Model Based Definition overview

Introduction and Highlights

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Session Highlights

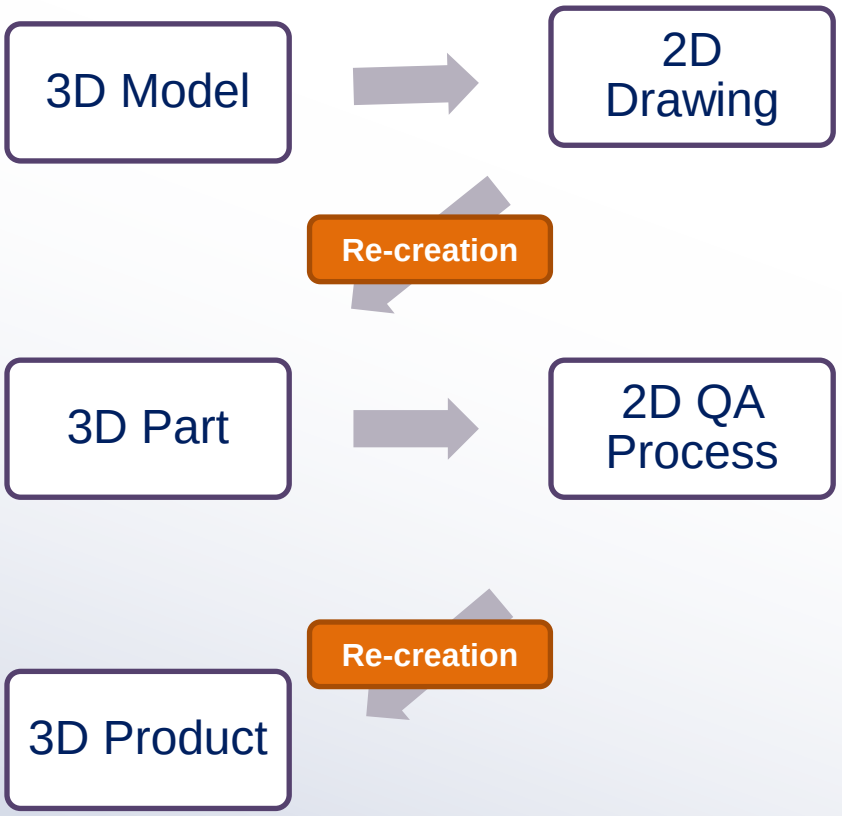
- Different from PLM
- Why MBD?
- What is MBD?
- Why Neutral
- Benefits of MBD
- MBD and AM

Different then PLM

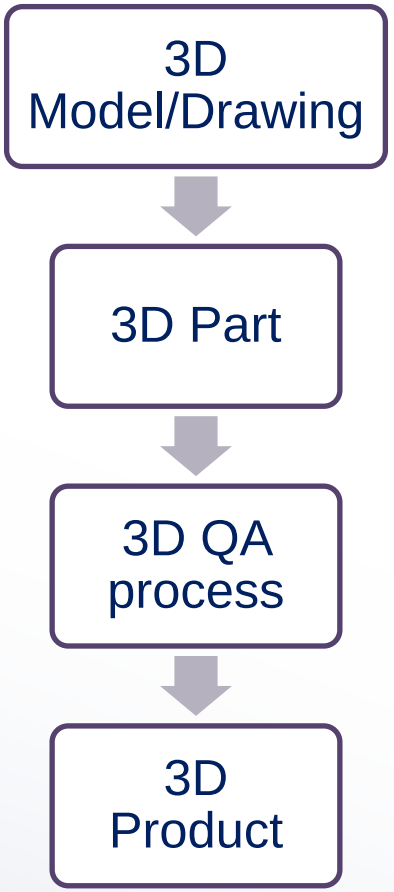
- PLM is an essential part of a model based enterprise
- However, integrating a PLM system alone will not:
  - Create a model based enterprise
  - Satisfy long term archiving requirements
  - Provide a neutral file format
- Provide a TDP with an independent approval indicator (Y14.100M)
  - Per ASME Y14.100, an approval indicator must be:
    - unique to an individual,
    - capable of verification, and
    - under the individual's sole control.

Why 3D MBD

Current design process:



3D Drawing design process:



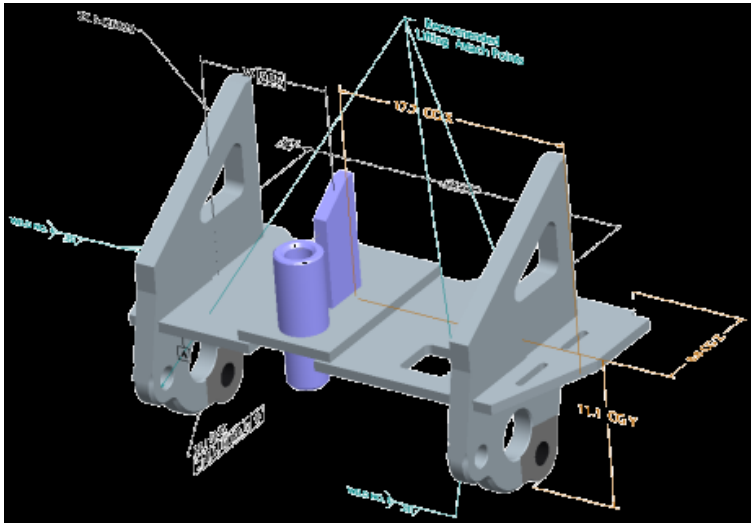
What is MBD?

- Model Based Definition (MBD) is the practice of using 3D digital data (models) combined with other data, such as 3D dimensions and tolerances, within 3D CAD software to provide a technical definition for individual components and product assemblies.
- The goal of MBD is to create 3D technical data packages (TDPs) to be used for manufacture, logistics, and acquisition. .

PDDS vs. MBD in Engineering

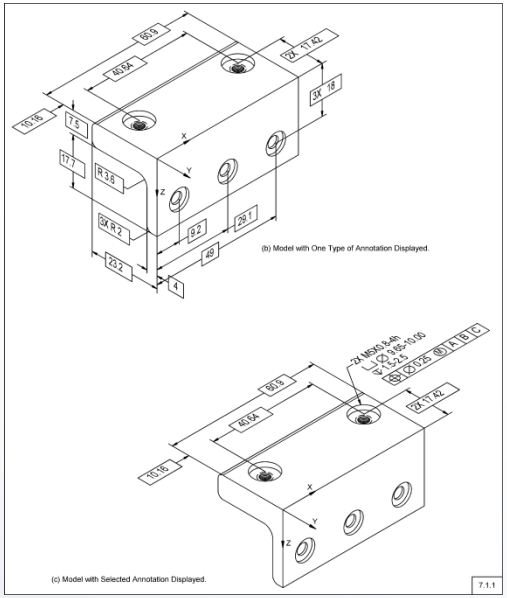
PDDS:

- Fully Annotated Model:
  - Model Used similar to conventional 2D drawing.
  - Fully dimensioned.
  - Part not defined by the model, but is defined by the dimensions on the model.
- 2D Drawing with an Associated Model:
  - Similar to the fully annotated model;
  - Has 2D drawing with associated model.

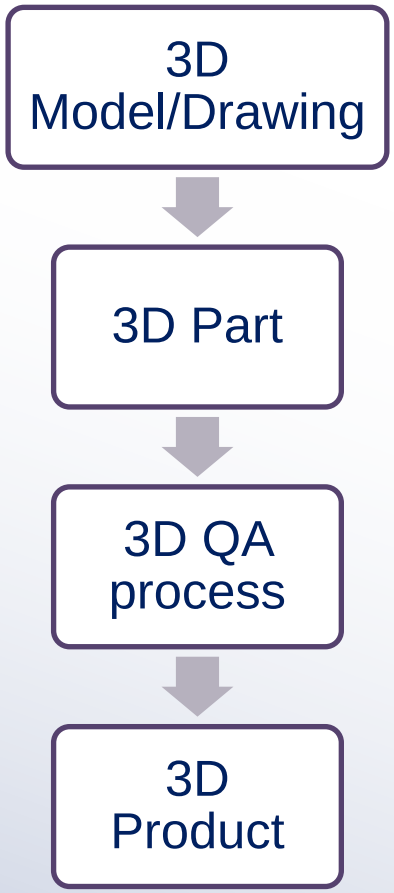


MBD:

- Different from the fully annotated model
- Model itself defines the part
- In true MBD, dimensions are optional and only used at the discretion of the cognizant engineer.
- The model is toleranced geometrically often using surface profile tolarancing.
- Accuracy of model becomes critical.
- Need for Verification



3D TDP Definition at NAWCADLKE



- Sheet 1
  - Critical metadata and traditional drawing information
- Sheet 2
  - 3D visualization file
- Embedded attachments
  - STEP 214 neutral file
    - STEP file used for import to drive downstream CAM equipment
  - Validation certificate

Why Neutral?

- Legal requirement
  - Utilization of a neutral file format eliminates the risk of a legal challenge to a procurement
- Long Term Archiving
  - Typical DoD development life cycle is 20+ years
- Translation Issues

Proprietary and Open Format Considerations

- The intellectual property belongs to the developer regardless of how much detail is provided to the third-party application providers.
- The developer has control over the definition of the standard, and can change it at will with or without the advice and consent of the user community.
- The developer can also determine who has access to the format and for what purpose, regardless of the value to the user community.

Monetary Benefits

- Realized benefits
  - 30% reduction in part fabrication
  - 10% reduction in other areas

Expected Savings Generated through MBD

Commodity	Annual Funding	Savings (%)	Savings ($)
Part fabrication	$10,000K	30%	$3,000K
Assembly	$2,000K	10%	$200K
QA	$2,000K	10%	$200K
		Total Savings:	$3,400K

- Expected benefits
  - 30% reduction in engineering time
  - Not realized in pilot due to full 3D dimensioning of models (done to ease transition from drawing downstream)

Non-monetary Benefits

- Improved communication and collaboration of engineering, manufacturing, and all project stakeholders
- Reduction in cycle time for new designs process
- Significant manufacturing error reduction resulting in significant cost-savings in avoidance of rework
- More effective allocation of resources

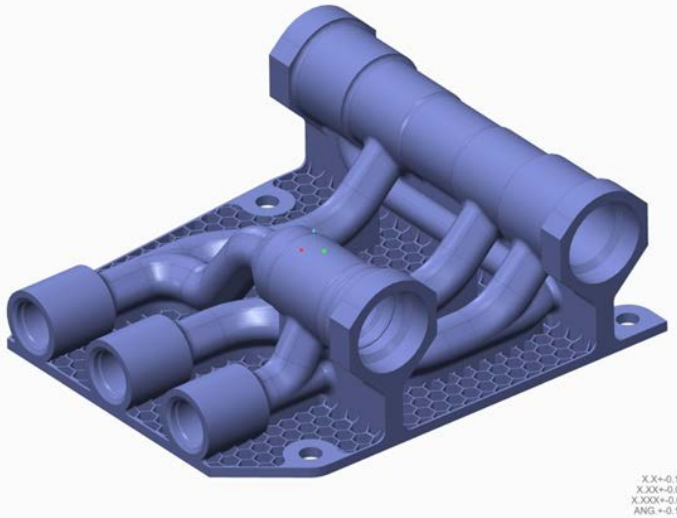
Additive Manufacturing & MBD

- Additive manufacturing (AM), also known as 3D printing, is a potentially disruptive technology that is likely to profoundly affect the Navy.

Additive Manufacturing

Hydraulic Manifold used in the V-22 Drag Strut Retract Actuator Test Stand

DLS 17-4ph Stainless Steel



Design Accomplishments

- 70% reduction in weight
- Smaller foot print
- Improved fluid flow
- Fewer leak points

Generated by Penn State ARL

Application & Benefit

- Design driven manufacturing
  - Do not have to design for manufacturing producibility
- Design limited only by human imagination
  - Topology Optimization
- Complexity does not increase cost
- Ability for mass customization
- Rapid qualification of small lots of parts..

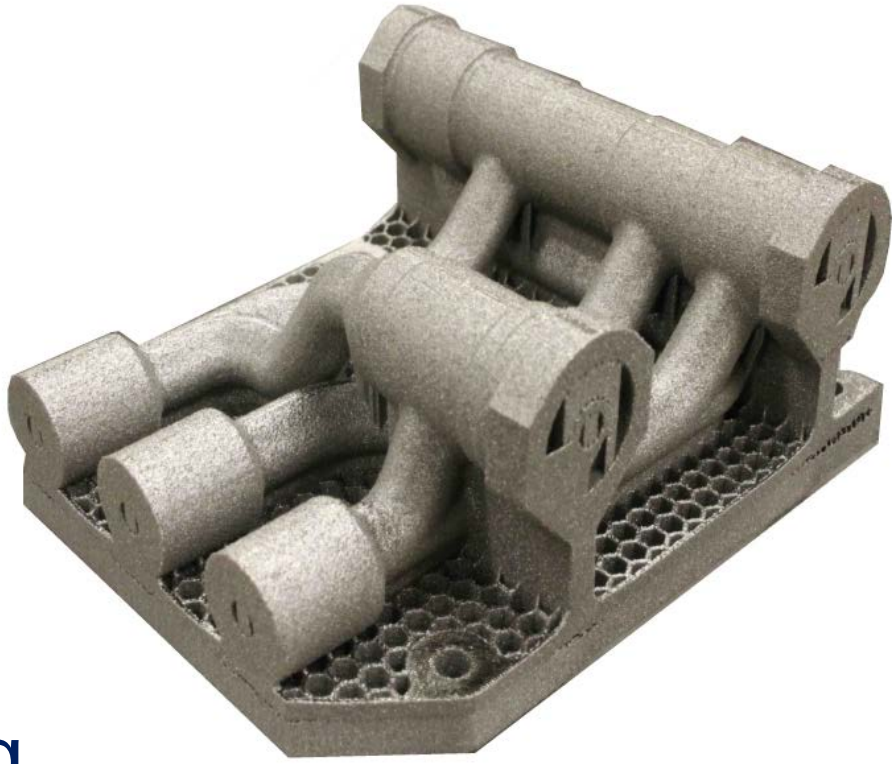
Challenges

- 3D CAD models are often not suitable to ensure manufacturing quality
- Capability to procure 3D models
- Capability to inspect 3D models
- Development of 3D Technical Data Package that incorporates a model-based definitions
- Material & AM process qualification

AM & MBD

- AM offers the ability to create complex designs never before imagined

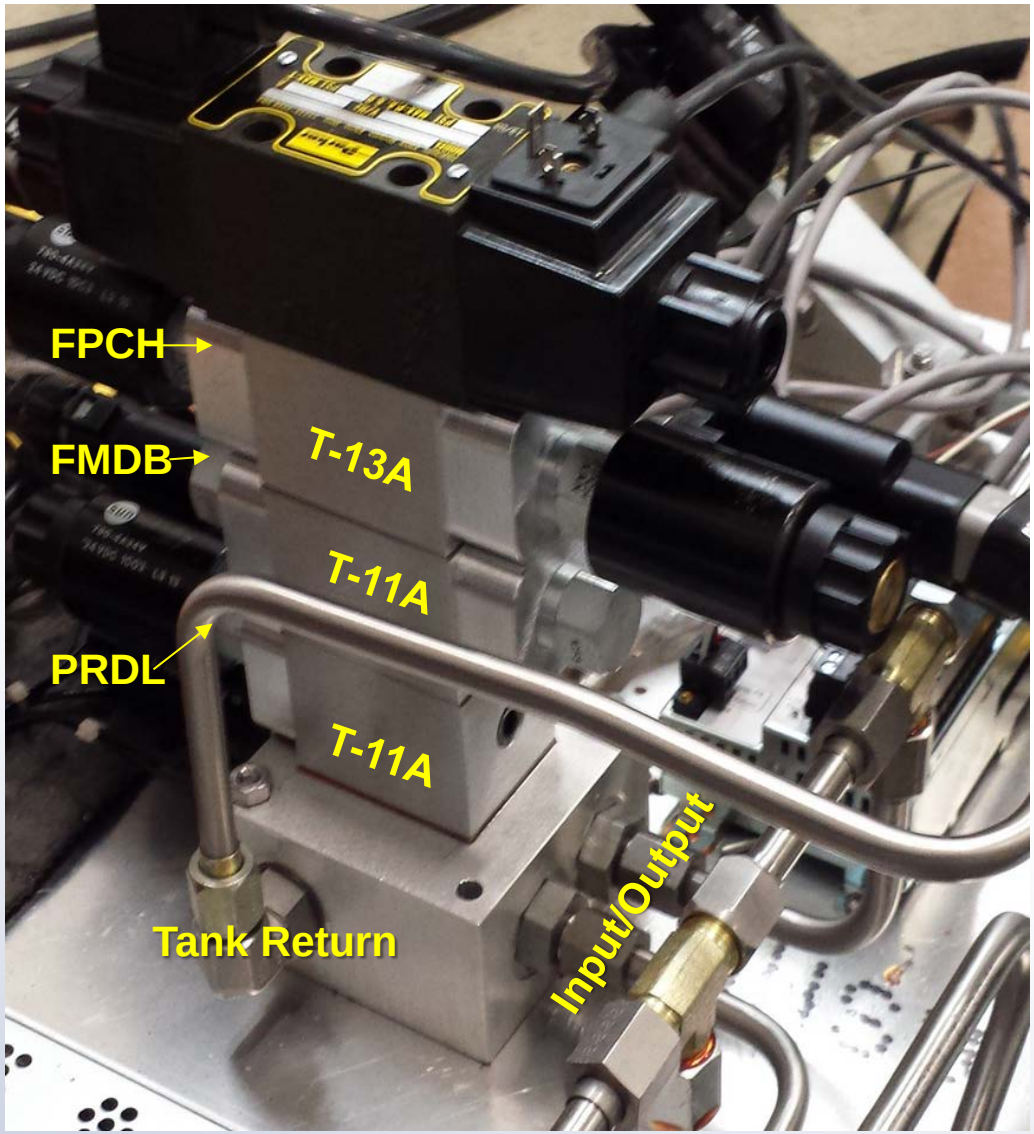
- Many of these designs are too complex to document in a conventional 2D drawing

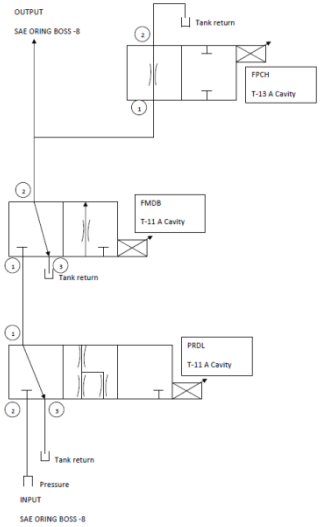


Picture of the 3D Manifold

• Only through MBD, can these new designs be properly documented.

AM & MBD

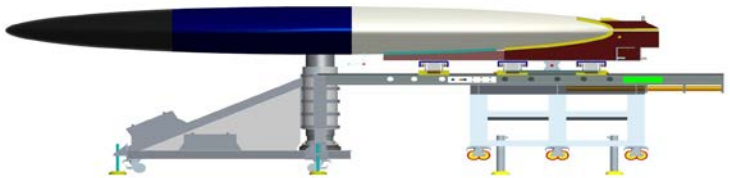


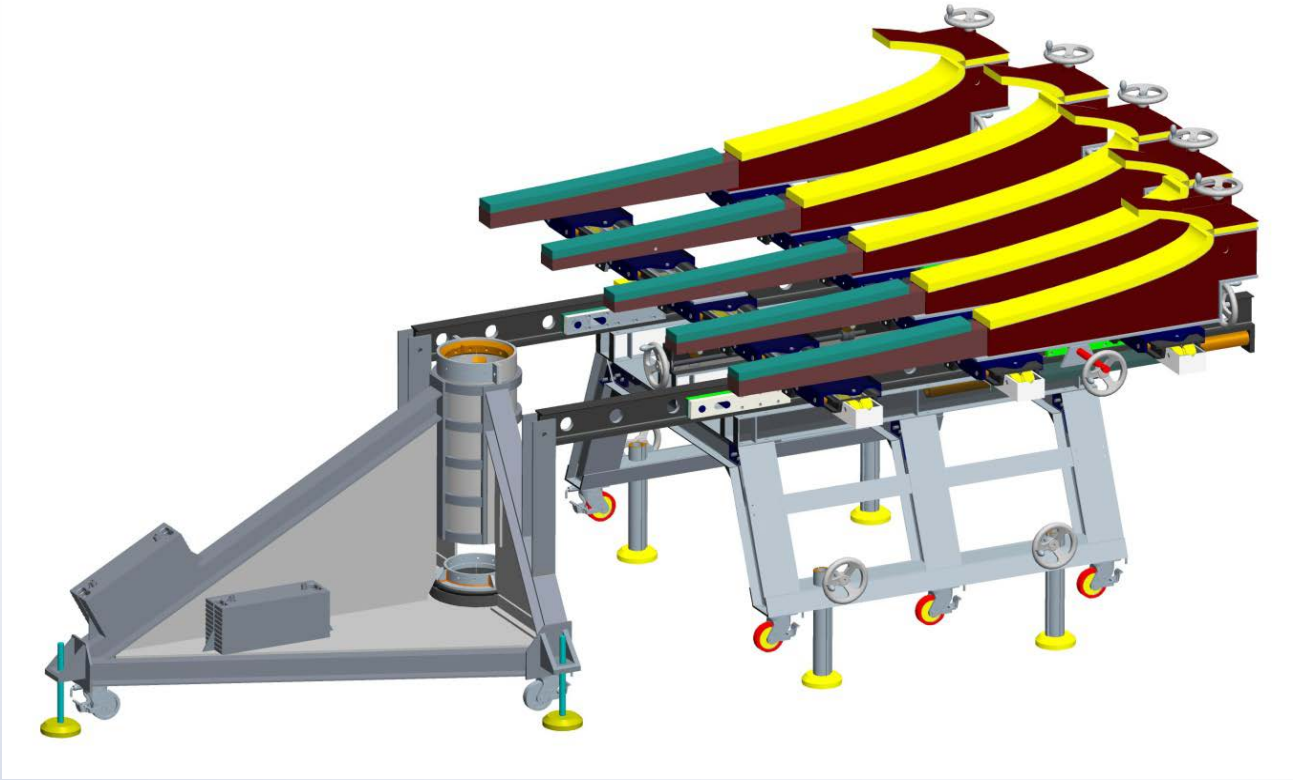


Existing manifold is heavy and bulky.

Next MBD Project

E-2D Rotodome Antenna Maintenance Stand





CTMA

- CTMA Project Phase I ($100K)
  - 3D TDP Format
  - 3D TDP Standard Practices
  - Model Validation/Verification

- CTMA Project Phase II (TBD)
  - Workflow automation
  - PLM Integration
  - Validation of 3D PDF graphics
  - MBD Expansion, (Other Bases, CAD Platforms, PLM Systems)