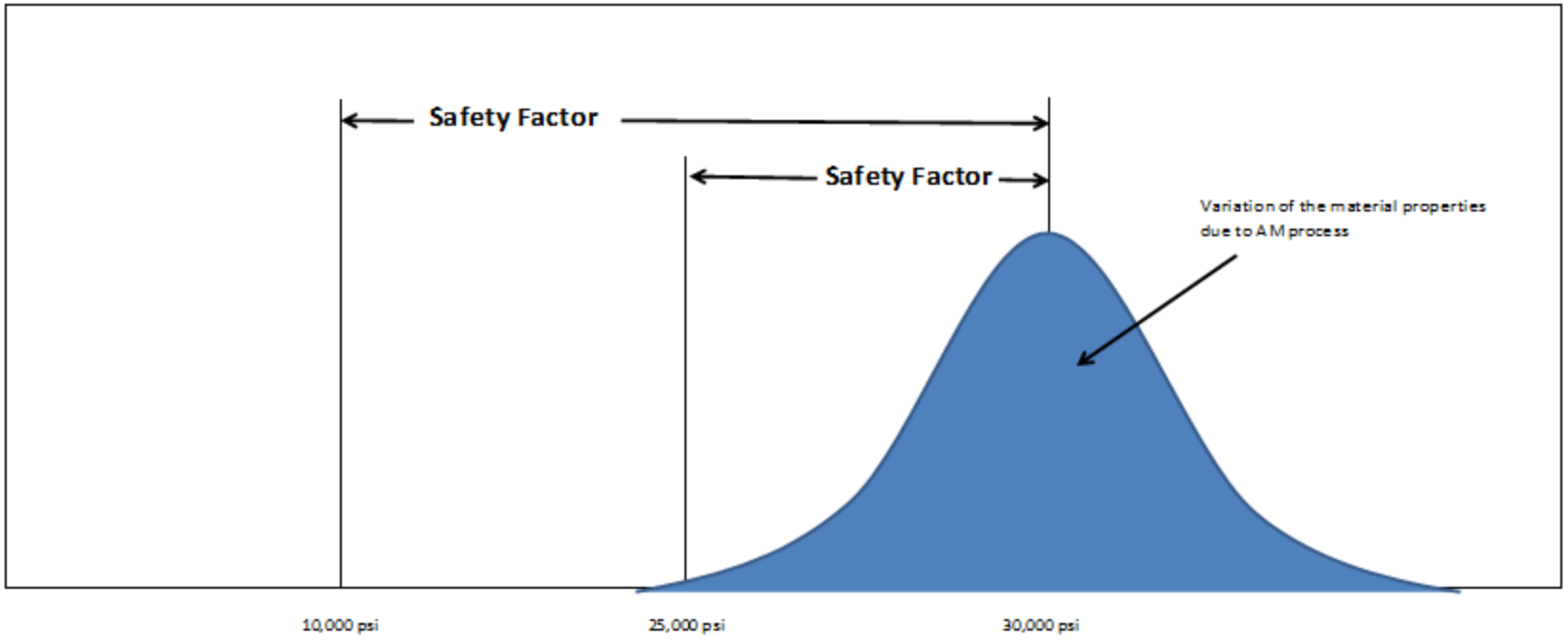
---------- END OF NOTES ----------



NotesList-ForReference
PartsList-ForReferenceOr
file:///C:/Users/john.SCHMELZLE/Documents/DLA/PartsList-ForReferenceOnly.html

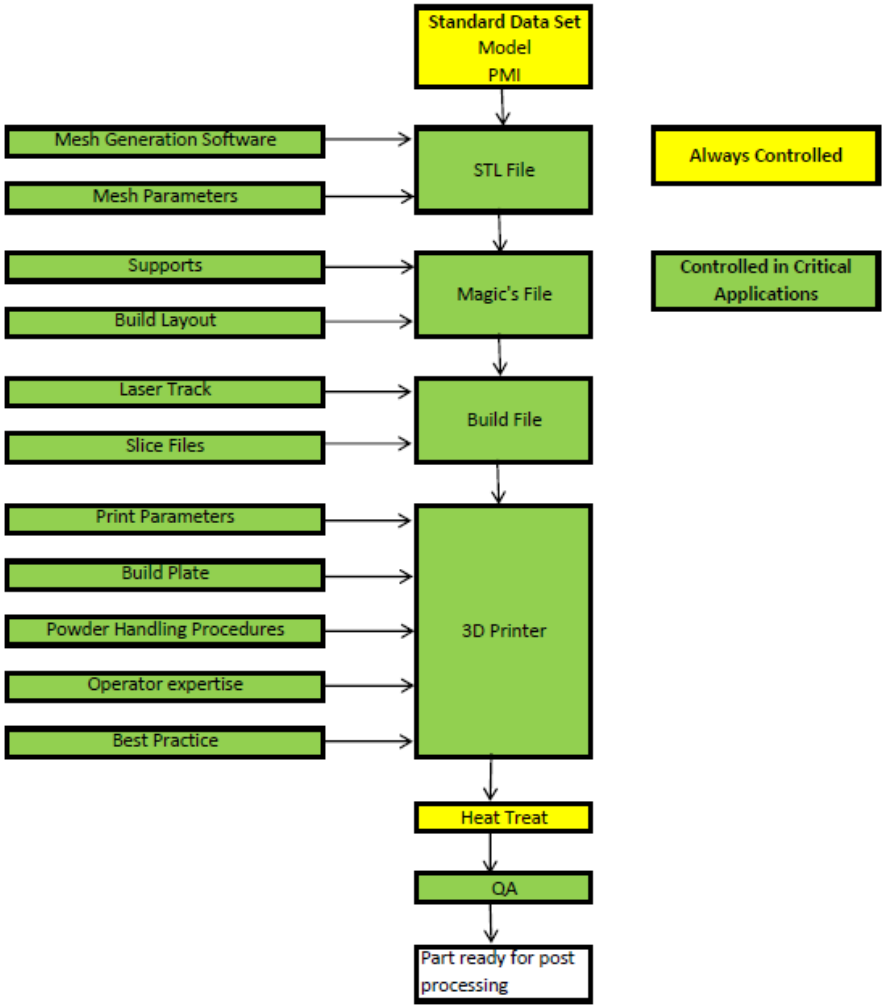
PARTS LIST (For Reference Only)					
QTY	CAGE	PART NUMBER	NOMENCLATURE	MATERIAL	SPECIFICATION
X	30003	4124AS1033-1	CLIP, LENS	STEEL	QQ-S-766

Part Criticality



Part Criticality

- End State
  - More Competitive
  - Greater Risk
- Entire Process
  - Less Competitive
  - Less Risk



Components of the AM TDP

Manufacture:

- Printer(s) Specific Build File(s),
- Authorized Practices Document
  - Equipment Requirements and
  - Personnel Training Requirements and Certification,
  - Allowable Environmental Conditions:,
  - Feedstock Handling Requirements
- Build Recovery, Post Processing
- Specific Print Parameters
- Assembly Instructions,.
- Feedstock Specification

Quality Assurance/Inspection

- Manufacturing Critical Characteristics and Process/Operations
- QIF File Quality,
- Conformance Inspection and Test Procedures:

AMTDP DID

DATA ITEM DESCRIPTION

Title: ADDITIVE MANUFACTURING TECHNICAL DATA PACKAGE

Number: OT-17-2XXXX
AMSC Number: TBD
DTIC Applicable: N/A
Preparing Activity: SA
Applicable Forms: N/A

Approval Date: Draft
Limitation: N/A
GIDEP Applicable: N/A
Project Number: TBD

Use/relationship:

The Additive Manufacturing Technical Data Package (AMTDP) is broader than a standard

- Joint Navy Effort
- Provides a description of the AM TDP and its components
- Would need to be Tailored in the SOW
- Facilitates AM Procurment

The NAVAIR TDP Standard

- Purpose
  - Create a uniform way of developing 3D TDPs in NAVAIR
  - Describes Criteria to Taylor the AMTDP
- Contents
  - Part Criticality
  - Dimensioning Schema:
  - Data Set Requirements
    - Specific PDDS Types and requirements
    - Attachments
    - Model Parameters
    - Design Model Requirements
  - Process
  - Approval
- Completion Date 1 Oct 2017

CDRL Requirements

Invoking the DID in the contract

3D Pdf
Production Level, 3D TDP per MIL-STD-31000.
IAW ASME Y14.100.
Model definition shall be IAW ASME Y14.41.
Model Parameters IAW ASME Y14.41.1

File Naming Conventions (Including Attachments)

Tailoring Requirement

Attachments
Dimensioning Schema

Standard Contractual Requirements

Data Rights, etc.

Intellectual Property (IP)

Navy Funded Design

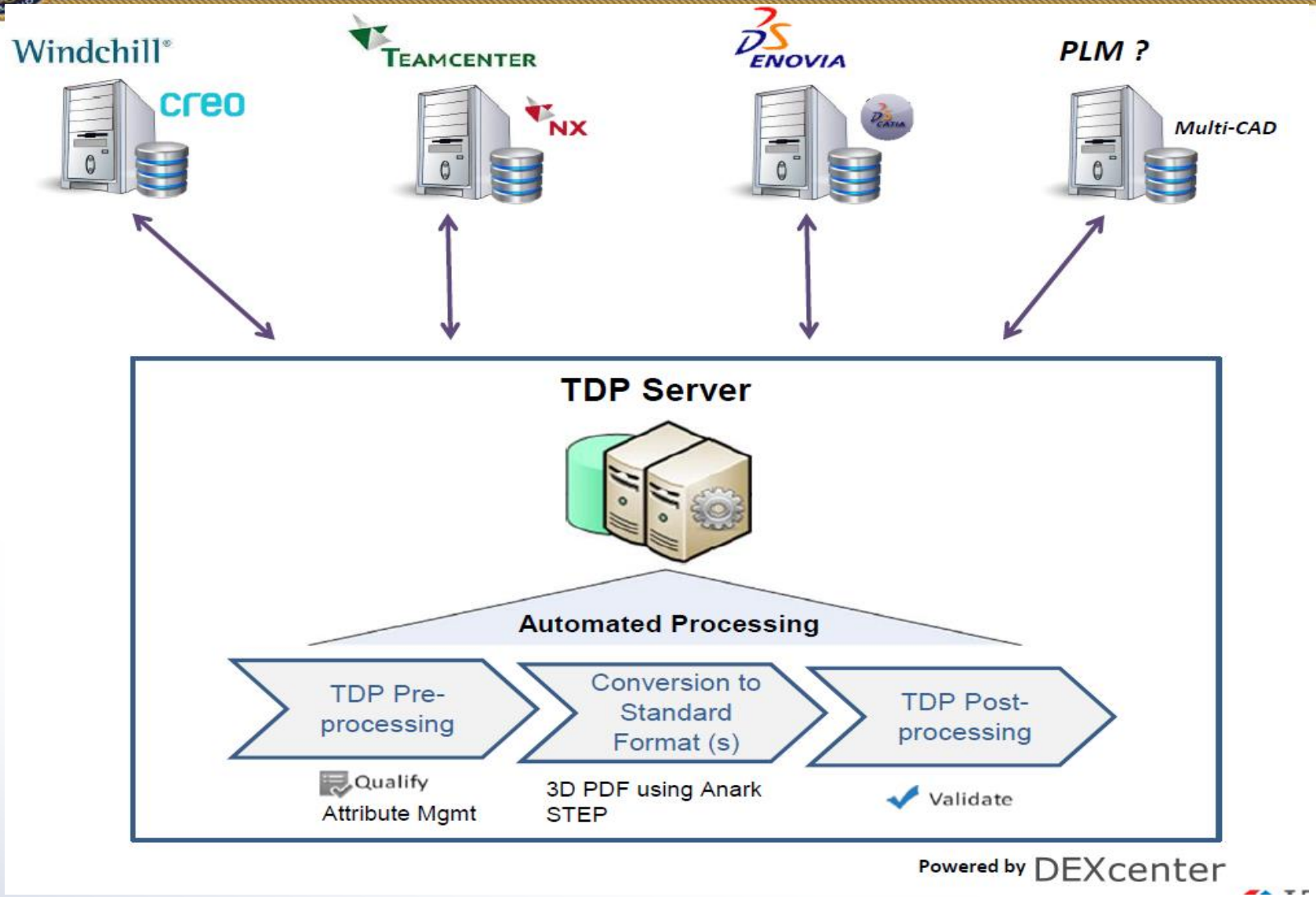
- Government owns everything developed with Navy Funds, including design & Manufacturing procedures.

- Contractor owns anything developed with their own funds.

- Contractor Developed Material
  (Metal Powder)

- Print Parameters
  This could be unique print parameters optimized to improve material properties such as Surface Finish.

Plan to expand the 3D TDP



3D Tech Data Use in Procurement

DoD/NIST/Industry 3Di PDF TDP Workshop

Tom Parks, LMI
Dick Tiano, ATI

January 30, 2018

This is a product of the DLA R&D
Weapon System Sustainment Program (WSSP)
Project # STP 7-L-03

LMI

Background

- Defense Logistics Agency (DLA) is America's Combat Logistics Support Agency
  - Buys spare parts for >2000 weapon systems (>4.1M NIINs; Class IX parts)
  - Needs comprehensive technical data to conduct competitive procurements
- Most weapon system technical data used by DLA is formatted as 2-dimensional (2D) drawings

DLA Routinely Procures Sustainment Parts Using 2D Tech Data

The Problem

- DLA's current procurement processes are built to use 2D technical data
- Industry and Services have transitioned to CAD and CAM, which produce and use 3-dimensional (3D) models for system design and documentation
- DLA needs capability to routinely procure parts using 3D technical data

DLA Must Be Able to Procure Parts Using 3D Tech Data

The Challenge of Using 3D Technical Data for Procurement

- To successfully use 3D technical data, DLA must resolve three major challenges
  - DLA personnel must be able to fully access and view technical data
  - DLA personnel must be able to easily locate and confirm inclusion of requisite information for manufacturing and procurement
  - Technical data included in solicitations must be accessible and useable by a majority of potential suppliers without need to procure software

DLA Conducted R&D Study to Evaluate Options

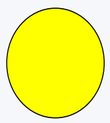
Options to Solve DLA's 3D Technical Data Challenges

- **Option 1:** purchase software packages and training for each unique proprietary CAD software platform
- **Option 2:** require technical data be recorded in a single proprietary CAD format*
- **Option 3:** require technical data be recorded in 'neutral file format'*

*DLA acquires copies of requisite software and training

LMI

Comparison of Options

Options	**Challenges**		
	Full Data Access	Easily Locate Data	Supplier Accessibility to Data
(1) Purchase S/W for each CAD Platform			
(2) Require TDPs in One CAD Format			
(3) Require TDPs in Neutral Format			

 Low cost solution

 High cost solution

 Does not solve challenge

Only Option 3 can solve all 3 challenges!

LMI

DLA's Preferred Format for 3D Technical Data[1]

- 3D PDF (PRC[2] format) + STEP[3] file (AP203 format)
  - Neutral file combination provides full product definition, includes geometry to create machine code for CNC manufacturing, meets TDP 'publishing' requirements, and is a stand-alone product
  - 3D PDF document can be read using Adobe Reader or Adobe Acrobat software
    - Widely available (installed on all DoD computers and ~90% of commercial computers)
    - Software is available via *free* web download
    - PDF format is intuitive to navigate

3D PDF Solution

1 Concept of Operations for DLA Procurement of Weapon System parts Using 3D Technical Data, LMI Report DL309T1, September 2014
2 Product Representation Compact
3 STEP = Standard for the Exchange of Product Data

LMI

Proving the ‘3D PDF Solution’ Works

- 3D PDF Demo R&D Project
  - Demonstrate/assess capability to acquire real parts (Class IX items)* using only 3D PDF technical data plus a STEP file (AP203)
    - Test ESA processes to develop and deliver 3D technical data to DLA
    - Test DLA ability to receive, review, and use 3D technical data in TDPs and solicitations
    - Test supplier’s ability to use 3D PDF and STEP files for bidding and manufacturing

DLA conducted actual part procurements using only 3D PDF and STEP files (no 2D data provided to suppliers)

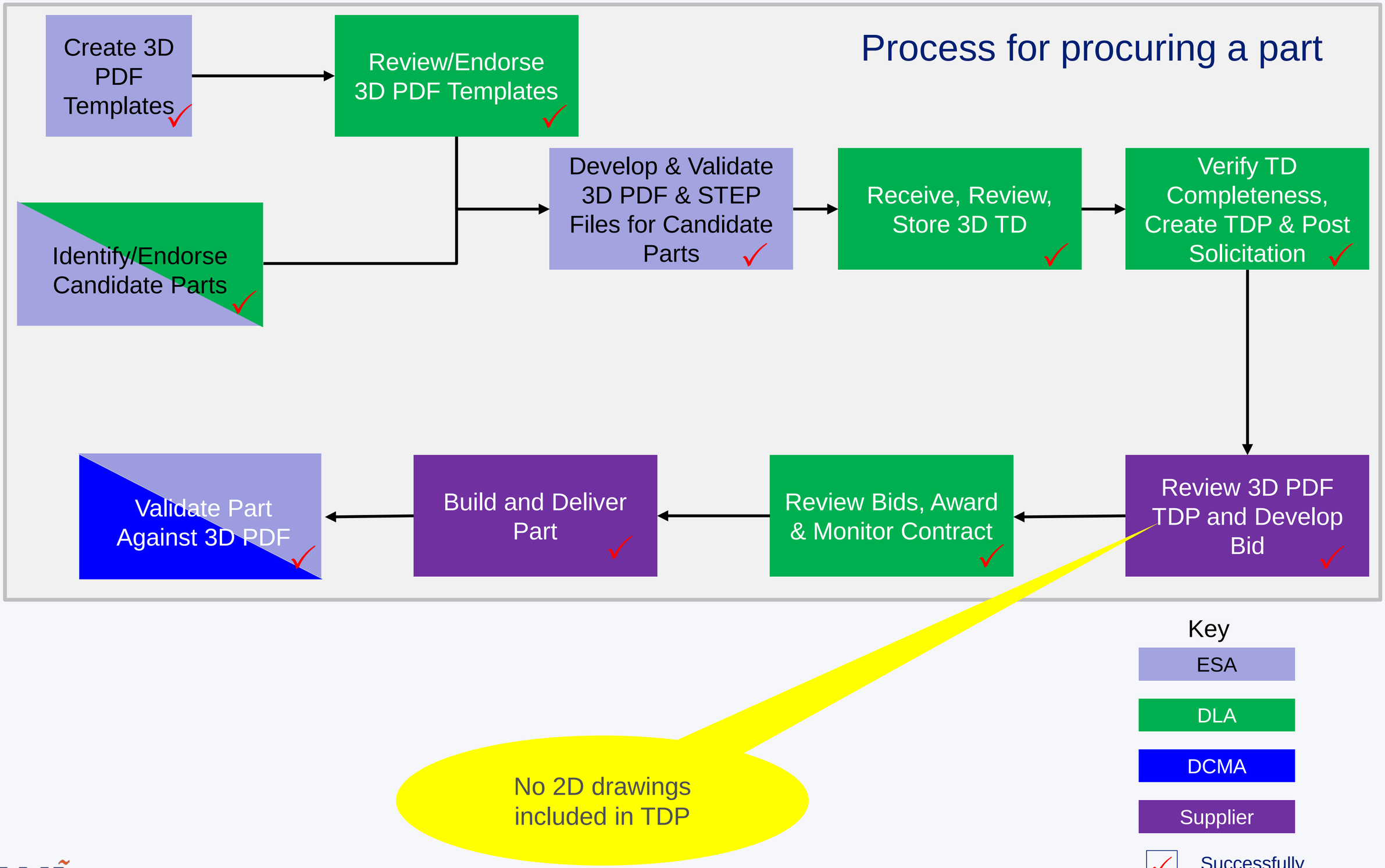
* Parts were for R&D purposes only and were not inserted into the operational supply chains

3D PDF Demo Procurements

- Demo included three different parts
  - Cable Sheave Guide, NSN 5340-01-608-4916
  - Brake Shoe Cam, NSN 1005-00-701-2756
  - Retaining Bearing Plate, NSN 3110-01-003-1296
- Parts managed by three different ESAs
  - NAWC Lakehurst
  - ARDEC Rock Island
  - Warner Robins
- Parts procured by three different DLA Supply Chains
  - Troop Support; Industrial Hardware (Philadelphia)
  - Land & Maritime (Columbus)
  - Aviation (Richmond)

Demo tested end-to-end process

DLA 3D PDF Demo: Process for Procuring Parts



Cable Sheave Guide Contract Results

- Small Midwest fabrication shop built parts
  - Never before used 3D PDF technical data
  - Set up time and cost were not impacted by 3D PDF data
  - 3D PDF slightly more difficult; personnel normally use 2D drawings
  - Ability to roll and zoom the part in space was a positive feature
  - Didn't use STEP file; CNC system uses 'conversational programming'
- Two test articles delivered to ESA on time
- Test articles validated against data of record (3D PDF file); two minor non-conformances noted
  - Non-conformances did not disqualify parts
  - Non-conformances did not result from 3D PDF errors/issues

Supplier built parts even though it'd never before used 3D PDF

Brake Shoe Cam Contract Results

- Picatinny Arsenal PIF* (organic manufacturing capability) used 3D PDF file to build parts
- Three test articles delivered to L&M mechanical test lab on 20 Sept
- Test articles validated against data of record (3D PDF file); one minor non-conformance noted
  - Non-conformance did not disqualify parts
  - Non-conformance did not result from 3D PDF errors/issues

*Production Integration Facility

Retaining Bearing Plate Contract Status

- Contract awarded 6 Sept to small Western hardware manufacturing company
- Three test articles to be delivered to Warner Robins (ESA) by 11 Dec 2017
- Test articles will undergo validation by ESA against data of record (3D PDF file); results TBD

Conclusions from DLA 3D PDF Demo R&D Project

- *DLA can use 3D PDF and STEP files in daily procurement operations*
- *Suppliers can use 3D PDF and STEP files to develop quotes and manufacture parts*
- ESA 3D PDF templates* meet all technical data requirements to support DLA procurement actions
- No process changes are required for transfer of 3D PDF and STEP files from ESA to DLA
- No procurement process changes are required for DLA use of 3D PDF and STEP files

DLA Can Procure Parts Using 3D PDF Solution

* ARDEC, NAWC Lakehurst, Warner Robins

Other DLA 3D Tech Data Efforts

- Assisted NAVAIR PMA-261 (CH53K Program Office) in evaluating OEM 3D technical data ability to support provisioning, cataloging , and sustainment processes
- Assisted NAVAIR PMA-261 in evaluating and adopting a 3D PDF solution for its technical data
- Working closely (FY18 - FY19) with various Engineering Support Activities (ESAs), In-Service Engineering Activities (ISEAs), and Program Management Offices (PMOs) to identify state/status of technical data and, as appropriate, conduct mini-pilots (3D PDF demos) to facilitate adoption/transition to 3D PDF solution
  - US Army: ARDEC, AMRDEC, CERDEC, ECBC, NSRDEC, TARDEC
  - US Navy: PMS-397, NAVSUP WSS, ESWG, NUWC Newport, PMA-261
  - US Air Force: TBD
  - USCG: TBD
  - USMC: TBD

POCs

- Emily Baigis, DLA R&D Project Lead
  - 215-737-5781
  - emily.baigis@dla.mil

- Bruce Kaplan, LMI R&D Program Manager
  - bkaplan@lmi.org
  - 703-917-7284

- Tom Parks, LMI Project Leader (thru 1 Feb 2018)
  - tparks@lmi.org
  - 703-917-7223

- Ben Jilson, LMI Project Leader (incoming)
  - bjilson@lmi.org
  - 703-917-7528

- Dick Tiano, ATI Lead
  - Dick.tiano@ati.org
  - 843-760-3333

Back-Up Slides

Service POCs for 3D PDF Information

US Army

- Jeff Windham, ARDEC, Rock Island
  - 309-782-8162
  - james.j.windham.civ@mail.mil
- John Kreider, ARDEC, Rock Island
  - 309-782-8162
  - john.d.kreider.civ@mail.mil
- Lynn Smith, ARDEC, Rock Island
  - 309-782-4534
  - lynn.e.smith26.civ@mail.mil

US Navy

- John Schmelzle, NAVAIR Lakehurst
  - 732-323-1945
  - John.schmelzle@navy.mil
- Eric Kline, NAVAIR Lakehurst
  - 732-323-7290
  - eric.kline2@navy.mil

US Air Force

- Chad Berdon, AFLCMC, Warner Robins
  - 478-327-2668
  - chad.berdon@us.af.mil
- Mark McMullan, AFLCMC, Warner Robins
  - 478-327-2846
  - mark.mcmullan.1@us.af.mil

Data Elements and Attributes Required by DLA as part of 3D Technical Data Package (TDP)* for Procurement

- Specifications
- Dimensions
- Tolerances
- Welding requirements
- Materials (ballistics)
- Temper
- Heat treatments
- Finishes
- Rights in Data
- License Agreement
- Distribution Statement
- Document Type–Parts List, Detailed Drawing, Assembly List, Quality
- Assurance Provision, etc.
- Security code
- Tech data availability code
- Foreign secure
- Nuclear
- Subsafe
- Control code
- Legibility
- Completeness
- Restrictions
- Document approval
- Document title
- Document number
- Revision and date
- Revision type
- Expiration date
- Document data code
- Size of drawing, number of sheets, frames
- Call outs
- Sources
- First Article Test requirements
- Inspection requirements
- Higher level contract quality requirements
- Part number
- NSN
- Export control
- Commercial and government entity (CAGE) code

LMI

* Concept of Operations for DLA Procurement of Weapon System Parts Using 3D Technical Data , Appendix A, LMI report DL309T1, September 2014

Synergy Software Design

Slide 1 of 14

Web3D NIST

Mike Russalesi | January 30, 2018

Show comments

Synergy Software Design

Introductions

- You may know me by my original name - VRML
- I am an XML based file format to store, display, and interact with 3D
- I have a 20+ year history making scene graphs better
- I am Royalty-Free

Web3D Consortium Board Members

Slide 2 of 14

Web3D NIST

Mike Russalesi | January 30, 2018

Show comments

Synergy Software Design

1 AWARENESS

To bring AWARENESS to our ISO standard 3D file format.

2 PROJECTS

To identify new PROJECTS with the greater NIST community and its partners.

3 CONTRIBUTE

To engage individuals and excite them to CONTRIBUTE to the standards.

JOIN NOW!

web3d.org/join

Slide 3 of 14

Web3D NIST

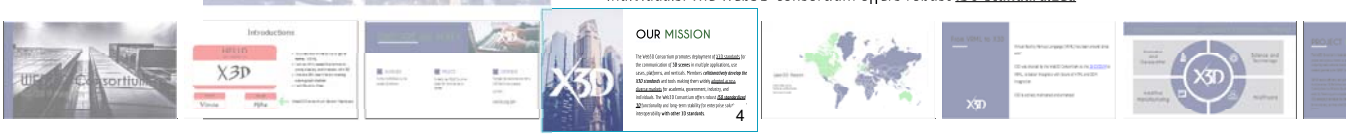
Mike Russalesi | January 30, 2018

Show comments

Synergy Software Design

OUR MISSION

The Web3D Consortium promotes deployment of X3D standards for the communication of **3D scenes** in multiple applications, use cases, platforms, and verticals. Members ***collaboratively develop the X3D standards*** and tools making them widely adopted across diverse markets for academia, government, industry, and individuals. The Web3D Consortium offers robust ***ISO standardized***



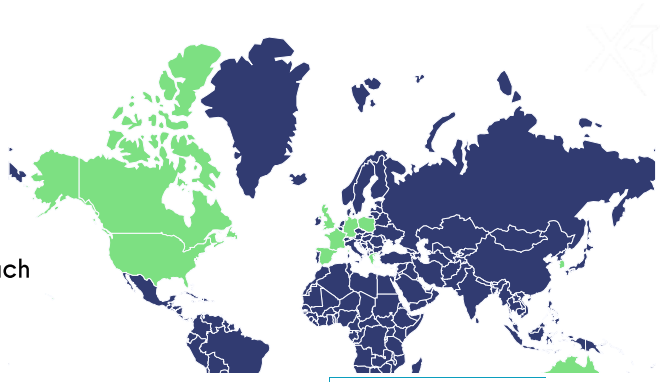
Slide 4 of 14

Web3D NIST

Mike Russalesi | January 30, 2018

Show comments

Synergy Software Design



Slide 5 of 14

Web3D NIST

Mike Russalesi | January 30, 2018

Show comments

Synergy Software Design

From VRML to X3D

Virtual Reality Markup Language (VRML) has been around since 1997

X3D was created by the Web3D Consortium as the *SUCCESSOR* to VRML, to better integrate with future of HTML and DOM integration

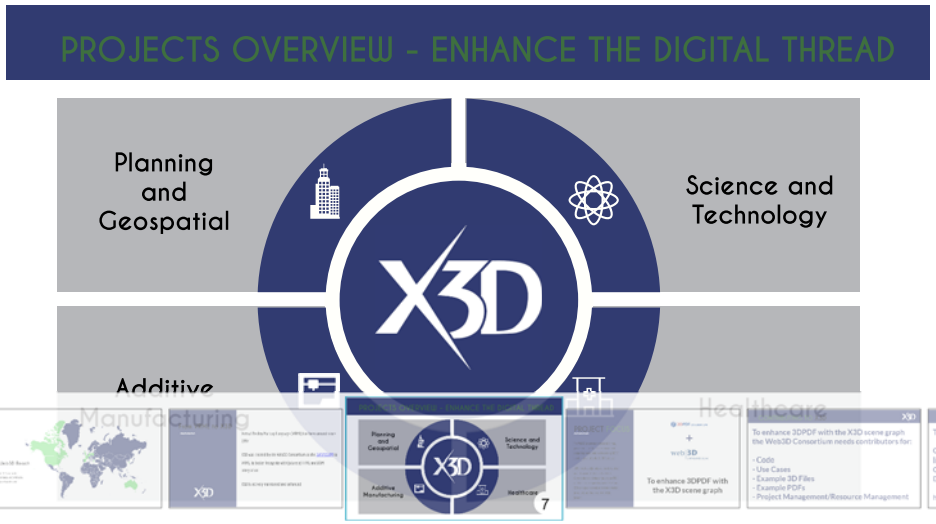
Slide 6 of 14

Web3D NIST

Mike Russalesi | January 30, 2018

Show comments

Synergy Software Design



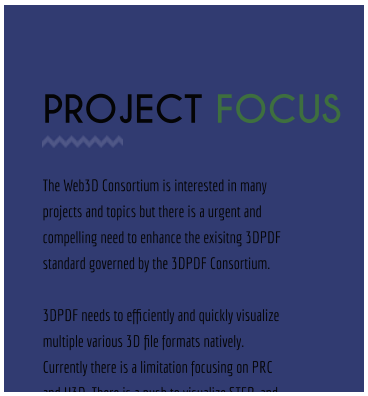
Slide 7 of 14

Web3D NIST

Mike Russalesi | January 30, 2018

Show comments

Synergy Software Design



3DPDF CONSORTIUM

+

web 3D CONSORTIUM

To enhance 3DPDF with

Slide 8 of 14

Web3D NIST

Mike Russalesi | January 30, 2018

Show comments

Synergy Software Design

CONTRIBUTING TO X3D

X3D

To enhance 3DPDF with the X3D scene graph the Web3D Consortium needs contributors for:

- Code
- Use Cases
- Example 3D Files
- Example PDFs
- Project Management/Resource Management

Slide 9 of 14

Web3D NIST

Mike Russalesi | January 30, 2018

Show comments

Synergy Software Design

CONTRIBUTING TO X3D

X3D

The levels of membership:

Community - Basic/Free
Individual - $50/student; $100/professional
Organizational - Starting at $1,500
Director - Starting at $2,500

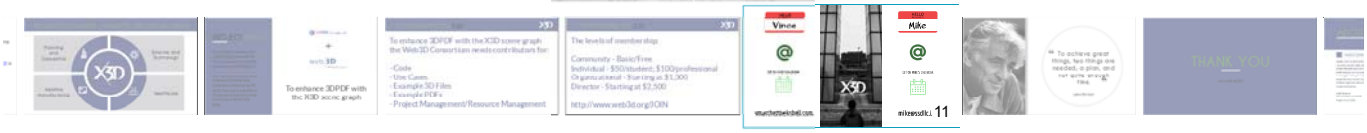
http://www.web3d.org/JOIN

Slide 10 of 14

Web3D NIST
Mike Russalesi | January 30, 2018

Show comments

Synergy Software Design



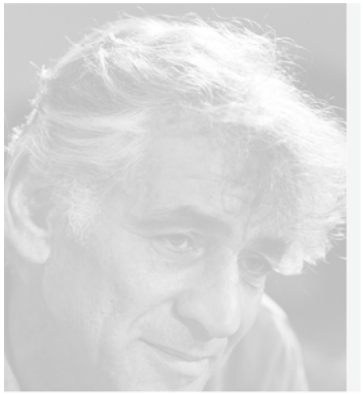
Slide 11 of 14

Web3D NIST

Mike Russalesi | January 30, 2018

Show comments

Synergy Software Design



"To achieve great things, two things are needed; a plan, and not quite enough time."

Slide 12 of 14

Web3D NIST

Mike Russalesi | January 30, 2018

Show comments

Synergy Software Design

Slide 13 of 14

Web3D NIST

Mike Russalesi | January 30, 2018

Show comments

Synergy Software Design

Web3D Consortium

Founded in 1997, the Web3D Consortium is an international, non-profit, member-funded, industry standards development organization. Today, the Web3D Consortium is utilizing its broad-based industry support to develop the X3D specification, designed for sharing interactive 3D graphics on the Web, between applications and across distributed networks and web services.

Vince Marchetti

Vincent Marchetti is a consultant currently working on projects involving GPS applications for surveying and the construction industry, and machine learning techniques for financial market analysis and bioinformatics. He has developed X3D applications for landfill management and is currently working on using the X3D standard as a tool for visualization of CAD/CAM information represented in STEP files. A component of this work is an online web application that

Michael Russalesi

Michael Russalesi is currently the Co-Founder and Chief Operating Officer of Synergy Software Design, LLC. Michael is also responsible for business development, user interface/experience design, and software development. Under his lead, Synergy deployed to the Navy an all-digital web-based solution for specialized facility inspections (SPIDERS). SPIDERS has reduced the total cost of Navy specialized facility inspections by 30%. Michael also lead the

Slide 14 of 14

Web3D NIST

Mike Russalesi | January 30, 2018

Show comments

ACTION ENGINEERING

HOW A 3D PDF ENABLES TO TDP

3Di Workshop // Jan. 30, 2018

TOPICS

Parts of the DP: Source, File Format, Validation Status

3D PDF Capability

Making the TDP MBD Ready for Adoption

Definition of MBD

Model-Based Definition (MBD)

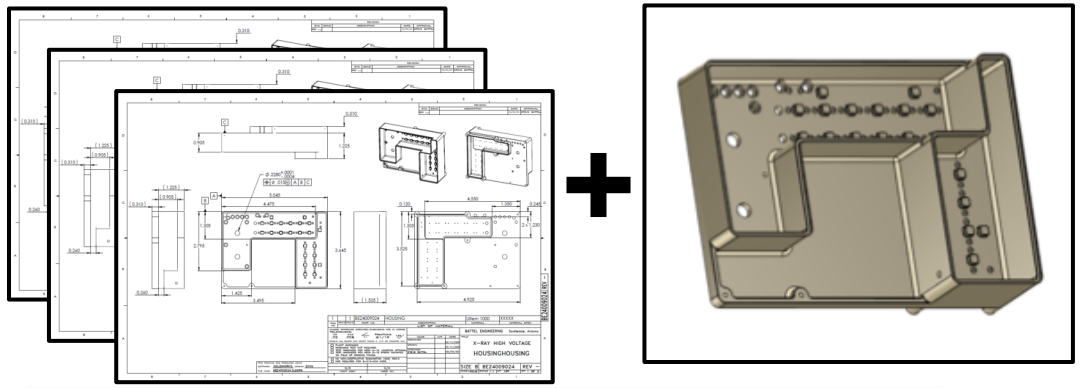
An annotated model and its associated data elements that define the product in a manner that can be used effectively without a drawing graphic sheet.

CITATION
ASME Y14.47

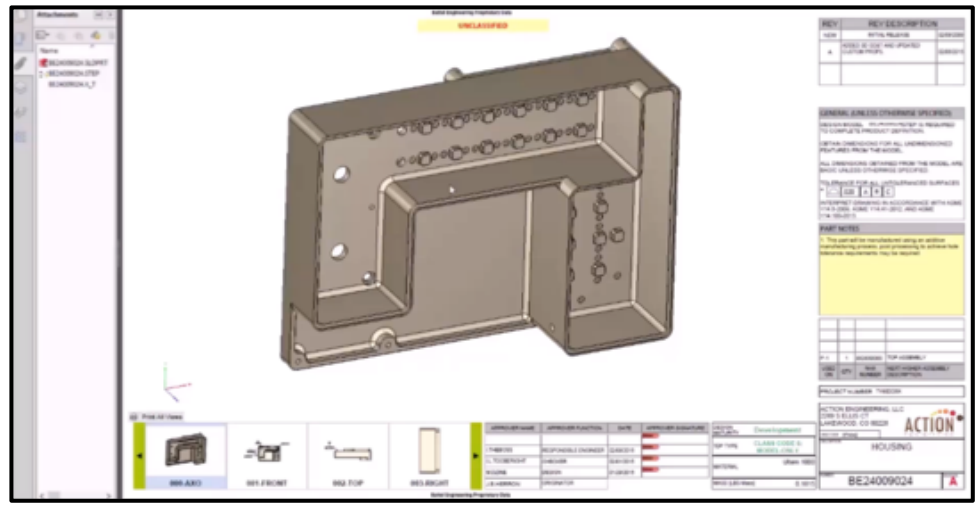
Human Readable Only

Machine Readable Only

Human + Machine Readable



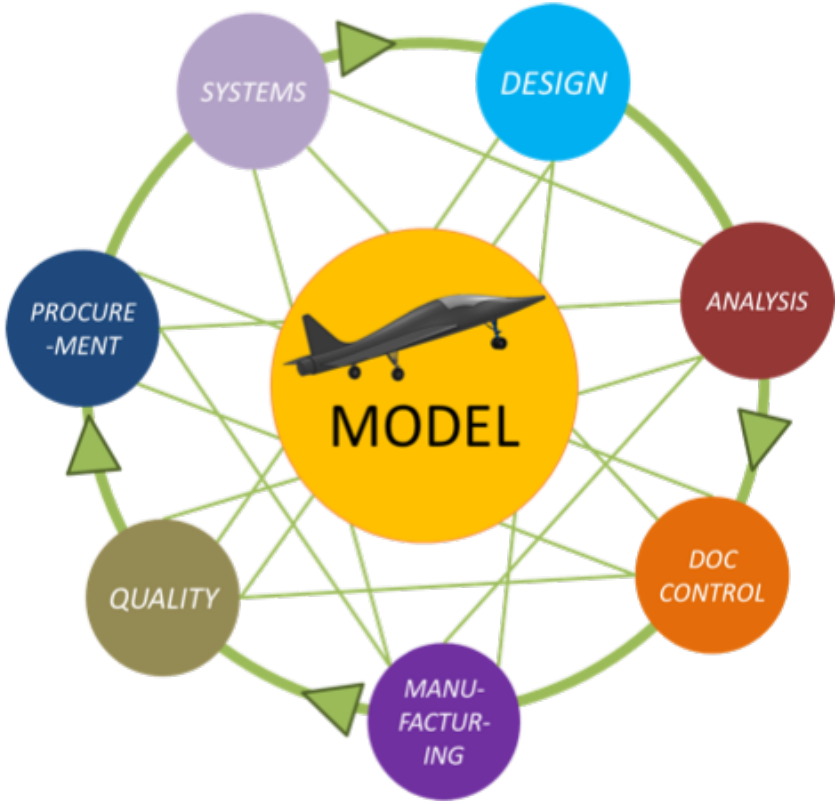
***Dimension-Based Tolerance (GD&T) Artwork**



***Geometric Tolerance (GT) Annotated Model**

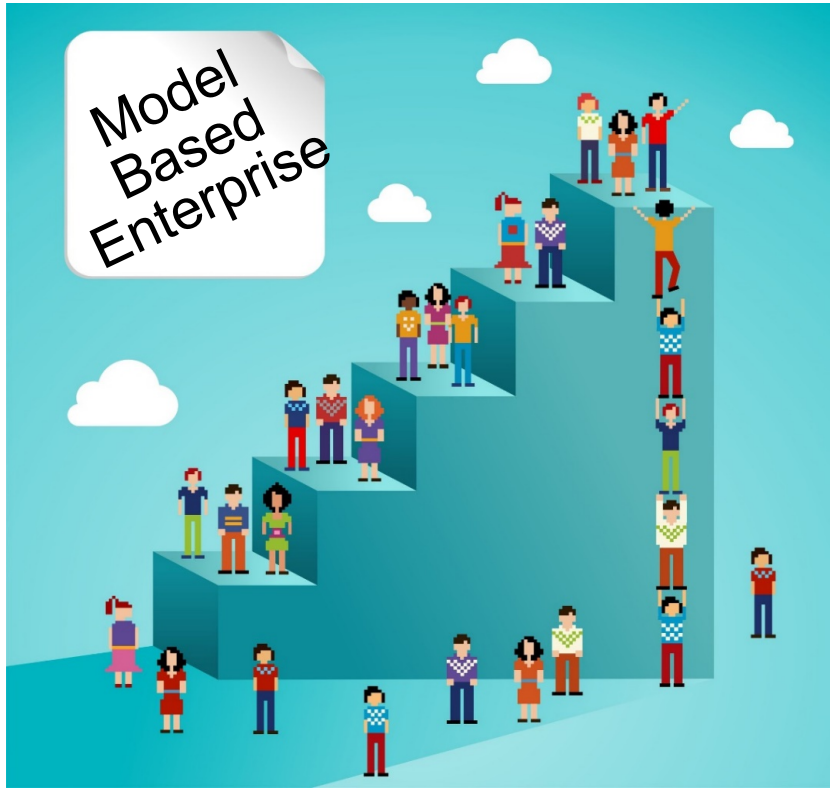
Definition of MBE

Model Based Engineering



MBE

Model Based Enterprise



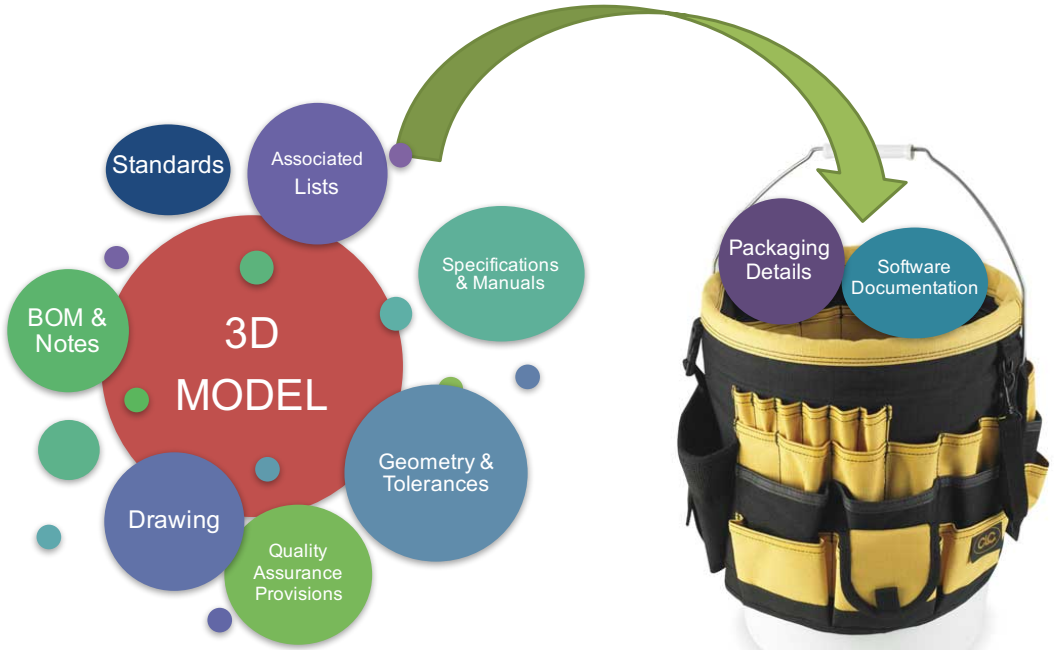
TDP Definition

Technical Data Package (TDP) **The authoritative technical description of an item.**

This technical description supports the acquisition, production, inspection, engineering, and logistics support of the item. The description defines the required design configuration and/or performance requirements, and procedures required to ensure adequacy of item performance. It consists of applicable technical data such as models, engineering design data, associated lists, specifications, standards, performance requirements, quality assurance provisions, software documentation and packaging details.

CITATION

MIL-STD-31000B



http://www.zoro.com
Bucket Organizer

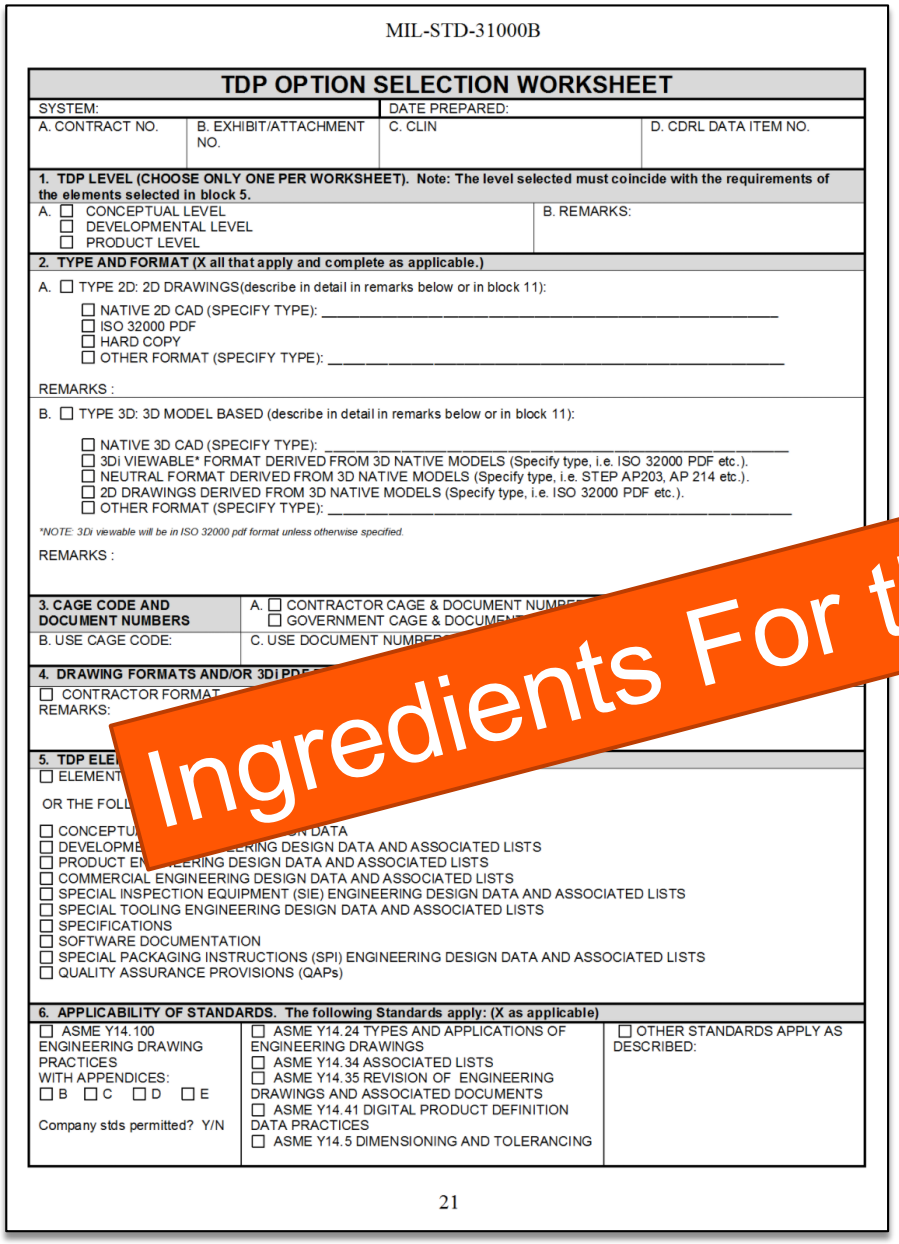
Parts of the DP

Fit For Purpose Data Packages (DP)

DATA PACKAGE (DP)

- TDP (MIL-STD-31000A/B)
- Manufacturing DP
  - CNC Data
  - In-Process Work Instructions
  - Neutral Format (e.g. STEP)
  - Dimensions and Tolerances Specific to Manufacturing
- Quality DP
  - Bill of Characteristics
  - CMM Programming
  - Measurement Results

Revision B TDP Option Selection Worksheet



MIL-STD-31000B

TDP OPTION SELECTION WORKSHEET

SYSTEM:		DATE PREPARED:	
A. CONTRACT NO.	B. EXHIBIT/ATTACHMENT NO.	C. CLIN	D. CDRL DATA ITEM NO.

1. TDP LEVEL (CHOOSE ONLY ONE PER WORKSHEET). Note: The level selected must coincide with the requirements of the elements selected in block 5.

A. ☐ CONCEPTUAL LEVEL
☐ DEVELOPMENTAL LEVEL
☐ PRODUCT LEVEL

B. REMARKS:

2. TYPE AND FORMAT (X all that apply and complete as applicable.)

A. ☐ TYPE 2D: 2D DRAWINGS(describe in detail in remarks below or in block 11):

☐ NATIVE 2D CAD (SPECIFY TYPE): _____
☐ ISO 32000 PDF
☐ HARD COPY
☐ OTHER FORMAT (SPECIFY TYPE): _____

REMARKS :

B. ☐ TYPE 3D: 3D MODEL BASED (describe in detail in remarks below or in block 11):

☐ NATIVE 3D CAD (SPECIFY TYPE): _____
☐ 3Di VIEWABLE* FORMAT DERIVED FROM 3D NATIVE MODELS (Specify type, i.e. ISO 32000 PDF etc.).
☐ NEUTRAL FORMAT DERIVED FROM 3D NATIVE MODELS (Specify type, i.e. STEP AP203, AP 214 etc.).
☐ 2D DRAWINGS DERIVED FROM 3D NATIVE MODELS (Specify type, i.e. ISO 32000 PDF etc.).
☐ OTHER FORMAT (SPECIFY TYPE): _____

*NOTE: 3Di viewable will be in ISO 32000 pdf format unless otherwise specified.

REMARKS :

3. CAGE CODE AND DOCUMENT NUMBERS

A. ☐ CONTRACTOR CAGE & DOCUMENT NUMBER
☐ GOVERNMENT CAGE & DOCUMENT

B. USE CAGE CODE:

C. USE DOCUMENT NUMBER

4. DRAWING FORMATS AND/OR 3Di PDF

☐ CONTRACTOR FORMAT

REMARKS:

5. TDP ELE

☐ ELEMENT

OR THE FOLL

☐ CONCEPTU ON DATA
☐ DEVELOPME ERING DESIGN DATA AND ASSOCIATED LISTS
☐ PRODUCT EN EERING DESIGN DATA AND ASSOCIATED LISTS
☐ COMMERCIAL ENGINEERING DESIGN DATA AND ASSOCIATED LISTS
☐ SPECIAL INSPECTION EQUIPMENT (SIE) ENGINEERING DESIGN DATA AND ASSOCIATED LISTS
☐ SPECIAL TOOLING ENGINEERING DESIGN DATA AND ASSOCIATED LISTS
☐ SPECIFICATIONS
☐ SOFTWARE DOCUMENTATION
☐ SPECIAL PACKAGING INSTRUCTIONS (SPI) ENGINEERING DESIGN DATA AND ASSOCIATED LISTS
☐ QUALITY ASSURANCE PROVISIONS (QAPs)

6. APPLICABILITY OF STANDARDS. The following Standards apply: (X as applicable)

☐ ASME Y14.100 ENGINEERING DRAWING PRACTICES WITH APPENDICES: ☐ B ☐ C ☐ D ☐ E Company stds permitted? Y/N	☐ ASME Y14.24 TYPES AND APPLICATIONS OF ENGINEERING DRAWINGS ☐ ASME Y14.34 ASSOCIATED LISTS ☐ ASME Y14.35 REVISION OF ENGINEERING DRAWINGS AND ASSOCIATED DOCUMENTS ☐ ASME Y14.41 DIGITAL PRODUCT DEFINITION DATA PRACTICES ☐ ASME Y14.5 DIMENSIONING AND TOLERANCING	☐ OTHER STANDARDS APPLY AS DESCRIBED:

TDP OPTION SELECTION WORKSHEET
PAGE 2

A. CONTRACT NO.	B. EXHIBIT/ATTACHMENT NO.	C. CLIN	D. CDRL DATA ITEM NO.

7. ASSOCIATED LISTS (X all that apply and complete as applicable.)

A. ☐ PARTS LISTS (X ONE)*	☐ (1) INTEGRATED		SELECT
B. ☐ DATA LISTS	☐ REQUIR		
C. ☐ INDEX LISTS			
D. ☐ WIR		☐ (2) SEPARATE	☐ (3) CONTRACTOR SELECT
	EGRATED	☐ (2) SEPARATE	☐ (3) CONTRACTOR SELECT
	☐ REQUIRED(Specify Levels of Assy) _____		

*USE OF SEPARATE PARTS LISTS IS NOT RECOMMENDED ESPECIALLY WITH TYPE 3D TDPS.

8. TDP DATA MANAGEMENT PRODUCTS

A. ☐ TECHNICAL DATA PACKAGE LIST (TDPL)
☐ SOURCE CONTROL APPROVAL REQUEST
☐ DOCUMENT NUMBER ASSIGNMENT REPORT
☐ PROPOSED CRITICAL MANUFACTURING PROCESS DESCRIPTION
☐ OTHER (DESCRIBE):_____

B. REMARKS:

9. TDP METADATA

☐ TDP METADATA REQUIRED (describe requirements):

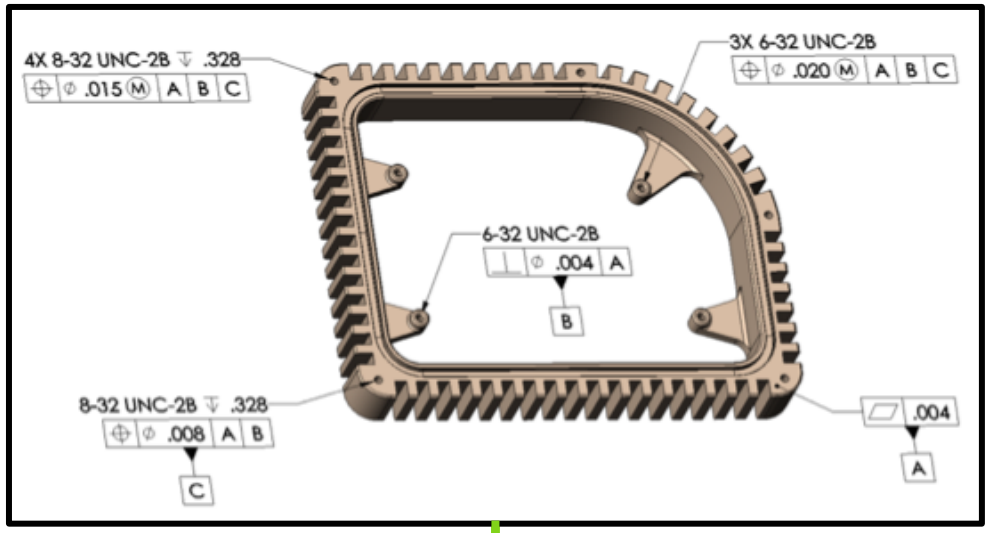
10. TDP SUPPLEMENTARY DATA

☐ TDP SUPPLEMENTARY DATA REQUIRED (describe requirements):

11. OTHER TAILORING (Attach additional sheets as necessary

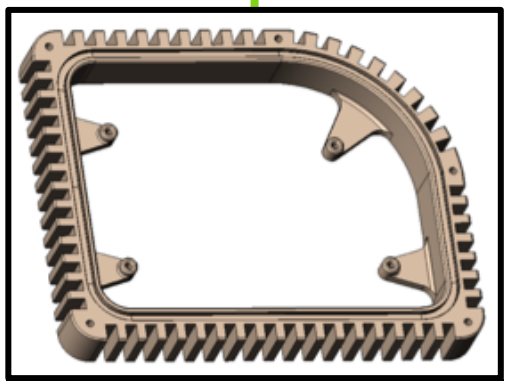
Ingredients For the Technical Data Package

Part of Model-Based Definition (MBD)

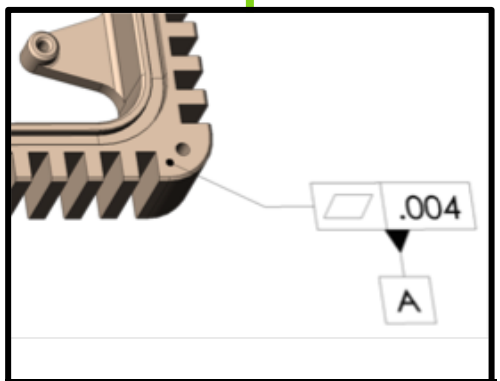


Model-Based Definition (MBD), is a model with PMI (Product Manufacturing Information) and consisting of:

1) the **3D geometry** (serves as the basic dimensions)
2) the **annotations** (displayed notes, dimensions and tolerances or GD&T)
3) the **attributes** (metadata, key characteristics, and queried data)
4) the **presentation** (saved views, presentation organization)



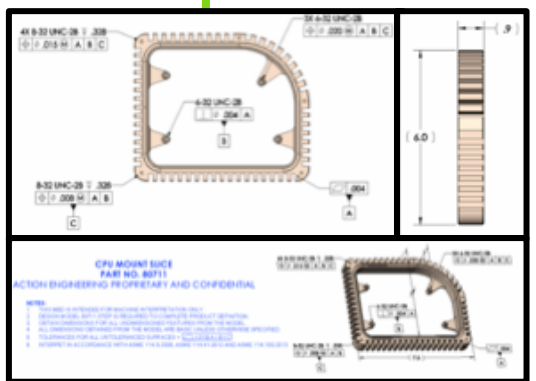
3D GEOMETRY



ANNOTATIONS

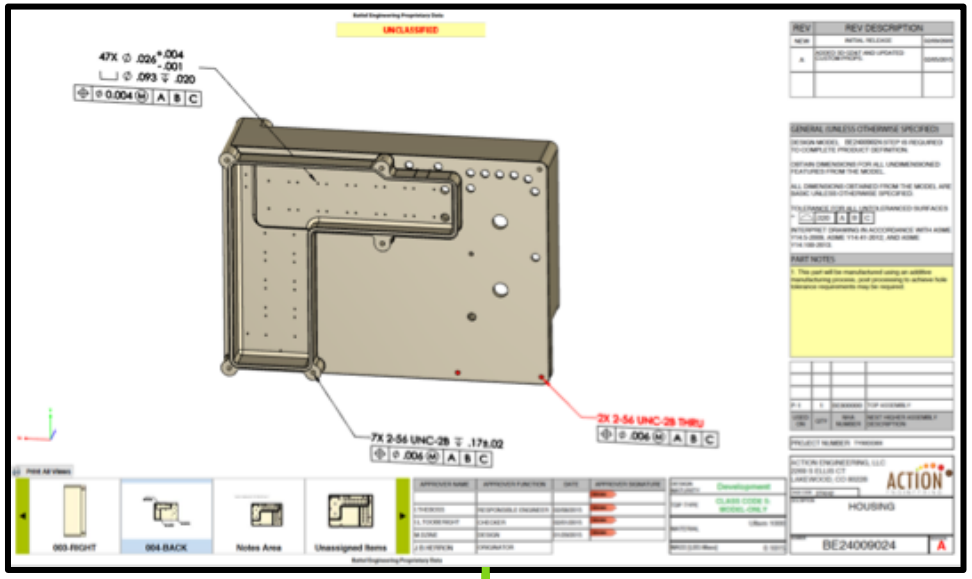
PART NUMBER	8742659
DESCRIPTION	CPU MOUNT SLICE
MATERIAL	AL 6061-T651
COMPANY	Action Engineering
DATA RIGHTS	PROPRIETARY & CONFIDENTIAL

ATTRIBUTES



PRESENTATION

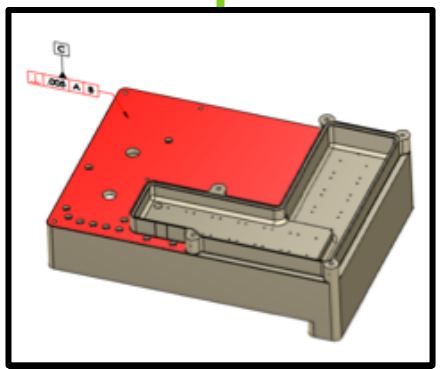
Parts of the Data Package (DP)



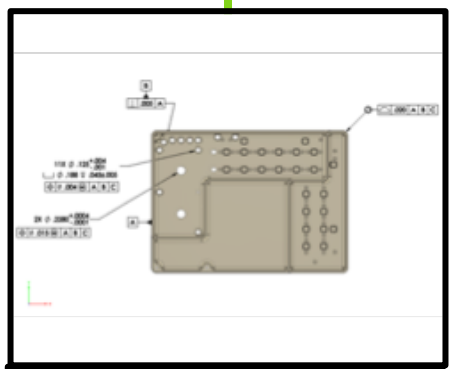
A Data Package (DP) bundles information together:

1) the **layout** organizes blocks of information
2) the **native** (Master) file
3) the **viewable** (Derivative – Authoritative or Reference) file
4) the **neutral** (Master or Derivative) file(s)
5) the **supplemental elements** required to complete the product definition

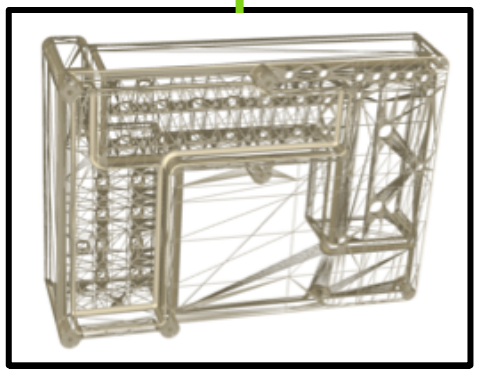
LAYOUT



NATIVE



VIEWABLE

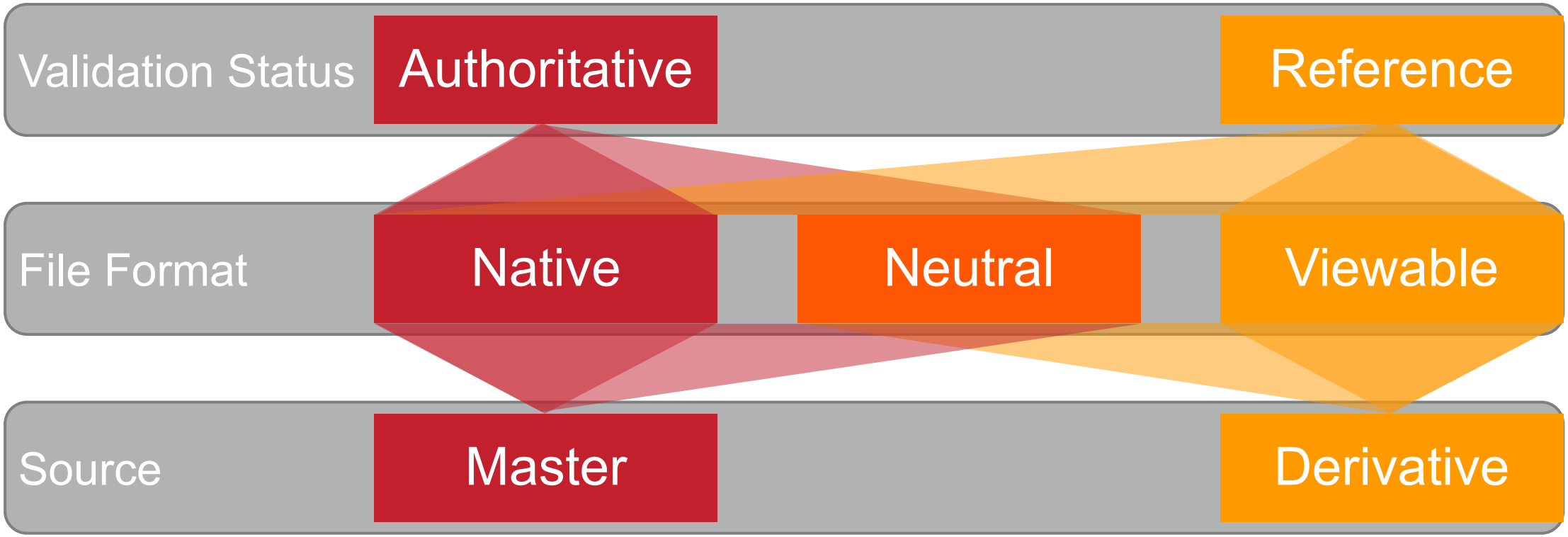


NEUTRAL

Drawings	SPI
Validation Results	QAP
Specs	Tooling
Software Doc	ECN
Results	

SUPPLEMENTAL ELEMENTS

TDP Big Picture



3D PDF Capability

What is a 3D PDF?

3D PDF is a secure container suited for delivering 2D & 3D CAD data.

Presentation	3D Models	Forms	Security
Text & Graphics	Geometry	XML Schema	Encryption
3D Models	Annotations	XML Form Data	Dig Signatures
Images	Attributes	Business Logic	Rights Management
Audio & Video	Presentation States	Interactive Fields	
	Product Structure		

All major CAD formats can be converted to a 3D PDF

ACTION ENGINEERING

SIEMENS
- XT
- JT
- NX
- Solid Edge
- I-DEAS

Standards
- STEP
- IGES
- PDF
- PRC
- STL
- U3D
- 3MF
- IFC
- VDA-FS

Other
- VRML
- Rhino

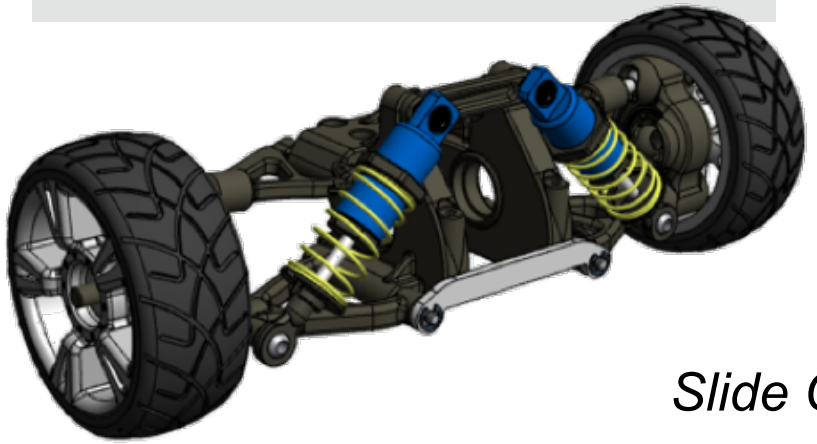
Adobe® PDF Reader

Gray – Read Supported Only
Orange – Write Supported Only
Blue – Read & Write Supported

DASSAULT SYSTEMES
- SOLIDWORKS
- ACIS
- CATIA V4
- CATIA V5
- CATIA V6

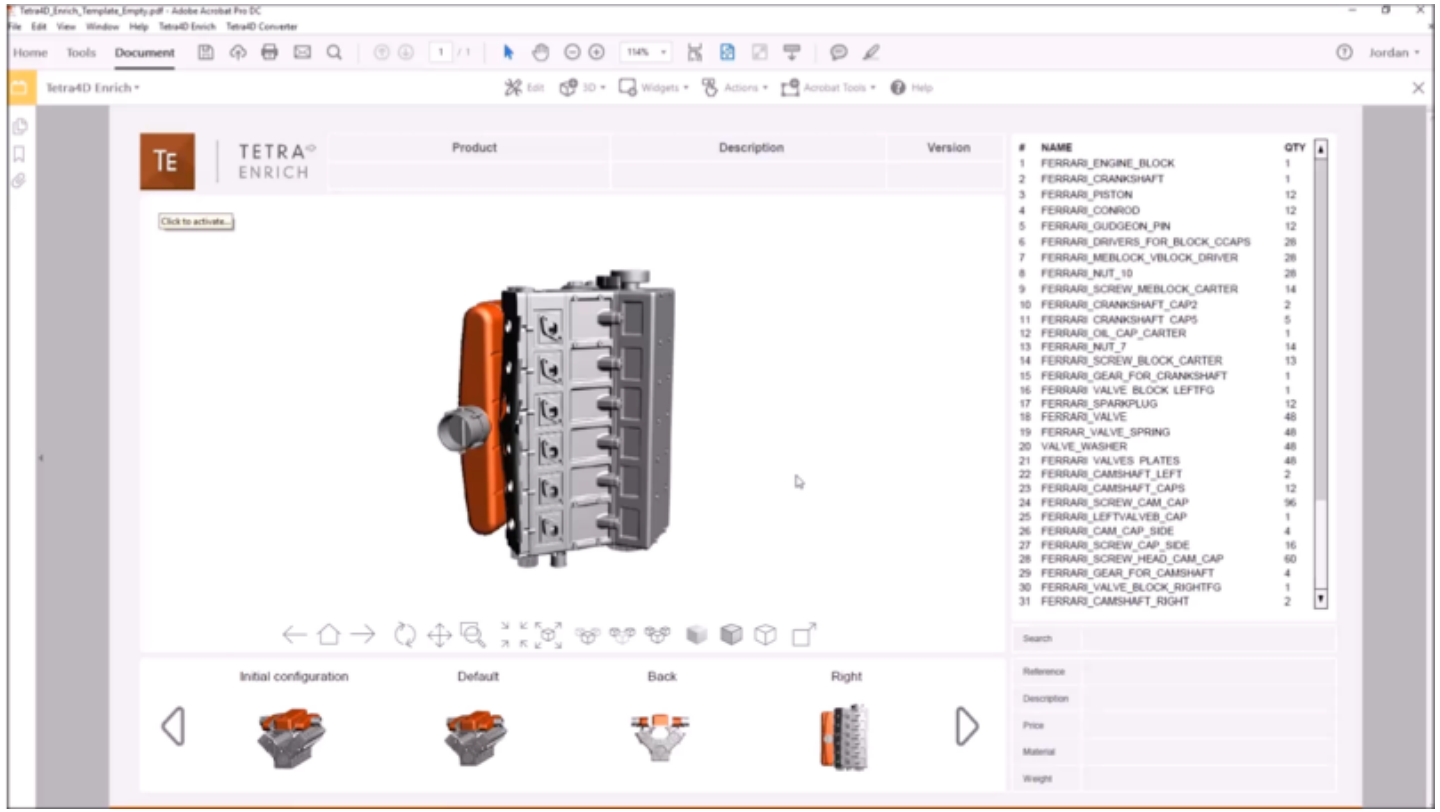
PTC®
- Creo
- Pro/E

AUTODESK.
- Inventor



Slide Courtesy of TECHSOFT 3D

PRC is an ISO standard

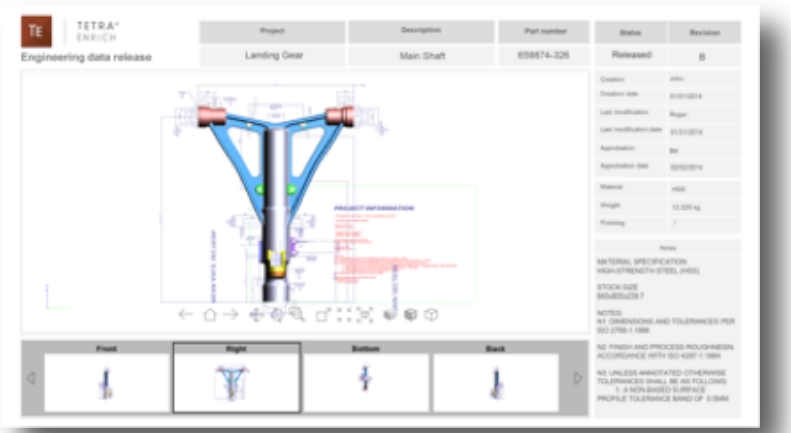


- Highly compressed format, 95% compression
- ISO 14739-1:2014
- PRC is inside Adobe Acrobat Reader
- Seamless fit with existing infrastructures
- Ubiquity of Acrobat Reader

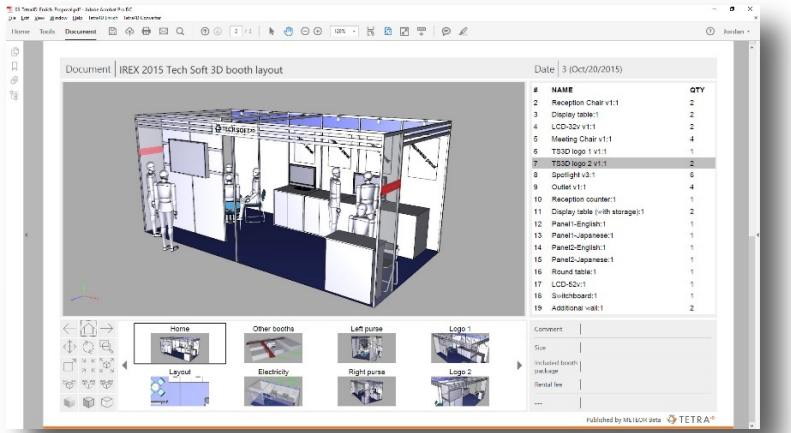
Slide Courtesy of TETRA 4D

Use 3DPs in Many Ways

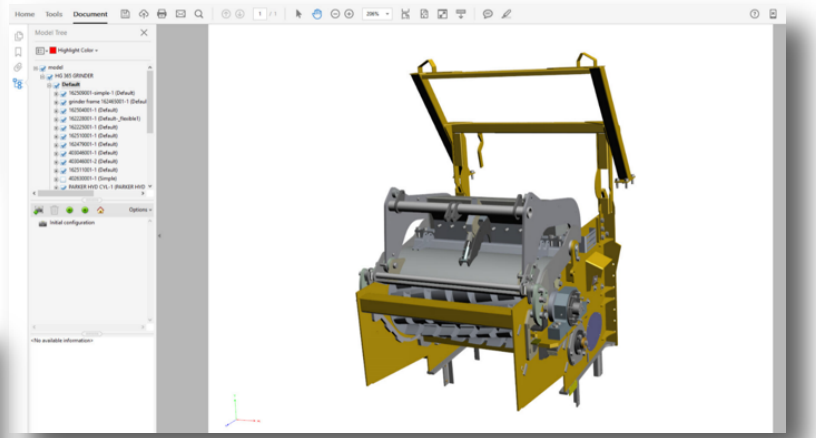
Engineering Data Release



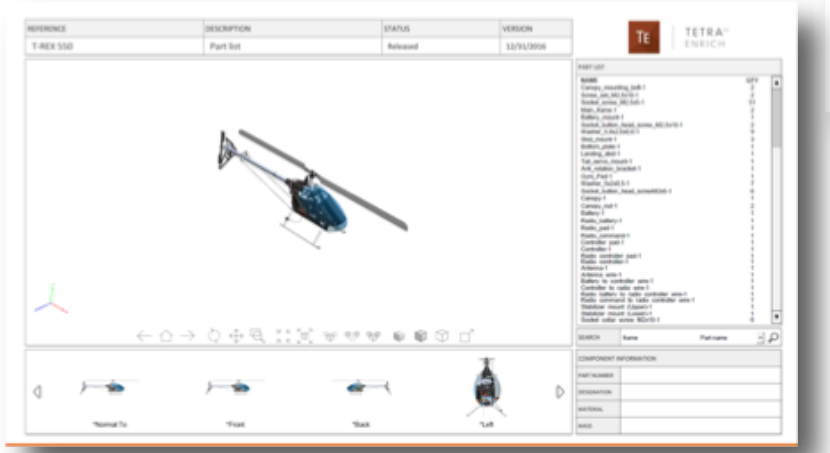
Product Presentation



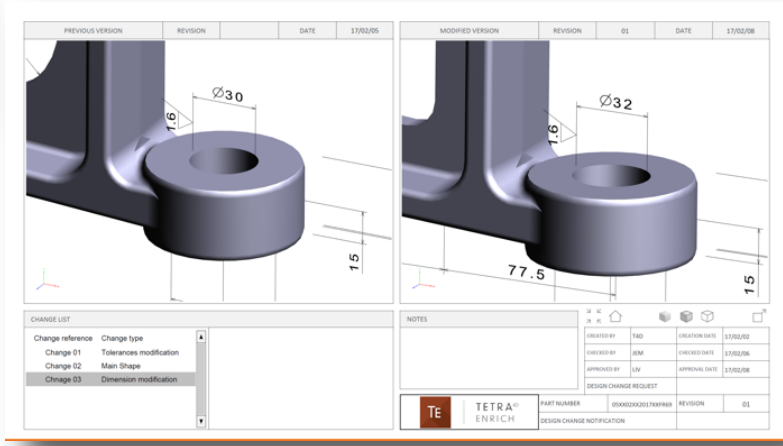
Visualization



Part Catalog



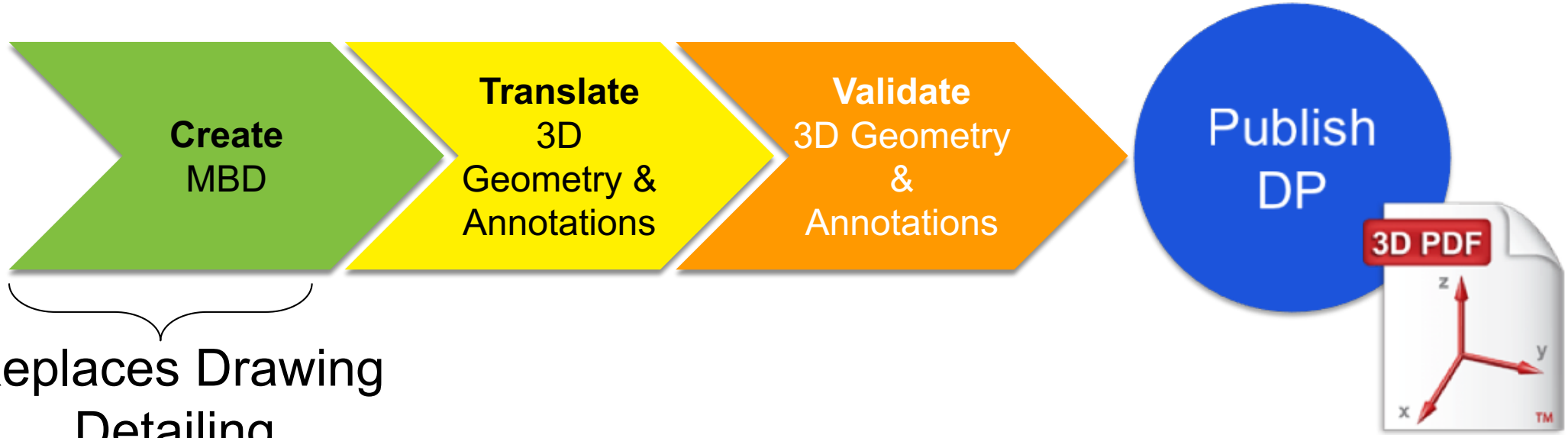
Design Change Notification



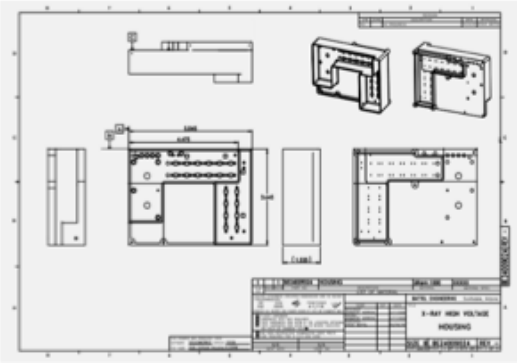
Slide Courtesy of TETRA 4D

Making the TDP MBD Ready for Adoption

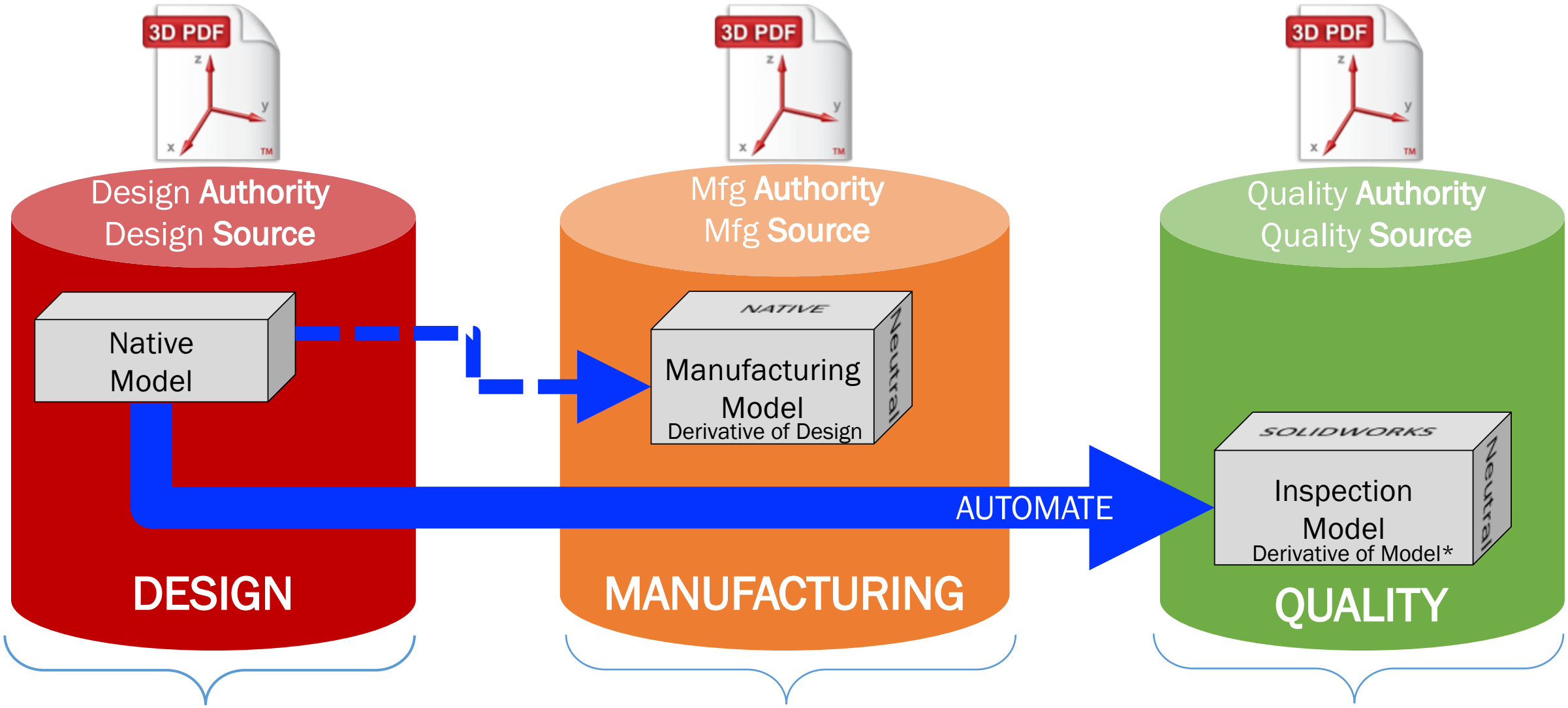
PUBLISH



Replaces Drawing Detailing



Data Packages Throughout the Lifecycle



MIL-STD-31000B Requested Edits

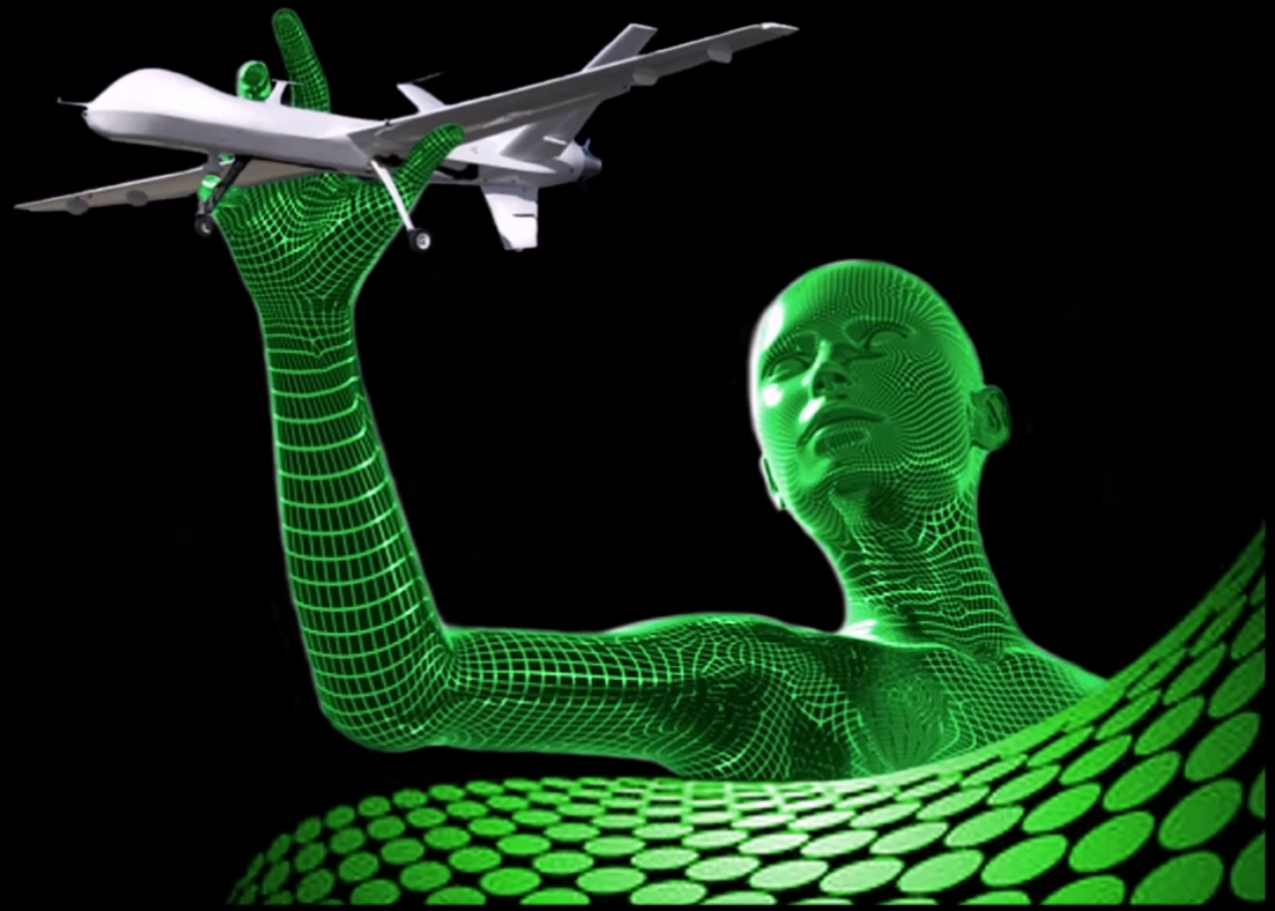
3.1.1 3-Dimensional Intelligent (3Di) technical data. A 3-dimensional viewable Computer Aided Design (CAD) representation which details the ~~**complete technical description**~~ of the required design configuration of an item provided in a widely available software format (e.g. ISO 32000-1 Portable Document Format (PDF)).

3.1.2 3Di **layout** ~~**format**~~. The standard arrangement and organization of information within a 3Di viewable representation of an item. This includes such features as the size and arrangement of information blocks (e.g. title blocks), notes, lists, revision information, view states, restriction notices and the use of optional or supplemental blocks (see related term Drawing Format).

3.1.36.3 Viewable ~~**CAD**~~ data. CAD data which is derived from the native format and converted into a format which can be displayed by a widely available software and for purposes of defining design intent in a human readable format (e.g. 3Di PDF). In general, viewable CAD data cannot serve as master technical data but may serve as either reference or authoritative technical data.

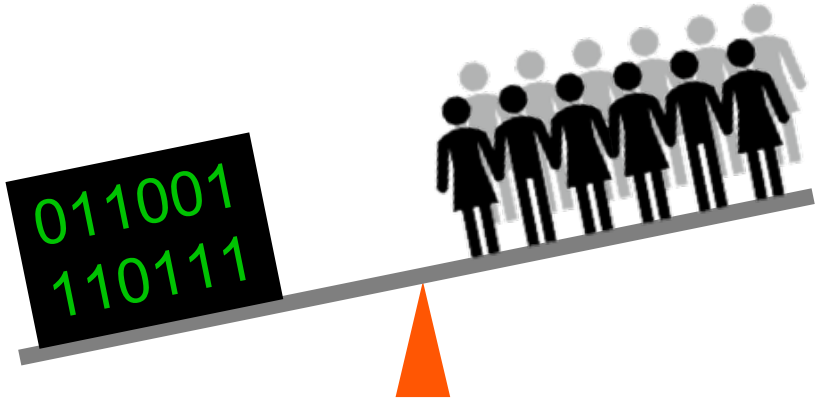
RE-USE YOUR CAD!

www.action-engineering.com

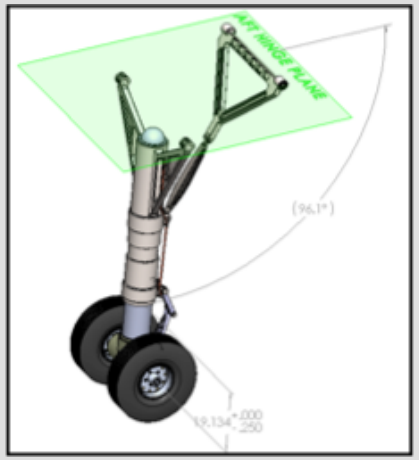


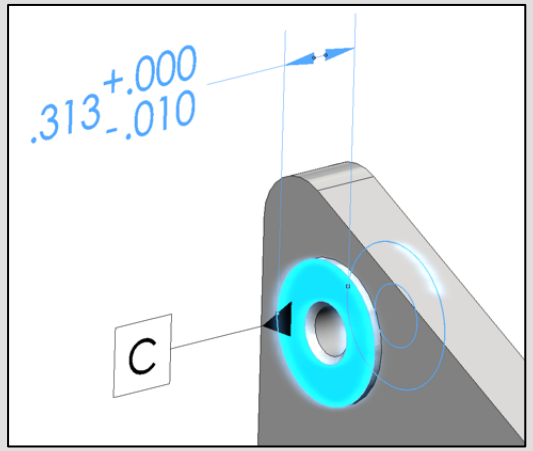
ACTION ENGINEERING

The Culture Company



Balancing Technology and People





Company Information – Based in Golden, Colorado

Model-Based Business and Implementation Coaching

Services:
https://www.action-engineering.com/services

TAKE ACTION TO BUILD YOUR DIGITAL ENTERPRISE™

Model-Based Training

MBD/MBE EDUCATION – CAD Agnostic
Model Based Enterprise (MBE) Overview – What, Benefits, How
Introduction to MBD – What, GD&T, How
PLANNING
MBE Implementation
MBE Planning and Roadmap Building
IMPLEMENTING
Model Schema and Organization – CAD Agnostic
How to Write a Modeling Guide – CAD Agnostic
Reading, Commenting and Publishing 3D PDFs

Full Course Listings:
https://www.action-engineering.com/courses

3DCIC Oct. 15-18 2018

Golden, CO

Agenda:
https://www.action-engineering.com/cicagenda

3D Collaboration & Interoperability Congress

Industry Organization Memberships

ASME SETTING THE STANDARD — Y14.46 Chair

QIF

Dimensional Metrology Standards Consortium DMSC — BOD

DMDII
DIGITAL MANUFACTURING AND DESIGN INNOVATION INSTITUTE

Success with Digital Data Requires the Entire Enterprise

	Design	Manufacturing	Quality	Procurement	Data Management
Standards	ASME Y14 Series	• STEP • ASME Y14	• QIF • ASME Y14	• QIF • ASME Y14 • STEP	Defined Method to Manage Information Throughout Enterprise
Processes	CAD Agnostic Modeling Processes	Part-Specific Process Specifications & Derivative Models	Part-Specific Process & Derivative Models	Defined Methods to Acquire MBD Parts	ASME Y14 Series
Tools	CAD Software	CAM Software	Metrology Software	Viewer Software	PDM and PLM
People & Culture	Defined, Commonly Understood & Executed Culture Fosters Adherence to New Rules and Methods				

Contact Action Engineering

Jennifer Herron

CEO

jennifer@action-engineering.com

Ryan Gelotte

MBE Analyst

ryan@action-engineering.com

Duane Hess

Application Engineer

duane@action-engineering.com

Michelle Nordwald

COO

michelle@action-engineering.com

720.595.4794

@ReUseYourCAD

action-engineering.com

Re-Use Your CAD

Anark Platform Overview

Connecting the Digital Thread

Jim Merry | Senior Director, Enterprise Sales | jim.merry@anark.com | 240 674 5547

Agenda

- Company Overview
- Partnerships
- Anark Platform Overview
- Challenges with adopting MBD/MBE
- Lessons Learned
- Customers: DoD, Industry
- Beyond 3D PDF: MBEWeb

Anark Corporation

Leading provider of visual collaboration software and solutions to industry leaders since 2000

Empowering Model Based Enterprise & Digital Thread revolutions within Aerospace, Defense, Automotive, Energy, Industrial, Electronics, and Medical Equipment Sector

Most capable, production-proven **automated data transformation and publishing platform** on market today.

Founding member of the **3D PDF Consortium**

Growing, profitable company, with world-wide network of technology, integration, and channel partners

Anark Corporation HQ in Boulder, Colorado

Offices, Dev & Integration Partners in multiple locations in North America, EU, and India

Anark Technology, Integration, Reseller Partners

Implementation & Integration

Geometric
An HCL Technologies Company

TATA
TATA CONSULTANCY SERVICES

QUEST
BORN TO ENGINEER

ITC INFOTECH
Business-friendly Solutions

SARATECH
Engineering and Management Solutions Provider

CAD, PLM, ERP Technology Integration

SIEMENS PLM SOFTWARE
SIEMENS

DASSAULT SYSTEMES

PTC

SolidWorks

AUTODESK.

ORACLE

Software Development

AUTODESK.

SolidWorks

Geometric
An HCL Technologies Company

Reseller-Commercial

Geometric
An HCL Technologies Company

CADD EDGE
Engineering Simplified

ITI
International TechneGroup

PLM GROUP
Experience 3D

Digital Thread / Model Based Enterprise Key Terms

- **Digital Thread**

  Communication framework that allows a connected data flow and integrated view of the asset's data throughout its lifecycle across traditionally siloed functional perspectives.

  The digital thread concept raises the bar for delivering *"the right information to the right place at the right time."* – Industry Week

- **3D MBE – Model Based Enterprise**

  Reuse of 3D engineering (MBD) outside of 3D CAD systems, including dimensions, tolerances, annotations, views for more effective communication and collaboration, including

  3D model-based assets, TDPs, inspection plans/reports, RFQs, manufacturing process, field service

  "A fully integrated and collaborative environment founded on 3D product definition detailed and shared across the enterprise; to enable rapid, seamless, and affordable deployment of products from concept to disposal." – Model-Based-Enterprise – Powered by UILABS

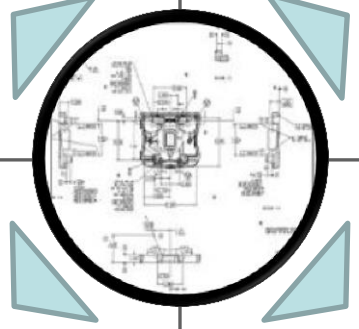
Why the Digital Thread? - Extended Enterprise Challenges w Data Exchange & Collaboration

Engineering

- Significant rework in creating 2D design deliverables
- Supplier data package is not in sync with the Engineering release data
- Protecting intellectual property across global supply chains

Manufacturing

- Difficult to understand instructions
- Instructions are not up-to-date and incomplete



Supply-Chain Collaboration

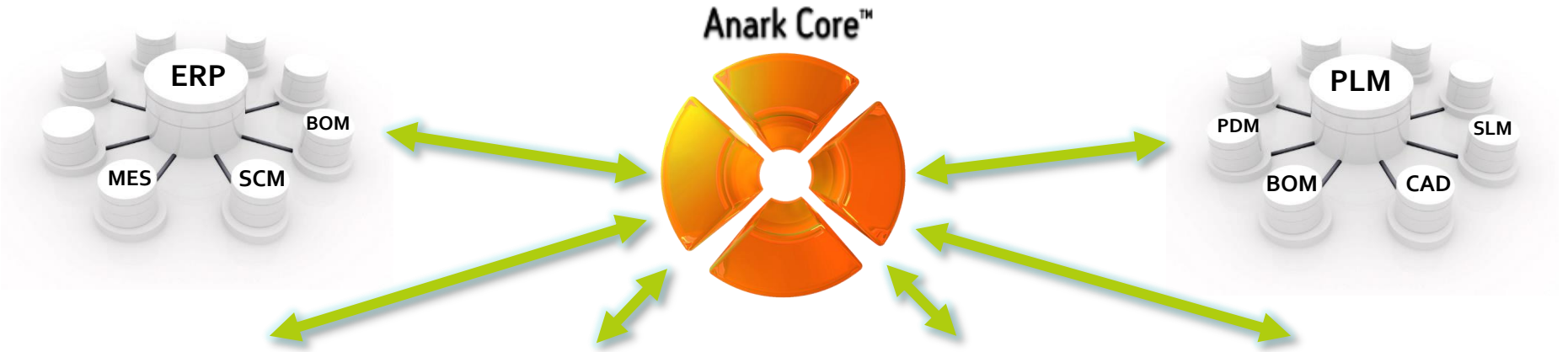
- Incomplete and out-of-date data to supplier
- Ad-Hoc, Mostly Manual Supplier Collaboration Practices
- Longer Supplier Turnaround time

Quality Process

- Key Characteristics not readily identifiable
- Hard to incorporate data manually

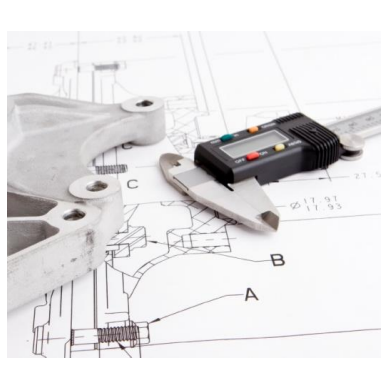
Anark Core: Generate Technical Content for the Extended Enterprise

Provide the right data, in the right form, to the right people, at the right time

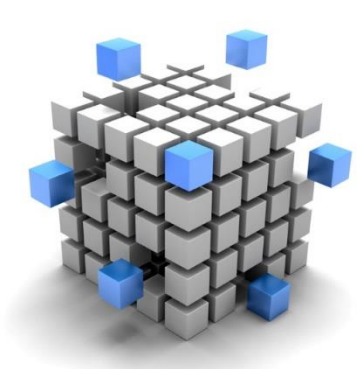


Engineering Release

Supply Chain



Quality Inspection



Manufacturing

Field Service

Anark MBEWeb: Digital Thread Across the Extended Enterprise

Extension Of Anark Core Technology Platform

Visual Collaboration for the Knowledge Worker

- Allows siloed knowledge workers across the extended enterprise to communicate and collaborate with fit-for-purpose, authoritative technical web content from any device.
- Publish content with Anark Core into MBEWeb with up-to-date content derived from PLM, ERP, and other critical data sources.
- Built with scalable cloud technologies that can be installed on-premise, with access control established from PLM, ERP, or independently from MBEWeb, insuring the protection of authoritative technical content.

Challenges/Lessons Learned – Questions Posed?

- What is the impact on industry to replace traditional 2D drawings with 3D PDF's?
  - Implementing 3D PDF's on the shop floor, increase/decrease in time to bid on a contract, interpretation of technical data, demand for paper printouts still?
- What investment is needed to implement 3D PDF's into industrial facilities?
  - Laptop computers on the shop floor, training, increase server capacity, etc?
- Are there savings in time and/or cost associated with implementing 3D PDF's?
  - If so, what are these and can examples be provided.
- What is industry saying are the pro's and con's of 3D PDF's?
  - No sugar coating 3D PDF's, what are the real challenges industry is having?

Challenges and Lesson Learned – Anark's experience

- Exec Sponsorship critical to successful MBE process change
- Upfront investment includes Software, Infrastructure, Process & Culture Change.
  - Use "Crawl, Walk, Run" phased approach
- Engineering MBD best-practices must be designed with downstream MBE requirements in mind, constraining the use of available CAD MBD modeling features
- People still want to be able to print.
- Specific 3D PDF challenges
  - Mobile Platform Support Lacking
  - Large Assembly performance Limitations
  - Markup and Collaboration Tools Difficult to Use
  - Limited Acrobat Forms UX toolset constrains UX design

3D MBE & Digital Thread Performance Benefits

ANARK

***Sources**: Benchmark & research studies presented by LNS Research, US Navy Naval Air Command, and National Institute of Standards & Technology (NIST)*

3D Model Based Enterprise Process Benefits

	Performance Benefits	MBE Contributors to Savings
1	**Easier to Accurately Interpret Information**	• Accelerates execution of process steps and overall pace of assembly. • Eliminates costly errors caused by misinterpretation.
2	**30% Reduction in Tooling Design & Fabrication Costs**	• There is no need to remodel the original design (typically from 2D Drawings) around which the Tooling/fabrication processes will be designed • 'Original engineering design intent' is more easily and quickly understood by the tooling designer
3	**10% Reduction in Overall Assembly Time**	• Complete Assembly process can all be seen within 1 - 3D PDF MBE document. • The exact assembly process, animated in 3D leaves less room for shop floor confusion or delays
4	**20% Reduction in Manufacturing and Supplier Scrap and Rework**	• Manufacturing and Supplier process documents automatically updated when an Engineering change or new version occurs • Both Manufacturing and Quality gain a much clearer idea of the Engineering Designers Key Characteristics, Important Assembly Datums and Sequence

***Source**: US Dept. of Defense, Analyst reports & studies presented at conferences*

Anark DoD Customers

- US Army – ARDEC – Creo, Windchill
  - Rock Island Arsenal - Technical Data Packages (TDPs)
  - Picatinny – TDPs, Work Instructions
  - Benet Labs – Model Based Work Instructions (MBWI)
- US Navy
  - NAVAIR Lakehurst - TDPs; Creo, NX and Windchill. Adding SolidWorks, CATIA, ENOVIA and Teamcenter
  - NAVAIR PMA 261 - ENOVIA + CATIA
  - NAVAIR FRCE - TDPs, Work Instructions (pilot) – Teamcenter, NX, Creo
- US Air Force –
  - Hill – Parts Provisioning Reports, TDPs
  - Robins - TDPs
  - Yulista - TDPs, MBWI

Select Anark Deployments – Non DoD

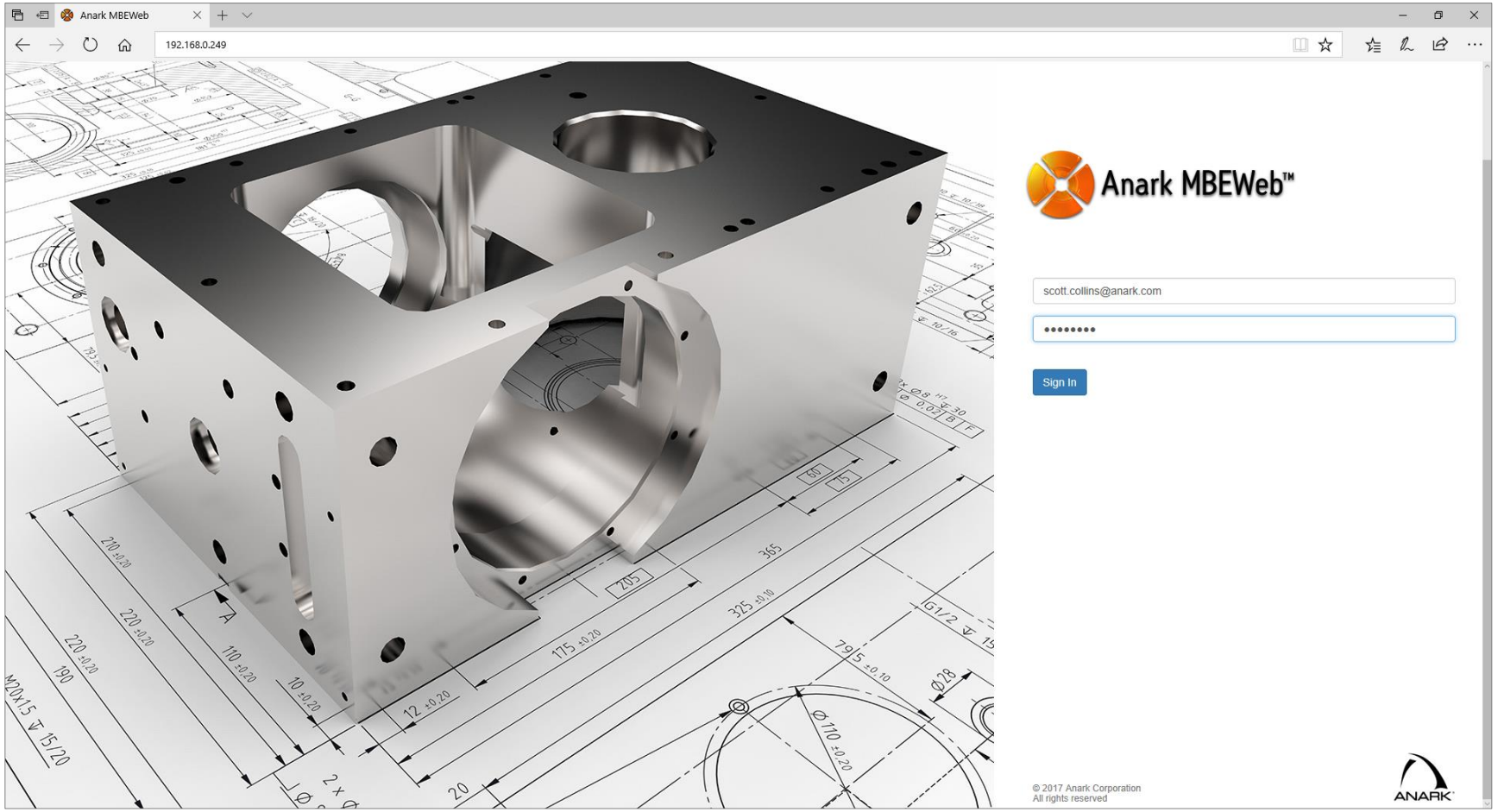
Aerospace & Defense Manufacturing:

- Raytheon – TDPs, Quality Inspection Plans, First Article Inspection documents, MBWI
  - RMS, SAS, IDS, IIS Divisions
- Boeing – A10 Wing Replacement Program
  - 3D PDF Parts Provisioning Reports, TDPs delivered to DoD DLA and used by Hill AFB
- Lockheed-Martin
- Honeywell – TDPs, MBWI
- General Dynamics – TDPs
- Cubic Defense – MBWI
- Ball Aerospace – TDPs

Commercial Manufacturing:

- General Electric –TDPs, Supply Chain Collaboration - 3D PDF and MBEWeb
  - Power, Aviation, Oil & Gas, Healthcare, Transportation
- Boeing Commercial – TDPs
- Rolls-Royce – TDPs, MBWI upcoming
- Navistar - TDPs
- CSR-Sifang – MBWI, TDP
- TE Connectivity (Tyco) – TDPs
- Cisco – TDPs
- Ericsson – TDPs
- Allison Transmission – Engineering Release

DEMO --- MBEWeb: Technical Collaboration for the Extended Enterprise



Thank You!

Jim Merry | Senior Director, Enterprise Sales | jim.merry@anark.com | 240 674 5547

Anark Product Line

Anark Core Server: Automated publishing server software with SOA for recipe-based transformation and publishing. Combine authoritative enterprise data from PLM and ERP, with advanced CAD integrations for NX, Creo, CATIA, SolidWorks, and Inventor.

Anark Core Workstation: Desktop software for defining server-side publishing “recipes”, as well as SME authoring for manual content generation. Combine enterprise data from PLM and ERP, with advanced CAD integrations for NX, Creo, CATIA, SolidWorks, and Inventor.

Anark Core SDK: Integration software development kit for connecting Anark Core software to other enterprise data sources and workflow engines.

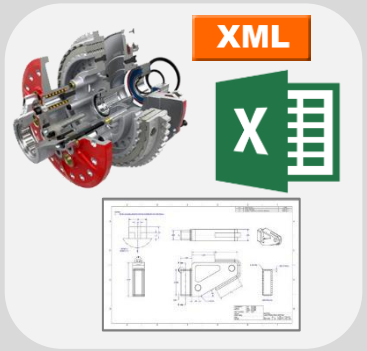
Anark Core Integrations for PDM: Reference integration code for **Teamcenter**, **Windchill PDMLink**, **ENOVIA**, and **SolidWorks EPDM** for workflow-driven, recipe-based publishing automation.

Anark MBEWeb: Cloud-based software that hosts template-driven, technical HTML5 content inside the firewall for all supported downstream use cases, with search and collaboration capabilities for knowledge workers throughout the extended enterprise.

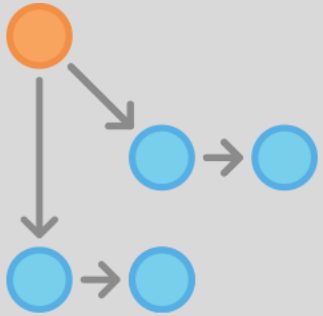
Anark Recipe Based Publishing for the Digital Thread

Anark Core™

Technical Data

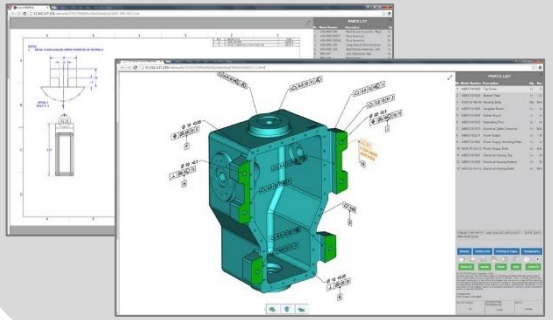


Recipe Actions



Anark MBEWeb™

HTML5: Use-Case-Specific Technical Content



Consume & Collaborate

PLM, ERP

PDF

PLM, ERP, MES, SLM, IOT

Advanced PLM and Systems Integration with Anark Platform

Automation Workflow:

1. Anark Core automation recipe is authored with Anark Core Workstation, deployed to Anark Core Server.

---

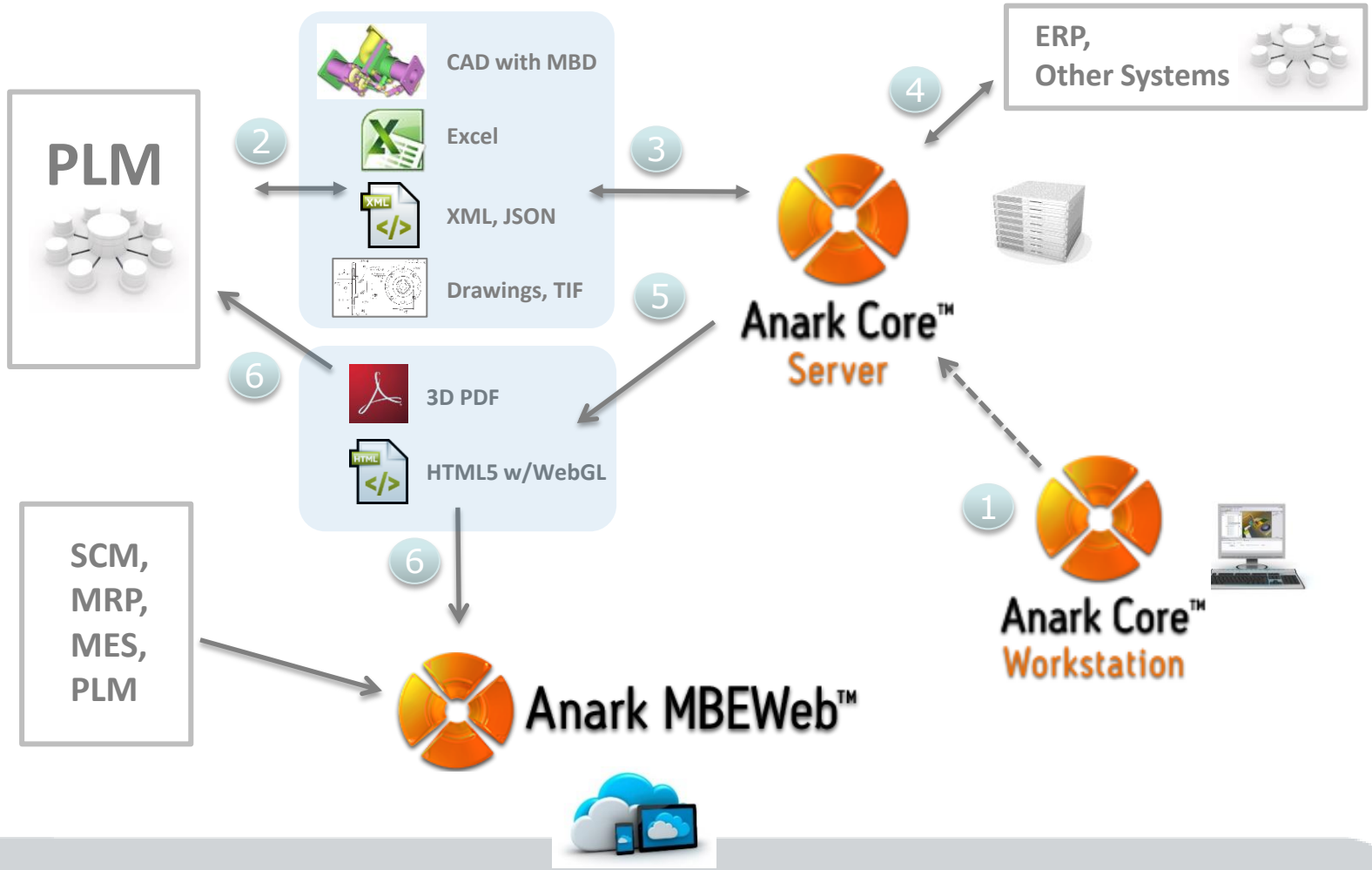
2. PLM workflow triggers Anark Core Integration for PLM, extracts PLM files and data.

3. PLM integration requests that automation recipe is run, typically using a designated recipe and template.

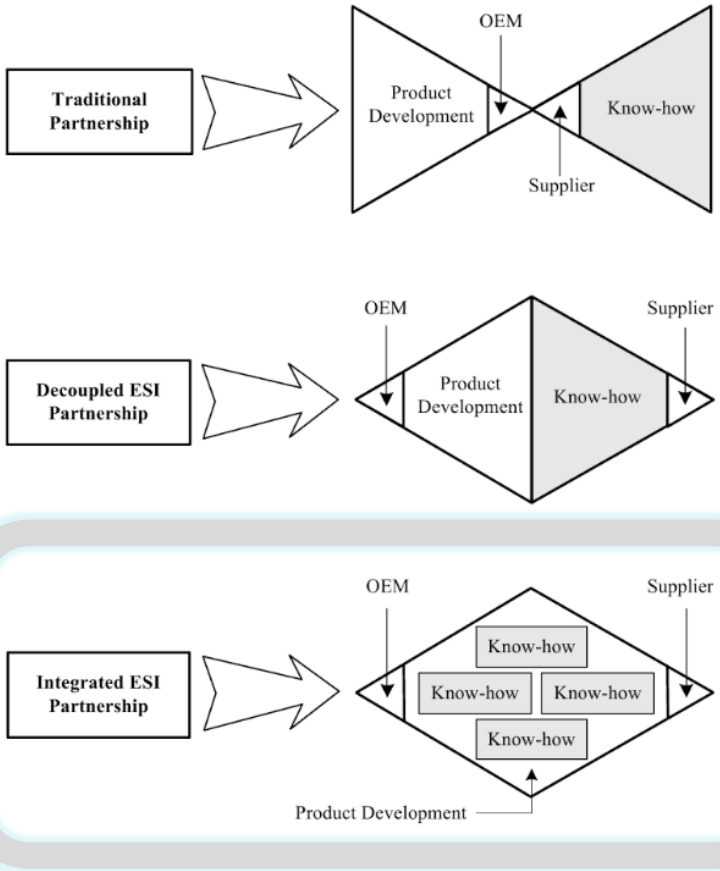
4. Exogenous data may be incorporated during publishing.

5. HTML or PDF content is published from Anark Core Server.

6. HTML content is hosted by Anark MBEWeb with downstream collaboration. PDFs are imported into PLM system for access and release control.



MBEWeb for Supplier Integration

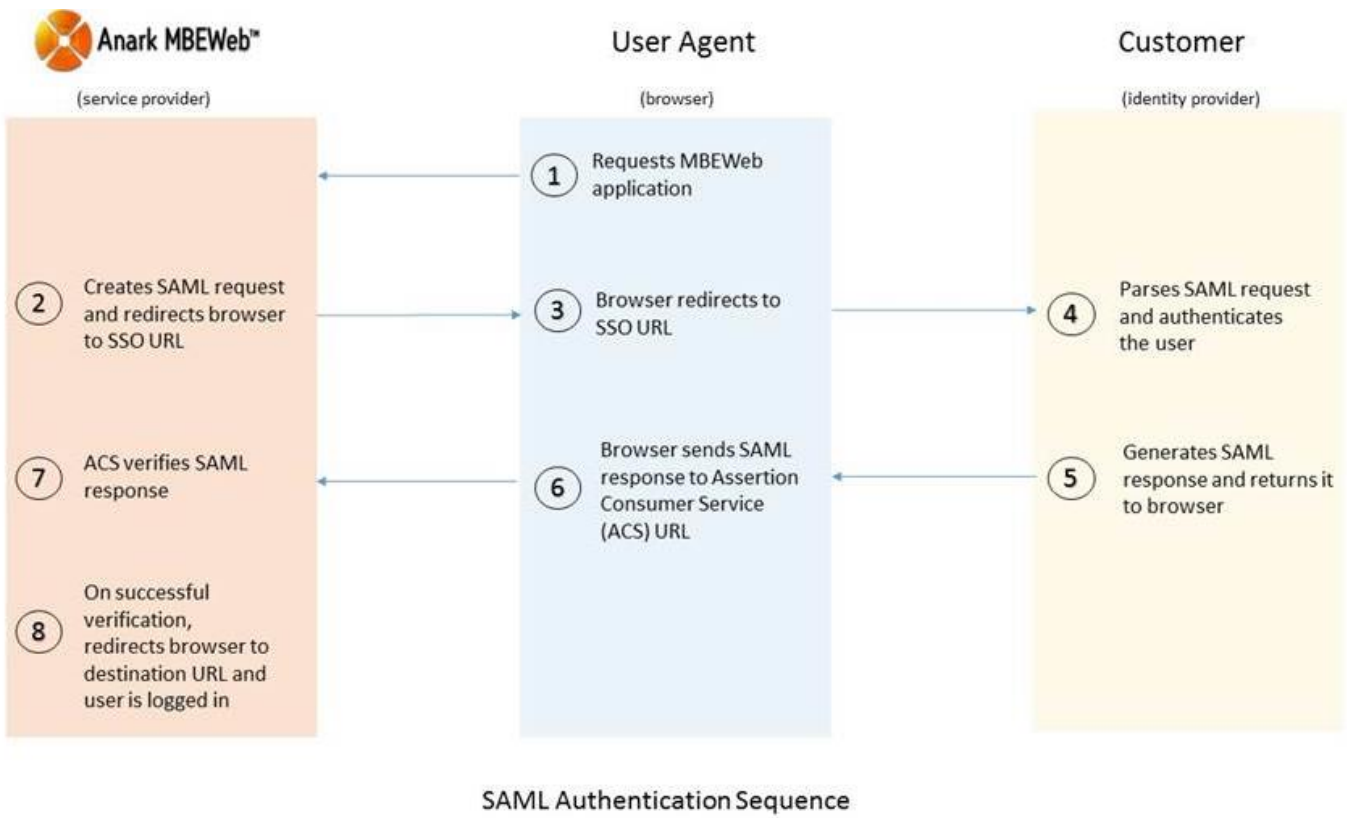


Anark MBEWeb™

- **OEM-to-supplier integration can significantly drive down product costs by**:
  - Increasing knowledge share,
  - Solving technical problems more quickly,
  - Increasing bid participation,
  - Identifying and reducing supplier capability risks, and
  - Reducing product delay risks.

Collaborative Design and Planning for Digital Manufacturing, Lihui Wang, Andrew Yeh Ching Nee, Springer, 2009

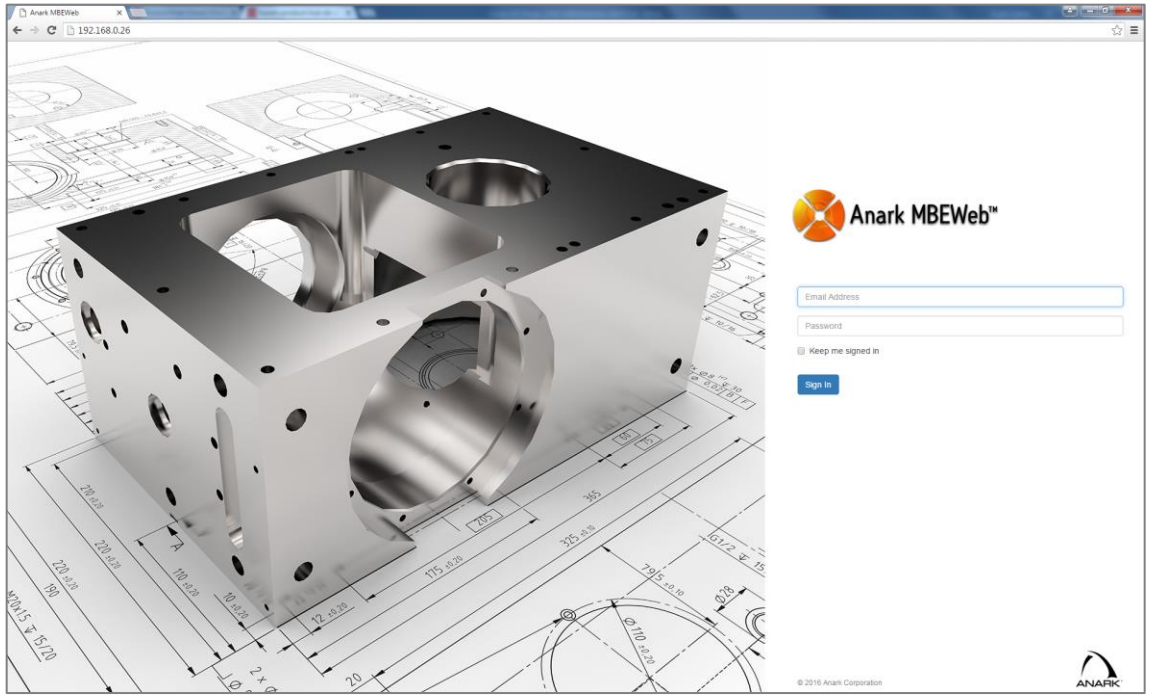
MBEWeb Security and Authentication



SAML Authentication Sequence

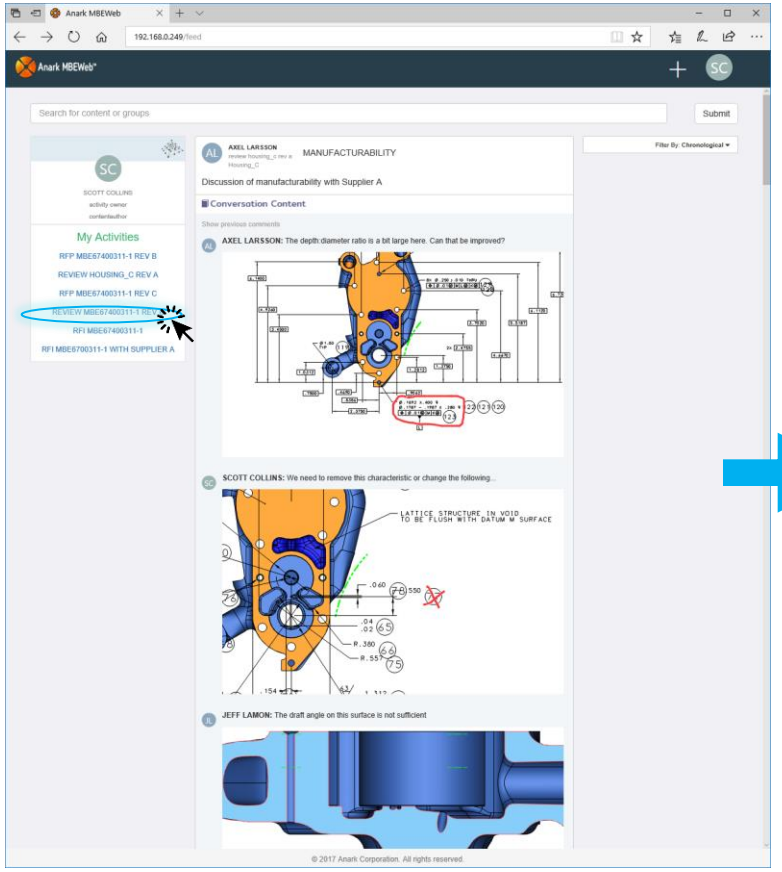
- Anark MBEWeb uses a flexible cloud technology stack operating on Linux:
  - MongoDB (database),
  - Node.js (application server), and
  - NGINX (web server).
- Supports authentication integration via SAML, LDAP, Local Account, and WAM (Siteminder, etc.)
- MBEWeb content is published with privileges integrally defined by publishing workflow.

MBEWeb Differences from PLM, Custom Portals, SharePoint

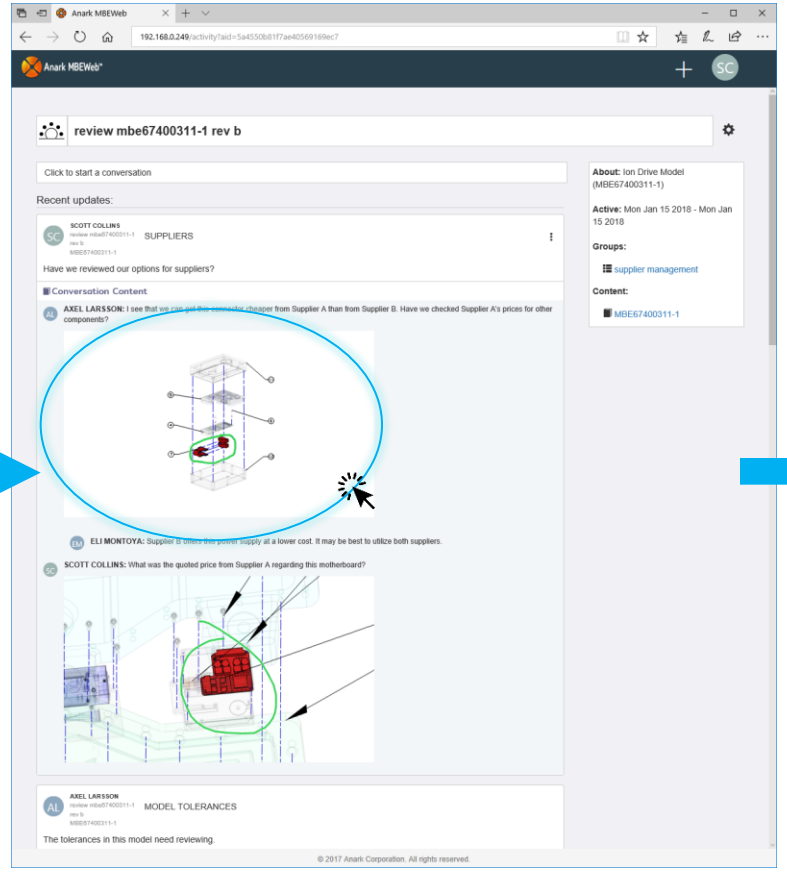


- **Inexpensive compared to PLM licenses and custom portals**. Allows the system to be used widely across the extended enterprise.
- **Easy to deploy, easy to use system** does not require specialized user training, with substantially reduced IT and user-support costs.
- **Generate role-and-use-case-specific content** such as TDPs from PLM for supplier integration, instead of hunt and peck for documents. More efficient access to critical data.
- **Content can be accessed from virtually any device**, anywhere in the enterprise: supply chain, manufacturing, field service. Allows flexibility with paperless access.
- **Integrated content-centric collaboration** supports critical technical conversations within the extended enterprise. More efficient than document, email, and web conferencing collaboration.

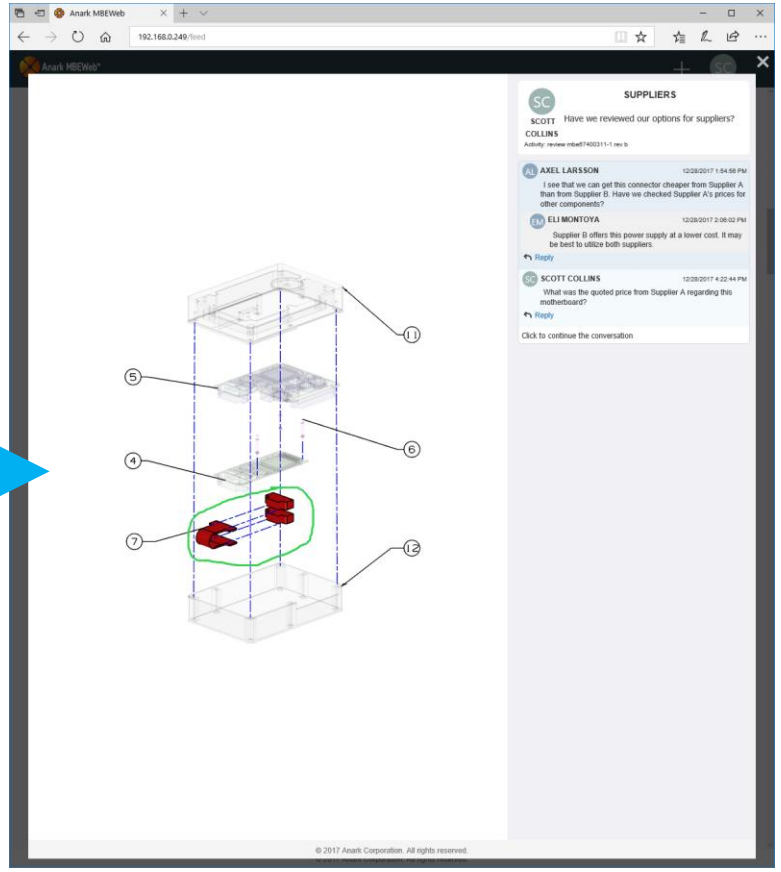
MBEWeb: Technical Collaboration for the Extended Enterprise



From the News Feed, select an Activity on which to focus.



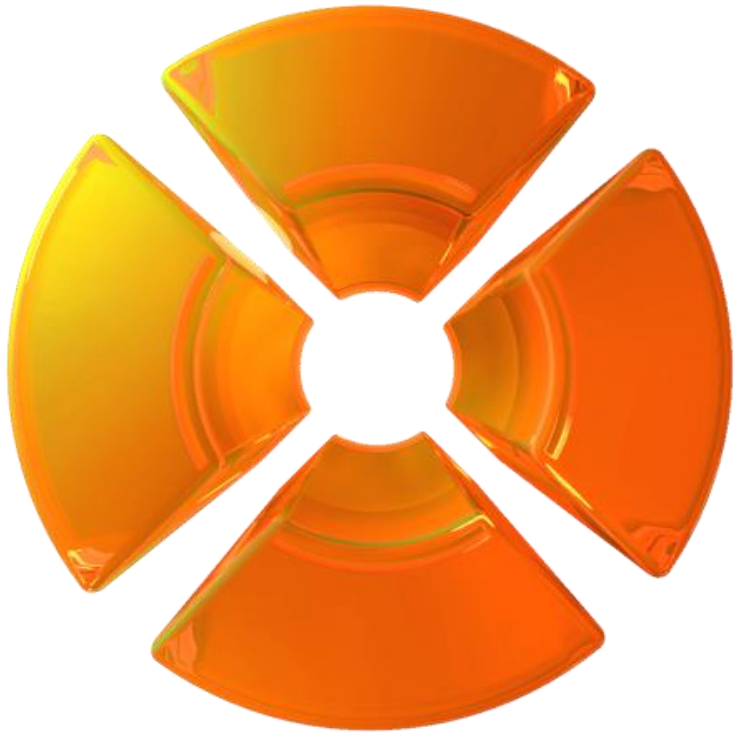
Click on the Activity News Feed to take a closer look.



Review comments and markup, reply, or add a new comment.

Publishing Automation and Collaboration Capabilities

- Recipe-based publishing automation, with multi-data support for 2D and 3D content, including support for advanced 3D MBD
- Packaging of MBEWeb HTML or PDF technical data packages (TDP) for downstream consumption in supply chain
- Web-based technical content management and collaboration with MBEWeb, with secure access and support for mobile
- Management of MBEWeb HTML or PDF dynamic data markings such as distribution notices and watermarks
- Control of custom attribute schemas for MBEWeb HTML or PDF content, without republishing content
- Extraction of PDF comments and form-fields data to databases
- Integrations for all major PLM systems supporting automated publishing



3D MBE & Digital Thread Performance Benefits – References

	Performance Benefits	MBE Contributors to Savings
1	**Easier to Accurately Interpret Information**	• Accelerates execution of process steps and overall pace of assembly. • Eliminates costly errors caused by misinterpretation.
2	**30% Reduction in Tooling Design & Fabrication Costs**	• There is no need to remodel the original design (typically from 2D Drawings) around which the Tooling/fabrication processes will be designed • 'Original engineering design intent' is more easily and quickly understood by the tooling designer
3	**10% Reduction in Overall Assembly Time**	• Complete Assembly process can all be seen within 1 - 3D PDF MBE document. • The exact assembly process, animated in 3D leaves less room for shop floor confusion or delays
4	**20% Reduction in Manufacturing and Supplier Scrap and Rework**	• Manufacturing and Supplier process documents automatically updated when an Engineering change or new version occurs • Both Manufacturing and Quality gain a much clearer idea of the Engineering Designers Key Characteristics, Important Assembly Datums and Sequence

John Schmelzle – NAVAIR – 2013 NIST MBEsummit
https://www.nist.gov/sites/default/files/documents/el/msid/2Schmelzle_MBD.pdf

LNS Research – December 2014
Understanding the Digital Thread in Aerospace & Defense
http://blog.lnsresearch.com/blog/bid/203158/Understanding-the-Digital-Thread-in-Aerospace-Defense-INFOGRAPHIC

ASME Publication – March 2016
Testing the Digital Thread in Support of Model-Based Manufacturing and Inspection
http://ws680.nist.gov/publication/get_pdf.cfm?pub_id=919497

3D PDF - The standard for TDP's

3D PDF Consortium

Phil Spreier – Technical Director

THE 3D PDF CONSORTIUM

- A ***community*** dedicated to driving adoption of 3D PDF enabled solutions through:
  - Defining industry needs and priorities
  - Administering and providing input to the PDF standards
  - Testing and validating PDF in engineering workflows
  - Creating recommended practices and other resources
  - Raising awareness
- A worldwide, non-profit, member organization
- Open to all companies

THE 3D PDF CONSORTIUM

Our Members

- Manufacturing companies
- Software developers
- Government organizations
- Universities
- Associations

THE 3D PDF CONSORTIUM

The PDF Standards Development Organization (SDO)

- The international developer of PDF standards
  - Experts in PDF and engineering
  - The ANSI Accredited Standards Developer for

PDF	(ISO 32000)
PDF/A	(ISO 19005)
PDF/E	(ISO 24517)
PRC	(ISO 14739)
PDF/UA	(ISO 14289)

  - US TAG Administrator and Secretariat to ISO TC 171 SC 2
  - Non-profit

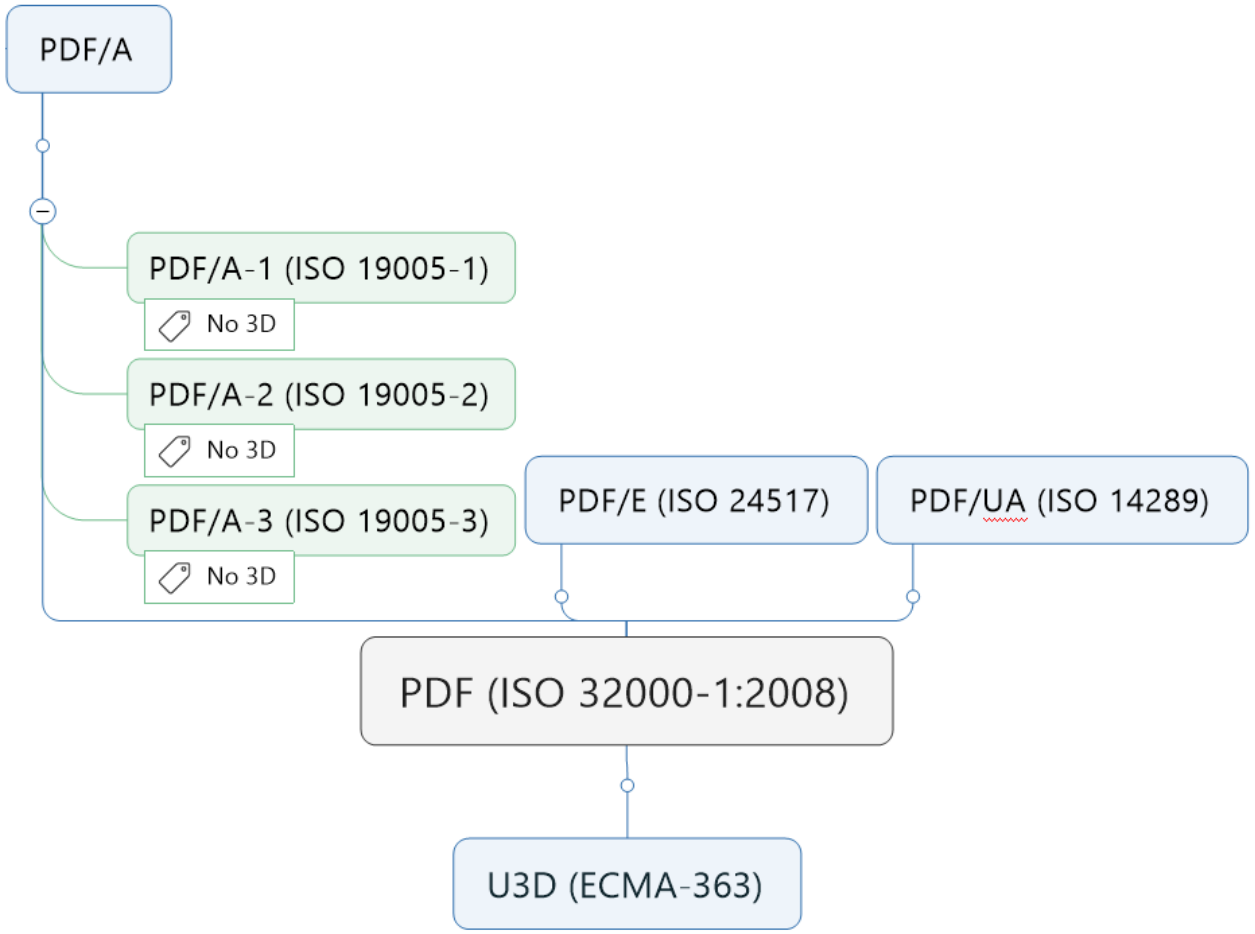
3D PDF IMPLEMENTOR FORUM (3DPDF-IF)

Testing and Recommended Practices

- Goal is ensure the quality and usability of 3D PDF in engineering workflows through cooperative testing
- Forum defines specific PDF Technical Data Packages and members develop example files
- Files are tested and validated in a cooperative and confidential manner
- Results are used as input for *Recommend Practices* documents
  - *Using 3D PDF with MIL-STD-31000A*

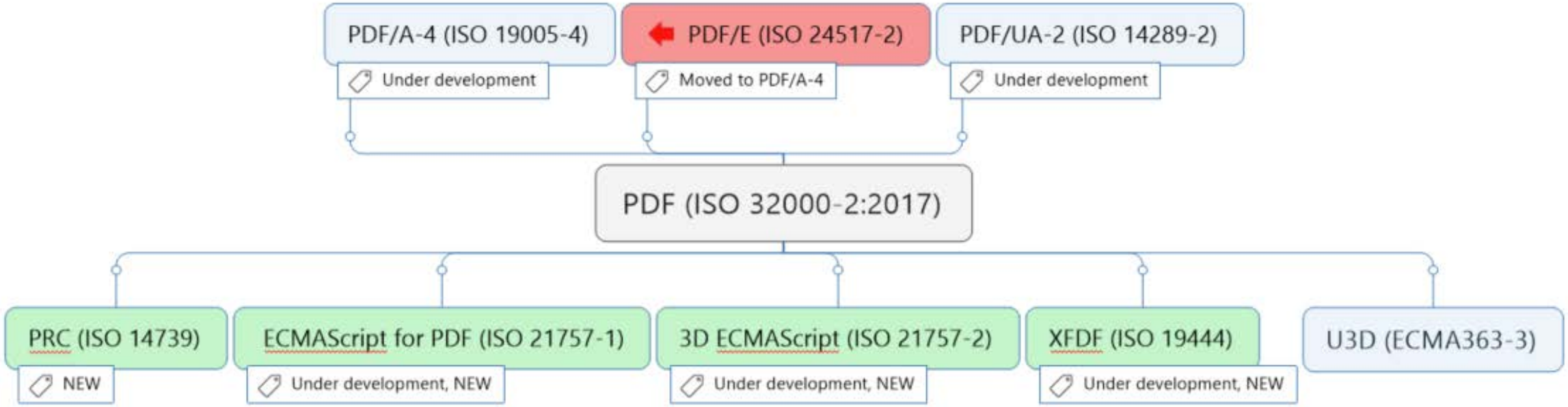
PDF STANDARDS

PDF-1



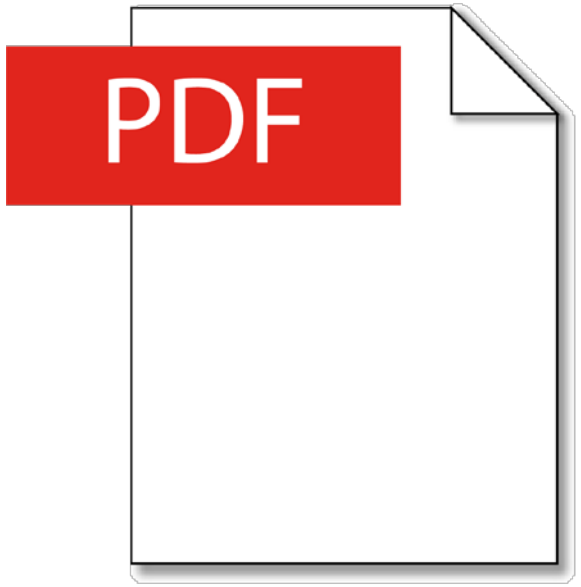
PDF STANDARDS

PDF-2



INSIDE PDF

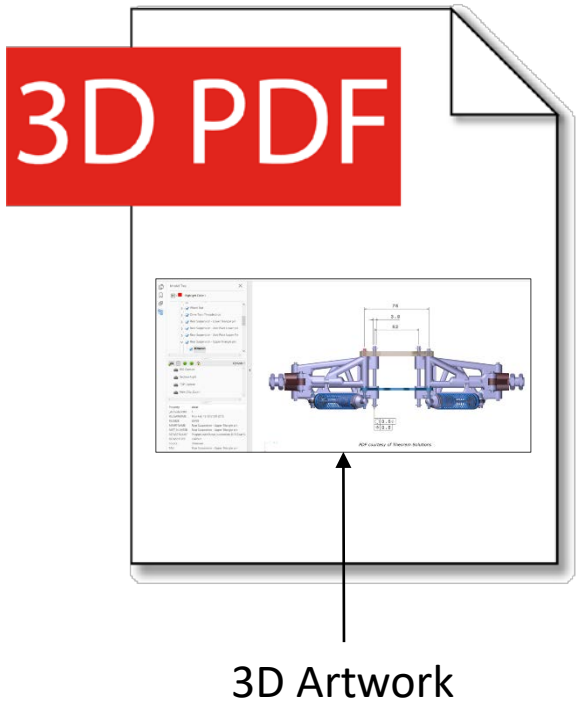
ISO 32000



- **Presentation**
- **JavaScript**
- **Markup (XFDF)**
- **Metadata (XMP)**
- **Forms**
- **Attachments**
- **Security**

INSIDE 3D PDF

ISO 32000



- Presentation
- JavaScript
- Markup (XFDF)
- Metadata (XMP)
- Forms
- Attachments
- Security

- **3D Artwork (model)**
- **3D JavaScript**
- **3D Markup (XFDF)**

ENGINEERING DOCUMENTATION LANDSCAPE

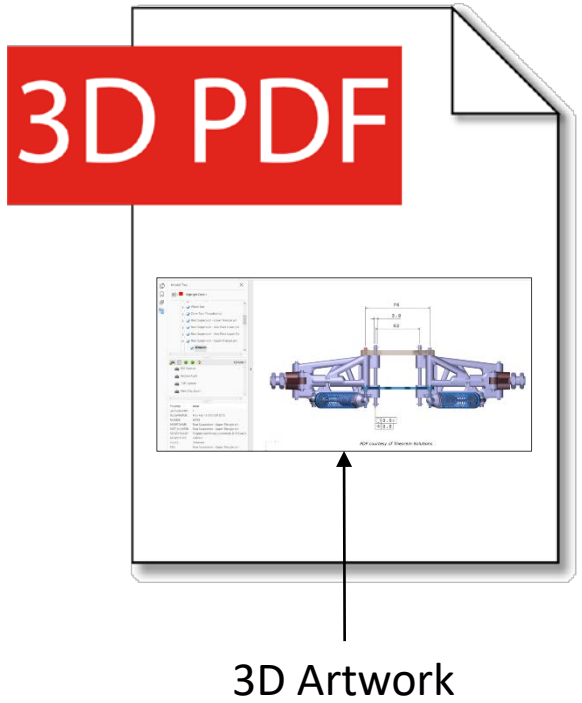
2017

- 3D PDF currently published natively from:

- 3D PDF Solutions available for most popular CAD programs
  - Autodesk AutoCAD®
  - CATIA ™
  - Siemens NX™


HOW TO START A
MOVEMENT
TEDTALKS

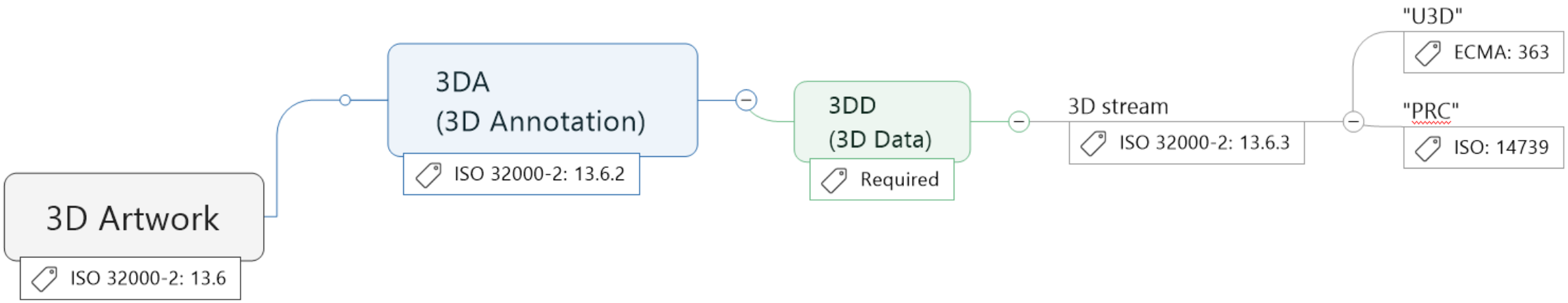
OUR MOVEMENT



Add STEP (AP-242) as a 3D Stream in PDF

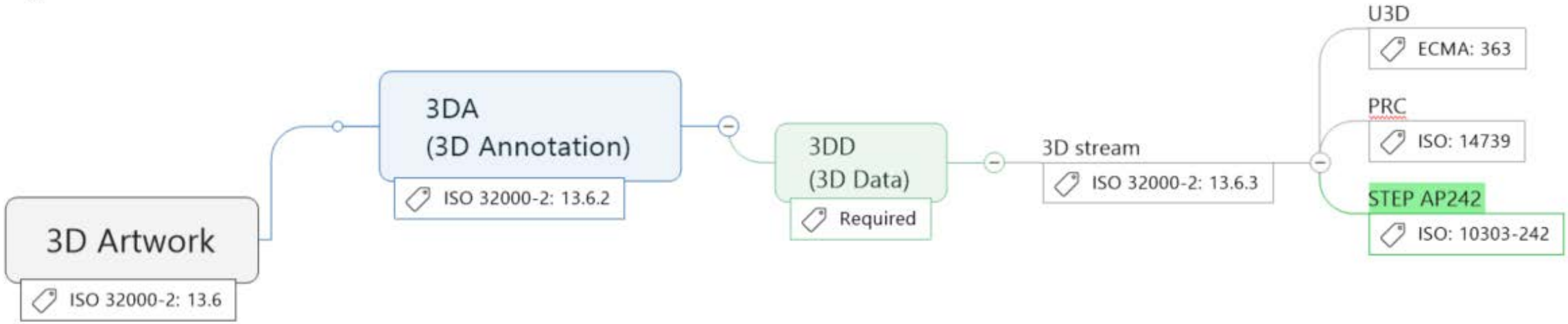
WHAT DOES THAT MEAN?

ISO 32000:2



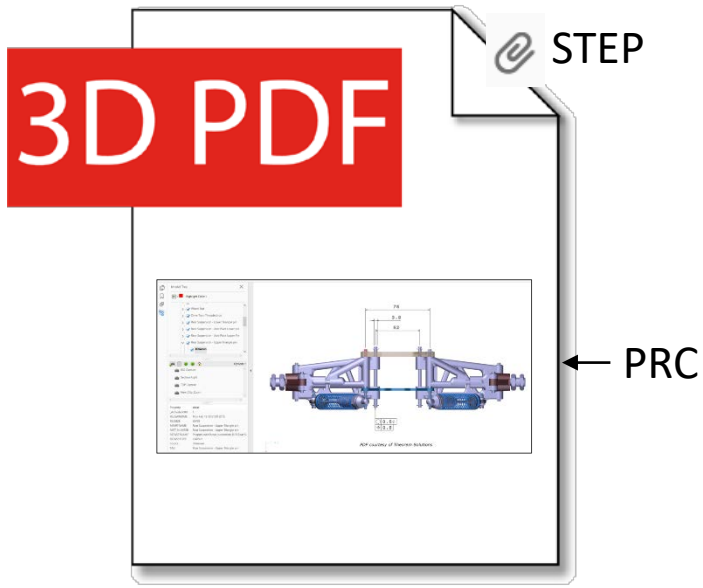
WHAT DOES THAT MEAN?

ISO 32000:AWESOME



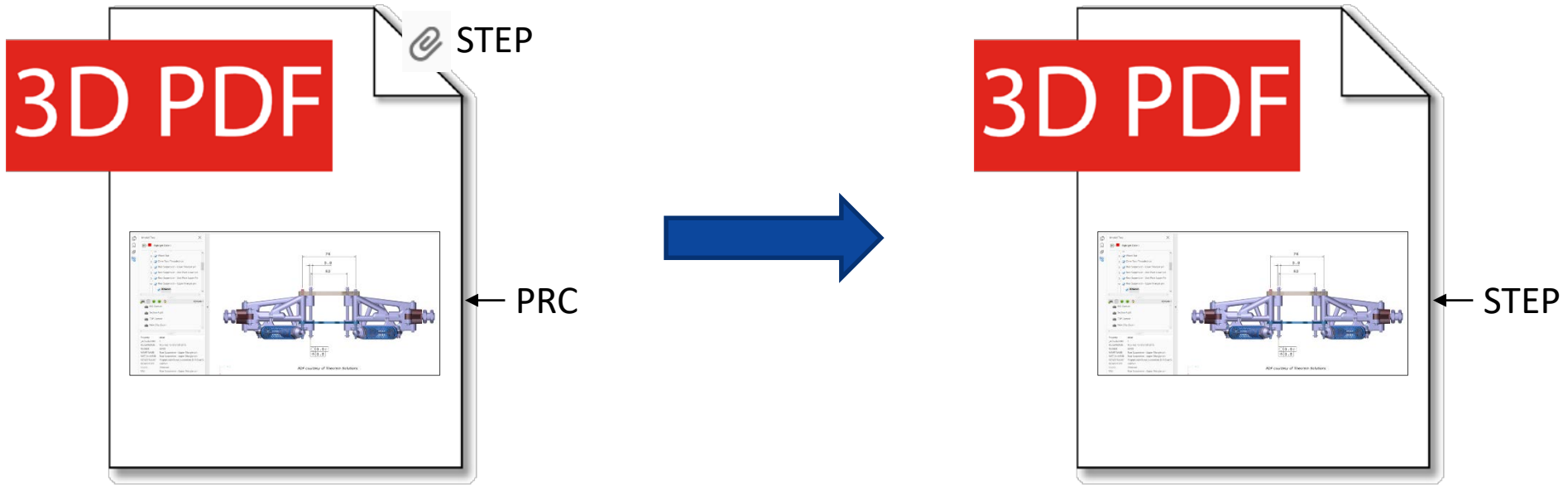
WHAT DOES THAT MEAN?

Todays PDF TDP



WHAT DOES THAT MEAN?

The Future of PDF TDP



HOW CAN WE POSSIBLY DO THIS?

- Change the Standard (ISO 32000)
  - Currently working with TC 184 SC 4 (STEP) to develop proposal - March
  - Propose New Work Item (NWI) – April
  - Develop the standard (18 – 36 months)
    - Pending approval of NWI ballot
- Promote Adoption
  - 3DPDF-IF
    - Test Round 3 – MIL-STD-31000B
    - Test Round 4 – MIL-STD-31000B w/STEP 3D Stream

HOW CAN YOU HELP?

- Take our 3D PDF Survey (https://www.surveymonkey.com/r/3dpdf_2017)
- Tell us what you think about our idea
- Be part of our movement
  - Participate in the 3D PDF Consortium
    - Low entry fee, high value
  - Provide input to the 3D PDF Implementor Forum

FIND OUT MORE

- Visit the 3D PDF Consortium website:
  - www.3dpdfconsortium.org
- Contact
  - phil.spreier@3dpdfconsortium.org
  - jerry.mcfeeters@3dpdfconsortium.org

THE VALUE OF PERFORMANCE.

NORTHROP GRUMMAN

Protection of IP in Model-Based Engineering Deliverables

DoD/NIST/Industry 3Di PDF TDP Workshop

31 January 2018

Robin Pruss

Engineer, Northrop Grumman Corporation

Summary of Slides

NORTHROP GRUMMAN

- Models are made of intellectual property
- Strategies for intellectual property management
- Encourage sensible TDP requests by default
- Modernize marking methods for models
- Expect list of assertions of limited data rights to grow over the course of a contract

Models are Made of Intellectual Property

NORTHROP GRUMMAN

- Unlike 2D drawings or printed documents, models may:
  - Be aware of how they were created, by whom
  - Contain design rules or merit functions defining what is “good” or “bad” about an approach or solution set
  - Include artifacts from other iterations of a design, past or future
  - Have comments or notes that were meant for internal knowledge capture and lessons-learned usage
  - Be able to generate new content using embedded intelligence
- Creating models uses Intellectual Property, including:
  - Trade secrets, best practices, institutional knowledge
  - Results of internal studies, expensive material testing
  - Existing patents, new inventions, proprietary information
  - Government-furnished information, firewalled information

All-Inclusive Models = All the IP in One Place

Strategies for Intellectual Property Management

NORTHROP GRUMMAN

- DoD Intellectual Property strategy per 2014 brochure:
  - Acquire a Technical Data Package created with funding provided on a contract, including associated rights needed to use the data
  - Use the TDP to maintain, sustain, repair, re-compete, or replace a technology
  - Limit risk of being locked-in to one supplier – reduce cost over lifecycle of a system

- Industry Intellectual Property strategy in DoD contracting (generically):
  - Preserve competitive advantages created in the course of development efforts under USG contracts – typically by limiting disclosure & use of technical data & computer software by other industry contractors *to only those activities required for performance of the contract* (example: NDA)
  - For IP developed solely with private funding, as provided for in DFARS, assert limited/restricted rights or government purpose rights in technical data & computer software deliverable under USG contracts
  - Comply 100% on contract terms/deliverables to the DoD customer: do not "over deliver"
    – or – as requested by customer and as appropriate,
    Consider priced options for delivery of greater rights in privately funded IP

Could TDP Definition Support Both Strategies?

Encourage Sensible TDP Requests by Default

NORTHROP GRUMMAN

- Tendency to “Check all the boxes” and “ask for everything”
  - Is there value gained from seeing artifacts contained in native CAD?
  - Inadvertently specifying use of a different CAD tool drives up costs of system
  - Seemingly straightforward requirement is too dependent on individuals’ tool setup to meet – similar to opening an MS Office file and flagging no spelling errors:

> d. Digital submittals shall open in the appropriate software without regeneration errors.

- Streamline MIL-STD-31000B TDP Option Form so that checking all the boxes results in a sensible deliverable
  - What set of data is already created, and useful to have in most situations?
  - What quality of delivered data is required for it to be useable?
  - What range of file formats and tool sets are acceptable, keeping in mind that even one supplier can have a variety of MCAD and ECAD systems deployed in-house?

☐ NATIVE 3D CAD (SPECIFY TYPE): _____
☐ 3Di VIEWABLE* FORMAT DERIVED FROM 3D NATIVE MODELS (Specify type, i.e. ISO 32000 PDF etc.).
☐ NEUTRAL FORMAT DERIVED FROM 3D NATIVE MODELS (Specify type, i.e. STEP AP203, AP 214 etc.).
☐ 2D DRAWINGS DERIVED FROM 3D NATIVE MODELS (Specify type, i.e. ISO 32000 PDF etc.).
☐ OTHER FORMAT (SPECIFY TYPE): _____

Modernize Marking Methods for Models

NORTHROP GRUMMAN

- Models don't tend to have "pages" or "cover sheets" to mark
- Models contain a mix of data that can all have different asserted data rights, depending on their original sources
- The tool used to open a model can affect which statements/markings are shown and which are hidden
- Showing statements/markings with a click-through whenever a model is opened is inefficient, can be dangerously distracting in the field
- Example: one MCAD tool attempts to standardize Data Rights marking of models using PMI, but currently enforces having only one statement defined per model

What is a good way to mark a model?

Expect List of Assertions of Limited Data Rights to Grow Over the Course of a Contract

NORTHROP GRUMMAN

- At the negotiation of a contract, only currently obvious instances of Intellectual Property are included in the assertions form
- As work on a contract proceeds, expect that more IP will be used that was not originally anticipated by the group of people writing the proposal or contract – part of the natural development process
- Previously, this IP would not be part of the deliverables, however:
  - While it wasn't included in the 2D drawings or "dumb" 3D information, it gets embedded into models created on the contract
  - Redacting information from a model may not be possible, may cause regeneration errors or warnings, and/or may completely break the model or its associations
  - Not delivering a model is not a choice if it was written into the CDRL requirements

Preserve incentives for internally funding development work

Summary of Slides

NORTHROP GRUMMAN

- Models are made of intellectual property
- Strategies for intellectual property management
- Encourage sensible TDP requests by default
- Modernize marking methods for models
- Expect list of assertions of limited data rights to grow over the course of a contract

MIL-STD-31000B is one piece of the IP in MBE puzzle


THE VALUE OF PERFORMANCE.
NORTHROP GRUMMAN