MIL-STD-31000 AND 3Di pdf TDP UPDATE

Jeff Windham

US Army ARDEC

James.j.Windham.civ@mail.mil

THE HISTORY

THE EVOLUTION

THE PURPOSE

THE GRADE

THE GOAL

THE STATUS

What is a Technical Data Package (TDP)?

Defined by MIL-STD-31000

The authoritative technical description of an item…

… supports the acquisition, production, inspection, engineering, and logistics …

… defines the required design configuration …

- **Common Myth:** The TDP exists for purposes of manufacturing the item.

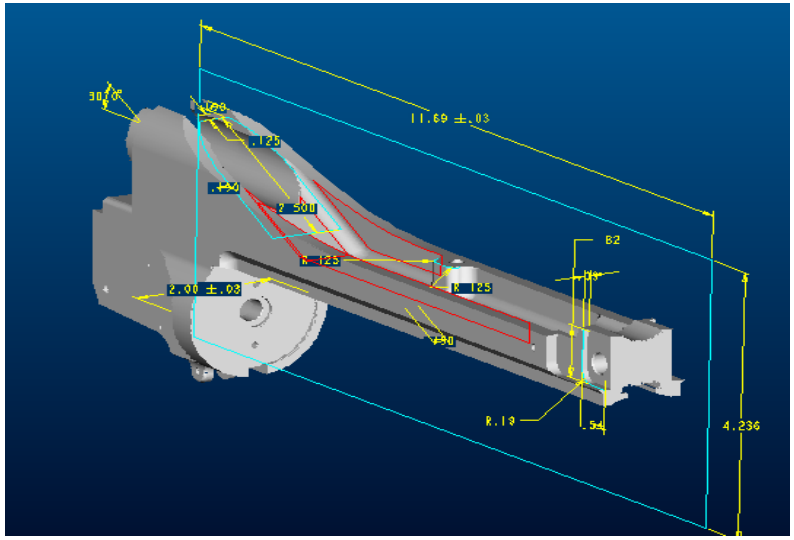
- **Fact:** The TDP exist for purposes of defining the item.

  - It is an engineering document, not a manufacturing document.

- As the single authoritative engineering definition of the item, it has many uses:
  - Manufacturing
  - Inspection/Quality Control
  - Logistics Support
  - Engineering Analysis
  - Configuration Mgt.
  - Interface Mgt.

THE HISTORY:
DOD TDP STANDARDS

DOD-D-1000	CIRCA 1970	
MIL-T-47500	BASE MAR 1989	
MIL-T-31000	BASE - DEC. 1989	
MIL-DTL-31000	A-REV - JUN. 1997	
	B-REV - DEC. 2001	
	C-REV - JUL. 2004	← FIRST MENTION OF 3D MODELS
MIL-STD-31000	BASE - NOV 2009	← DOD/NIST COLLABORATION
	A-REV - FEB. 2013	
	B-REV - OCT. 2018	← 3Di pdf ADDED

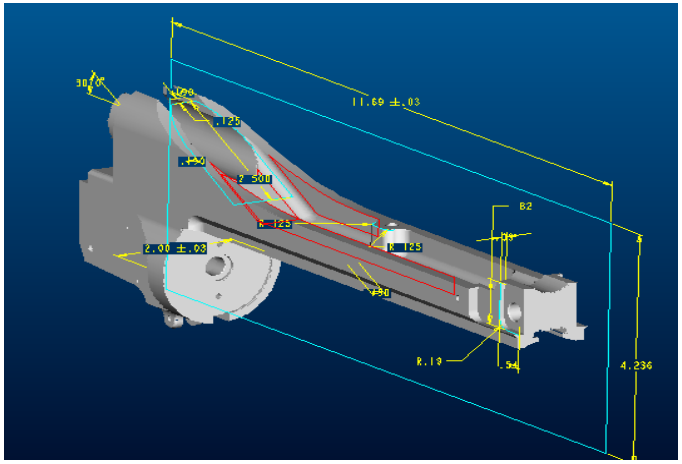


- DESIGN IT.
- BUILD IT.
- SUPPORT IT.

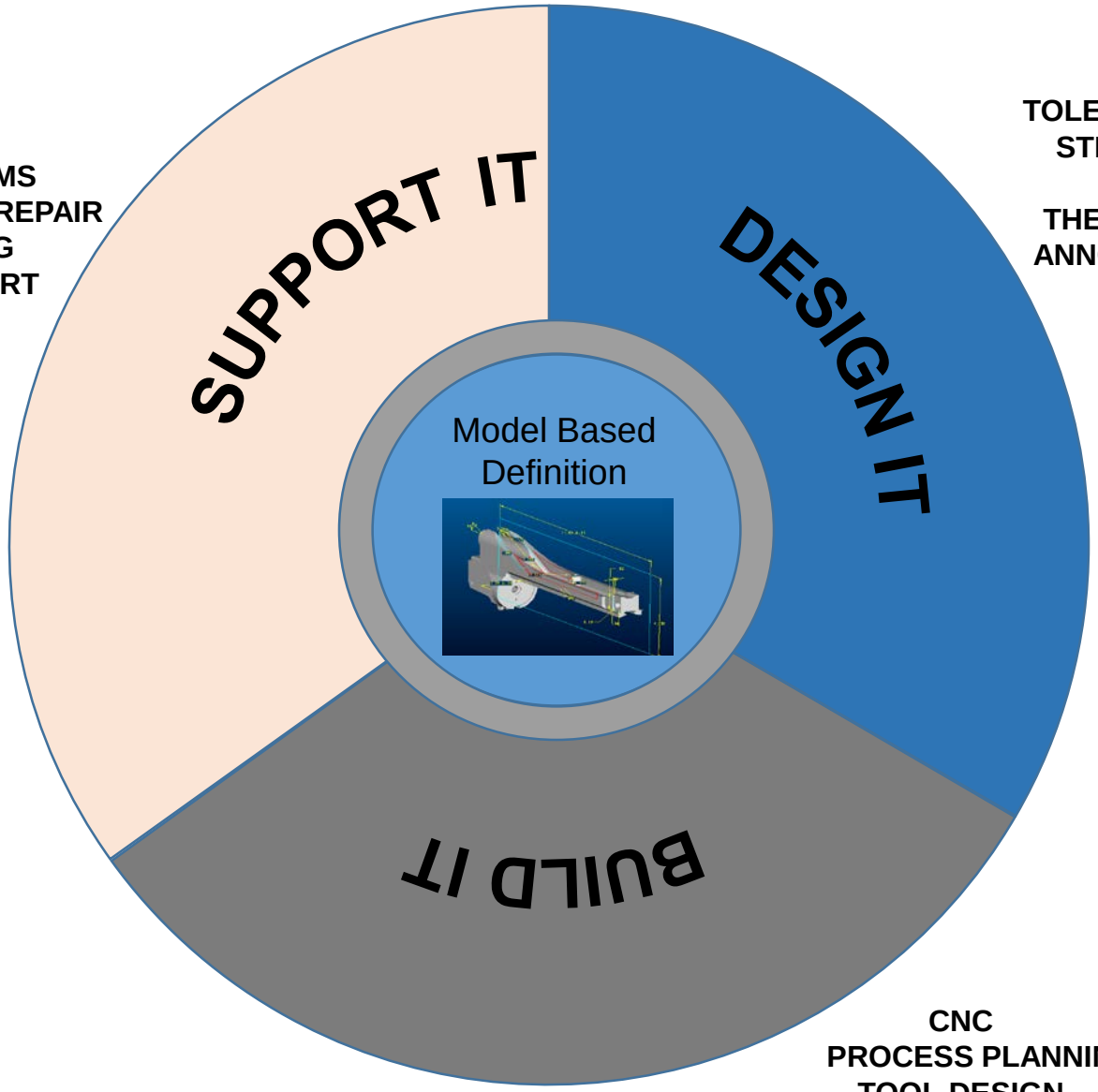
Why Model Based Enterprise?

The Model Based Enterprise lets us design it, build it and support it –

faster, better and cheaper.



MODEL BASED ENTERPRISE



TRAINING
TECH PUBS/ETMS
DEPOT OVERHAUL/REPAIR
PROVISIONING
SUPPLY SUPPORT
DEMIL
TOOLS

TOLERANCE ANALYSIS
STRESS ANALYSIS
KINEMATICS
THERMAL ANALYSIS
ANNOTATED MODELS
2D DRAWING

CNC
PROCESS PLANNING
TOOL DESIGN
PLANT LAYOUT
INSPECTION
QUALITY CONTROL

Model Based Enterprise
Consist of several sub-elements (MBx)

- MBSE: System Engineering
- MBT&E: Testing & Evaluation
- MBI: Inspection/QA
- MBM: Manufacturing
- MBS: Sustainment (Operation, Maintenance & Logistics)
- MBDes/EA: Design, Engineering Analysis
- MBDef: Model Based Definition 

THE PURPOSE:
MODEL BASED ENTERPRISE

- Build organizations around the 3D model
- Have a seamless flow of information thru the organization
- Grow the use of models (of all types) across the organization
- Improve models in the MBx areas
- Stop recreating information, over and over and over again.

THE GRADE:

- Improving models in the MBx areas? Grade: A
- Building organizations around the 3D model? Grade: B
- Stop recreating information over and over? Grade: C-
- Having a seamless flow of information thru the org.? Grade: D-
- Grow the use of models across the org? Grade: Incomplete

HOW DO WE “RAISE THE FLOOR”:

- Hugh variation in MBE implementation across DOD programs.
- Many programs/organizations doing phenomenal MBE efforts. Others little or nothing.
- How do we “RAISE THE FLOOR”?
- The three primary tools to raise the floor:
  - Standards, training, policy.

UPDATE OF MIL-STD-31000 B Rev

THE GOAL:

Transform DOD to a modern technical data infrastructure based on 3Di pdf models.

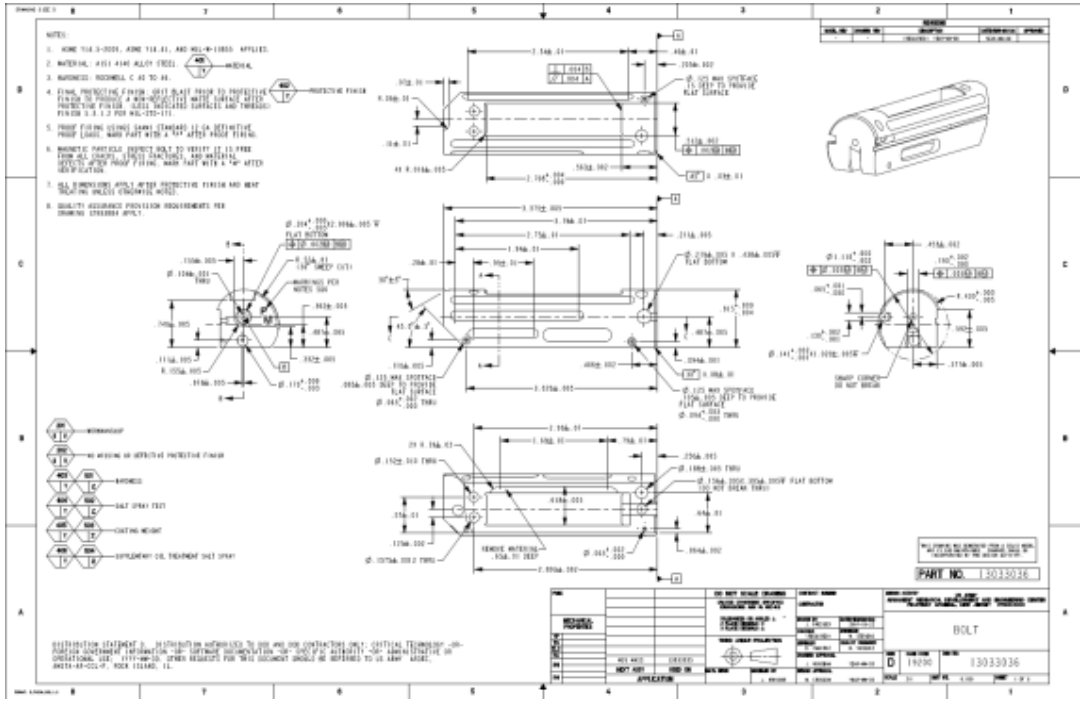
The TDP, as the authoritative definition of the item:

Anything which allows for better communication of design intent is **GOOD**.

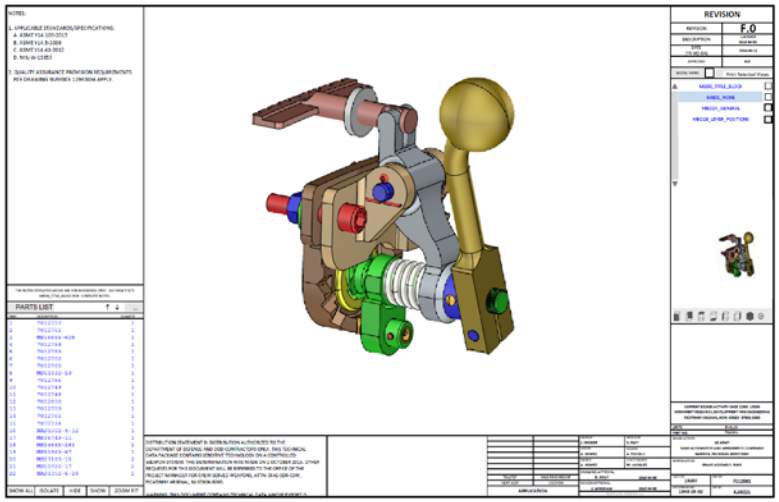
Anything which detracts from communication of design intent is **BAD**.

The 3Di pdf is a better way to communicate design intent.

In DOD, despite advances in 3D CAD, the TDP is still largely defined by black line art, third angle projection, “FRONT-TOP-SIDE” View, 2D engineering drawings.



3Di PDF Example



Adobe Acrobat Document

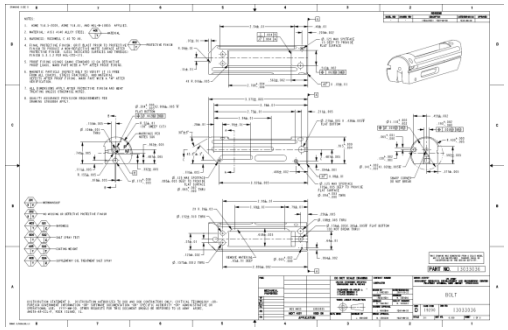
Adobe Acrobat Document

Why 3Di pdf TDPs?

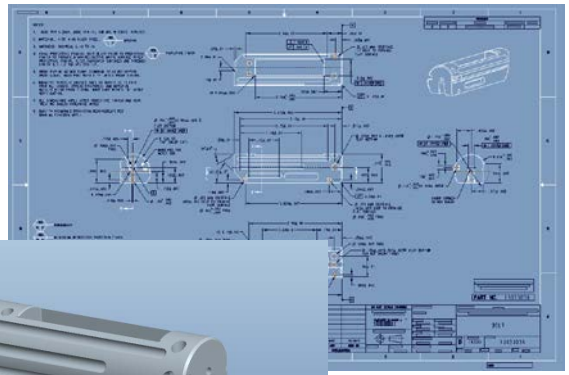
- 3Di pdf provides better method to convey design intent over traditional black line art, 3rd angle projection “front-top-side” 2D drawings.
- Can provide a complete, authoritative engineering definition.
- CAD agnostic.
- 3Di pdf does not require training (to use) and can be opened without special software.
- 3Di pdf is interactive, allowing user to select annotations with visible surfaces and features highlighted.
- 3Di pdf utilizes feature based view states for more logical presentation of the design features.
- Future addition of STEP to the 3D pdf adds more capability.
- The technology is here today, all we need are the standards, business processes, and training to implement it.

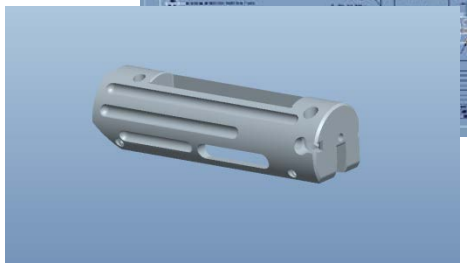
Tech Data Evolution

2D Drawing

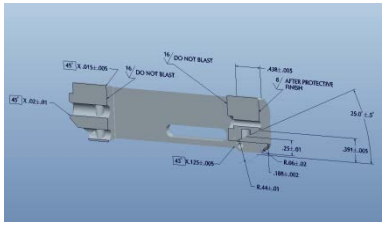


3D TDP

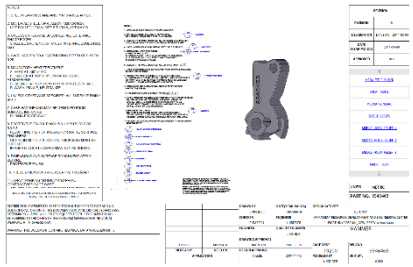




Fully Annotated Models



3Di pdf



Past

Present

Future

3Di TDP Implementation: What do we need to do?

- Standardize processes across DOD where it makes sense.
- Implement the processes in real world programs.
- Grow the capability such that is standard business.
- Update of MIL-STD-31000 to allow for and encourage 3Di based TDPs.

Update of MIL-STD-31000.

- Published as B Revision Oct 2018.
- Incorporates the concept of 3Di pdf models.
- 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 series)*
  - *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-31000 A Rev to B Rev

- TDP types.
  - **Type 2D:** 2-Dimensional Technical Data Package.
  - **Type 3D:** 3-Dimensional Technical Data Package. Type 3D will include one or more:
    1) 3D models only.
    2) 3D models with associated 2D drawings.

- TDP types.
  - **Type 2D:** 2-Dimensional Technical Data Package.
  - **Type 3D:** 3-Dimensional 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.

New 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.

Summary.

- DOD is moving to a modern Technical Data infrastructure based on 3Di (3D Intelligent) models.
- 3Di model based TDPs are better than 2D, black line art, third angle projection, “front-top-side”.
- Govt/Industry teams need to engage early and often on best TDP solution for their programs.
- Get familiar with MIL-STD-31000B and use it on your programs.
- Be advised, requirement to deliver 3Di pdf based TDP may be coming soon to a contract near you.

BACKUP SLIDES

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:

USAGE CASES:

-Buys TDPs for Things.
-Maintains TDPs for Things.

Govt Acquiring Activity (PM-Engineering Activity)

-Use TDPs to buy Things.

Govt Logistics Activity (DLA-Contracting Command-Logistics Activity)

Design Contractor (OEM)

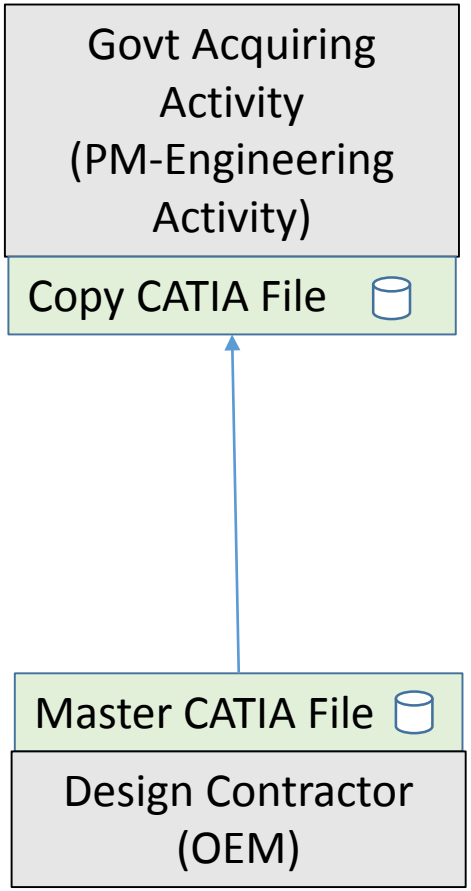
-Creates TDPs for Things.
-Maintains TDPs for Things.

Manufacturing Contractor

-Mfgs Things IAW TDPs.

USAGE CASE 1:

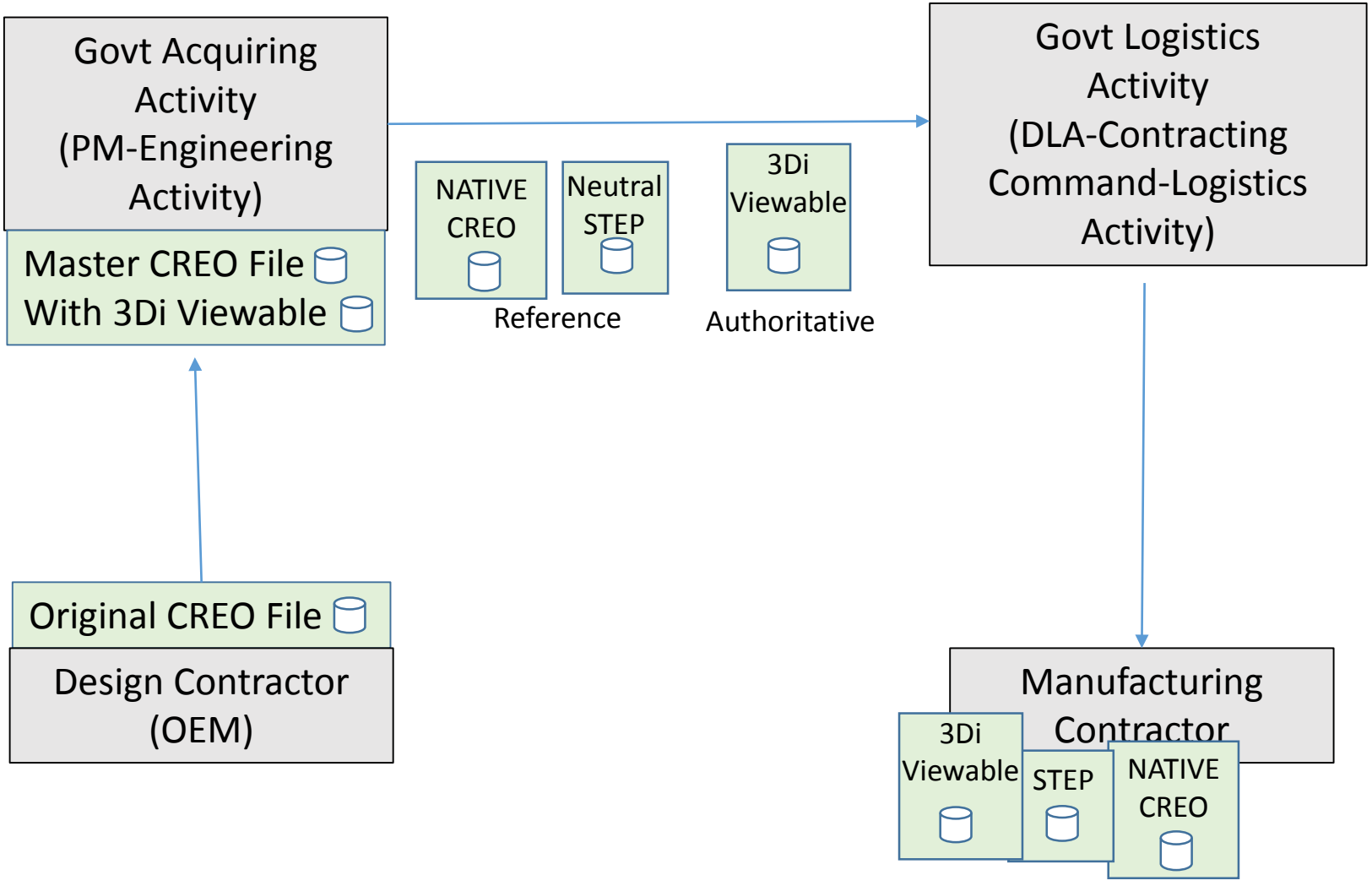
Govt Activity sole source with OEM Design contractor. No intent to manufacture outside OEM. Both OEM and Govt Acquiring Activity are CATIA capable. OEM will maintain data.



CATIA File is Native and Authoritative. CATIA File is also Master and resides with Design Contractor

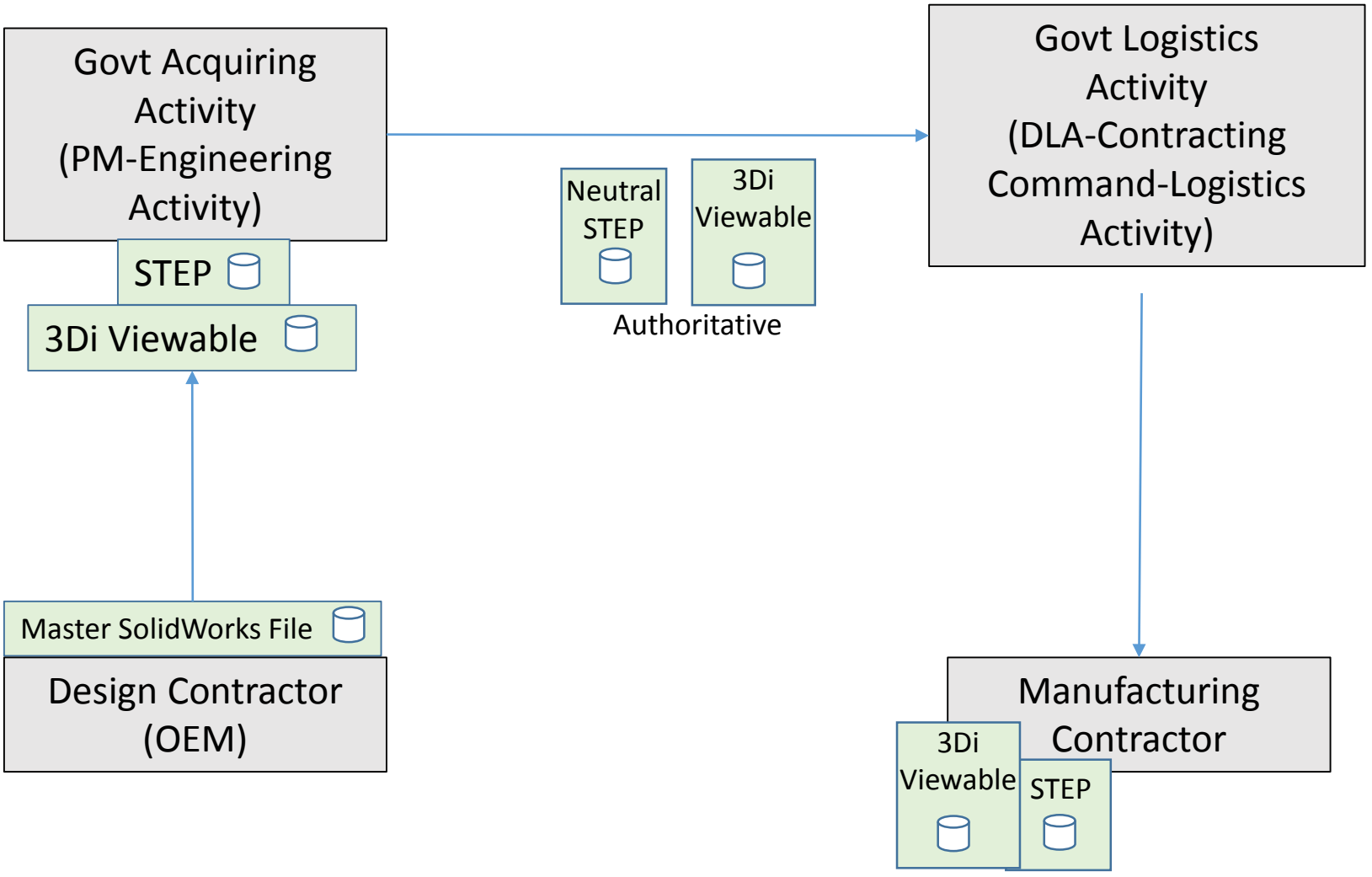
USAGE CASE 2:

Govt Activity procuring TDP from Design Contractor. Govt activity will maintain the master and procure from multiple sources using Govt Logistics Activity. Design Contractor and Govt Acquiring Activity are both CREO capable.



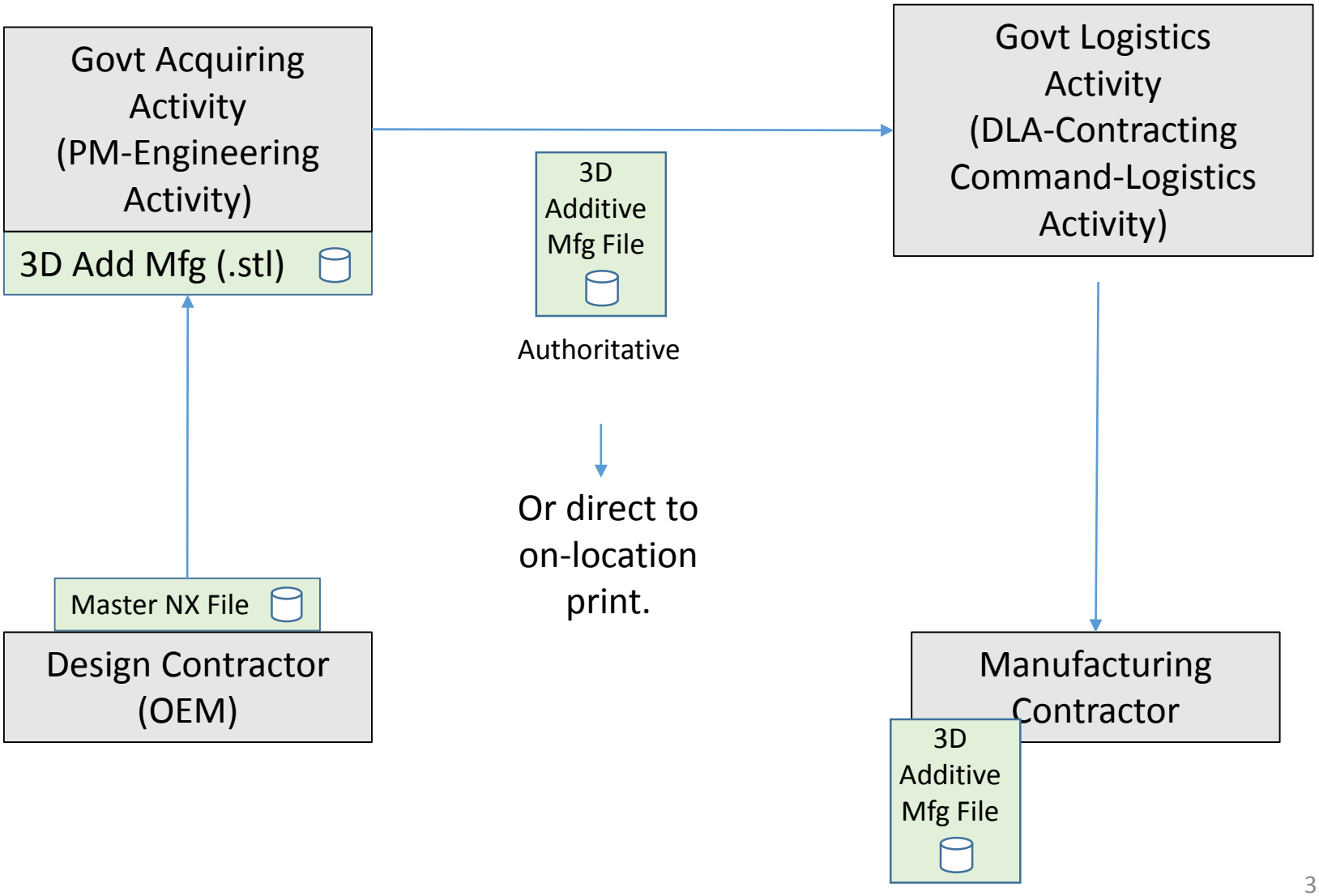
USAGE CASE 3:

Govt Activity procuring design from Design Contractor. Design Ctr will maintain the Native master and provide validated neutral and viewable to Govt Acquiring Activity. Design Contractor is Solid Works capable. Govt Acquiring Activity is CREO capable only.



USAGE CASE 4:

Govt Activity procuring design from Design Contractor. Design Ctr will maintain the Native master and provide validated additive mfg file Govt Acquiring Activity. Design Contractor is NX capable. Govt Acquiring Activity is Solidworks capable only.



- Standardization on a NATIVE CAD software is a desirable, but unachievable goal.

3Di: Not your Grandfather's TDP.

- **PAST/PRESENT:** TDPs based on 2D, black line art, third angle projection, "front-top-side", paper based.
  - Didn't matter how you got there, as long as you delivered the 2D drawing.
  - 2D drawing was universally understood.
  - Form and format didn't matter because everything could be rendered to paper.
  - Human readable information.

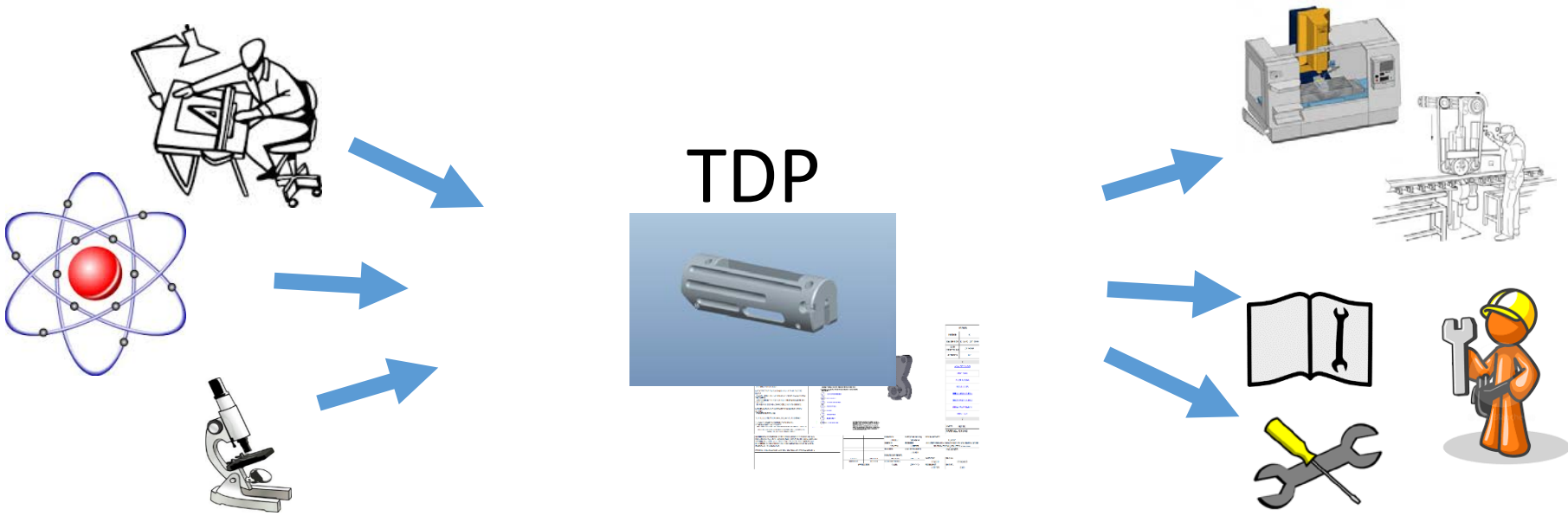
- **FUTURE:** Much more complex.
  - Data form and pedigree matters.
  - Multiple formats being used likely.
  - Programs will vary in how they operate.
  - Both human and machine readable information.
  - We need a common language.

Summary

- 2D drawing based TDPs are the past.
- 3Di pdf based TDPs are the future.
- DOD organizations and our OEMs/suppliers need to establish the ability to deliver and use 3Di based TDPs.
    - Training
    - Infrastructure
    - Standards
    - Procedures

- The TDP is the single authoritative definition of the product.
- It is the culmination of the science, engineering and design efforts that came before it...,

... and is source data for all mfg., logistics, and acquisition activities which comes after it.



DLA Study

- Defense Logistics Agency conducted a study of using 3Di pdf, in conjunction with STEP format.
- Procured parts from a variety of manufacturer's using 3Di pdf technical data.

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