Connecting the MBE:
Integrating 3D Technical Data Across the Life-Cycle

MBE Summit 2018

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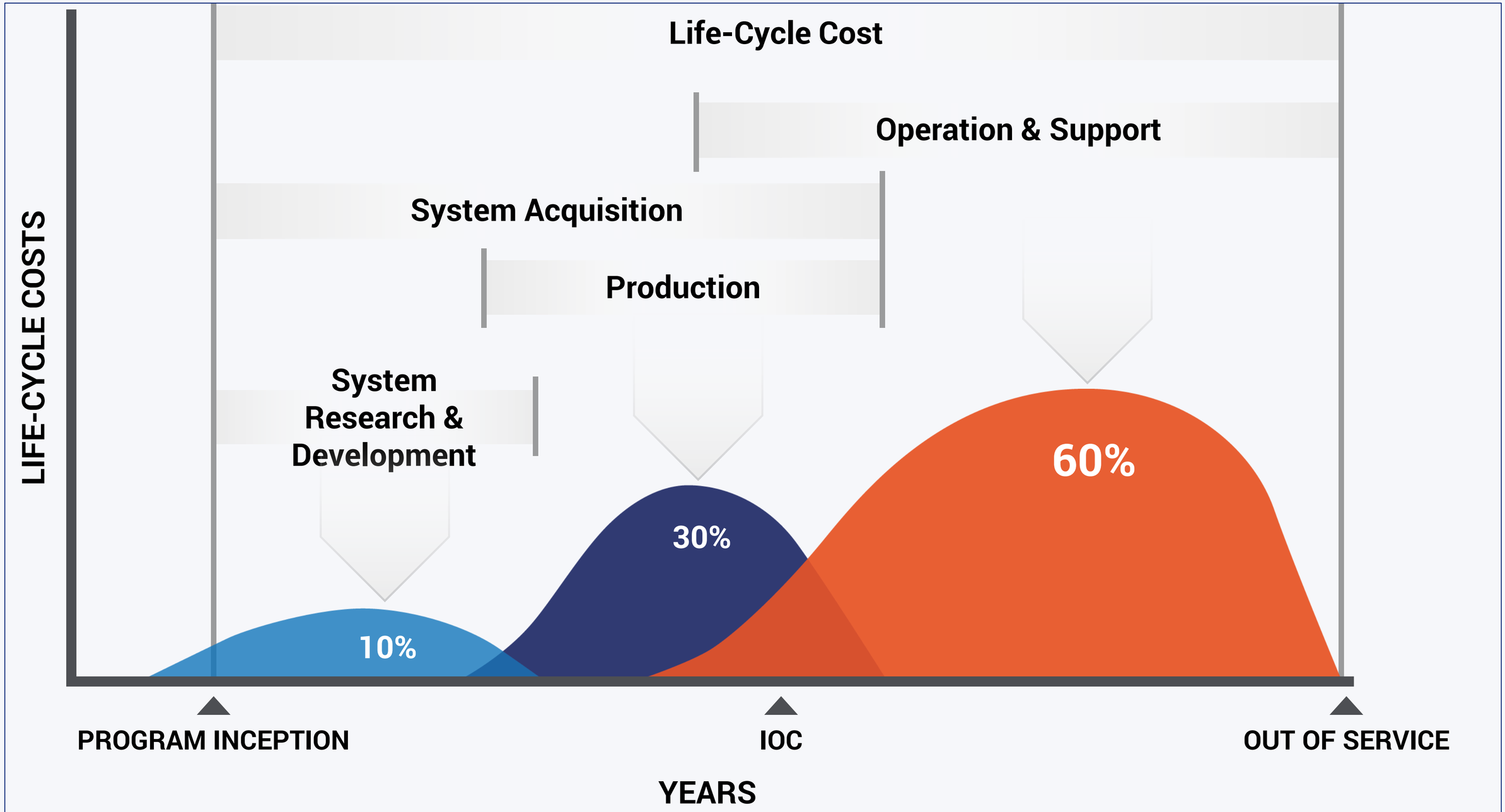
Situation

- Model Based Enterprise (MBE) is the new standard for life cycle management of weapon systems
  - System definition optimized around a core set of product models
  - Promises rapid, seamless, efficient, and affordable deployment
  - Source model created during system design phase then reused across DoD enterprise throughout the lifecycle (design to disposal)
- Proficient employment of MBE requires models to include more than just geometry to support a wide range of uses
  - Designers/modelers must consider system lifecycle needs (beyond design)
  - Digital Master should be the bedrock for manufacturing, provisioning, cataloging, maintenance, overhaul, parts procurement, and other operations and sustainment processes throughout the lifecycle

System Life Cycle vs Cost



60% of System Total Costs Result from Operations and Support, which covers 75 – 85% of the Lifecycle

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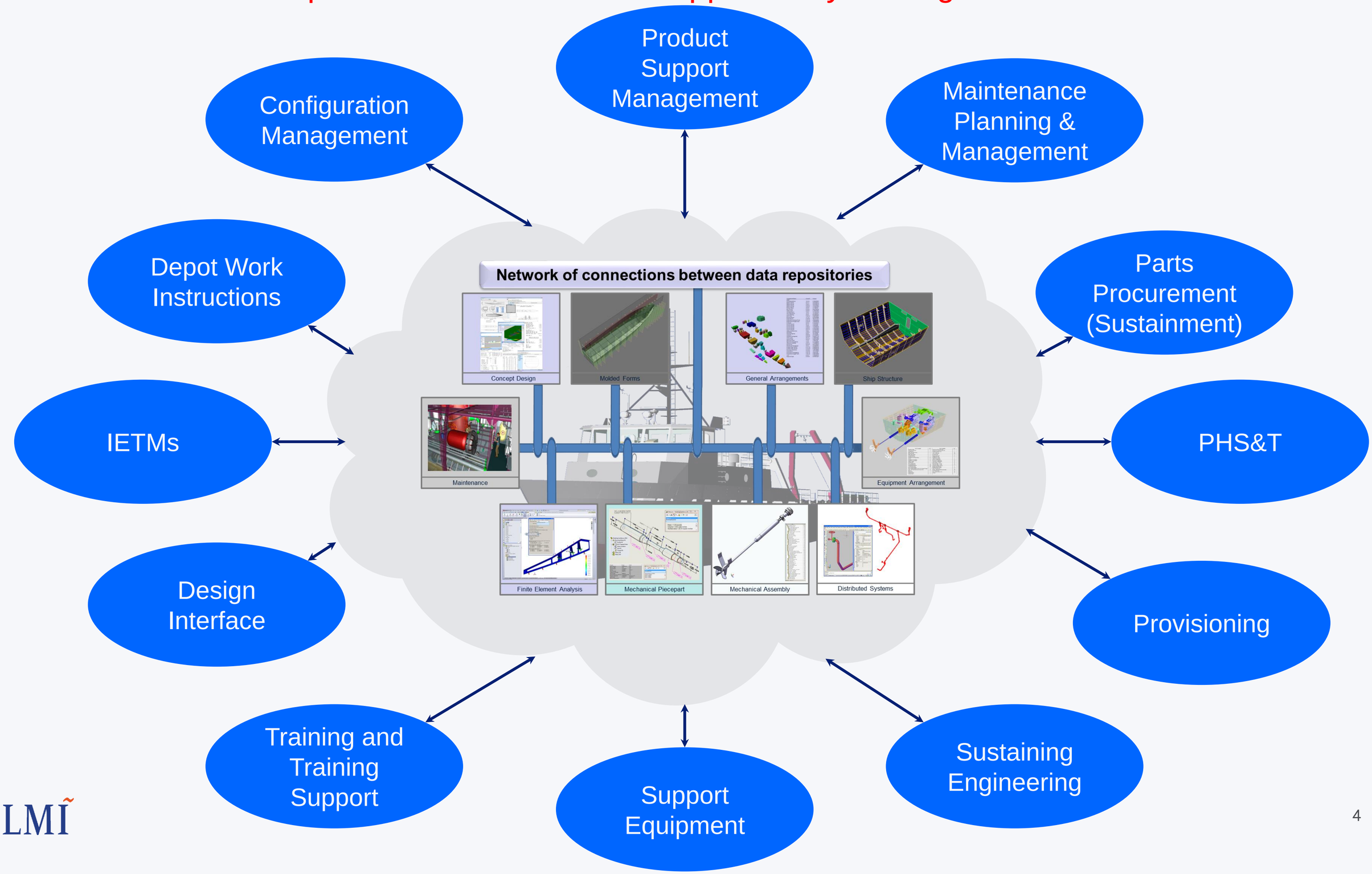
Ref : Operating and Support Cost Estimating Guide", 2014 https://dap.dau.mil/acquipedia/Pages/ArticleDetails.aspx?aid=e8a6d81f-3798-4cd3-ae18-d1abafaacf9f

Digital Master *Must* Support Multiple Needs

Each area of Life Cycle Support comes with it's own (and sometimes) unique data requirements that must be supported by the Digital Master.



Digital Master *Must* Support Parts Procurement

Product Support Management

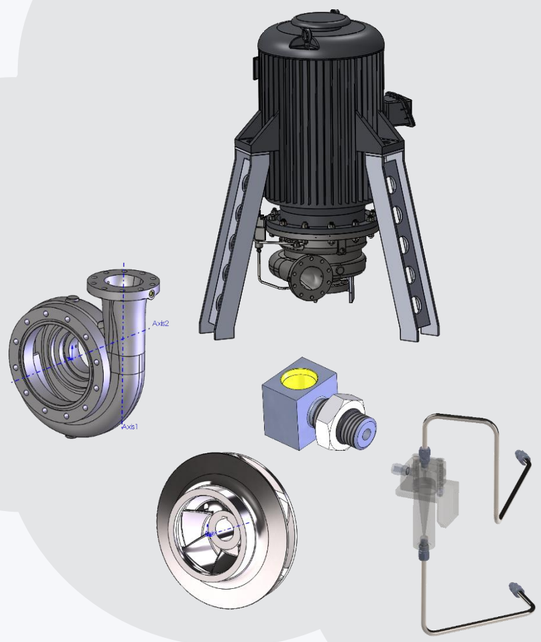
Configuration Management

Maintenance Planning & Management

Depot Work Instructions

Parts Procurement (Sustainment)

Geometry



Non Graphical Attributes

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                <Instruction>None</Instruction>
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</Assembly>
```

IETMs

PHS&T

Design Interface

Provisioning

Training and Training Support

Support Equipment

Sustaining Engineering

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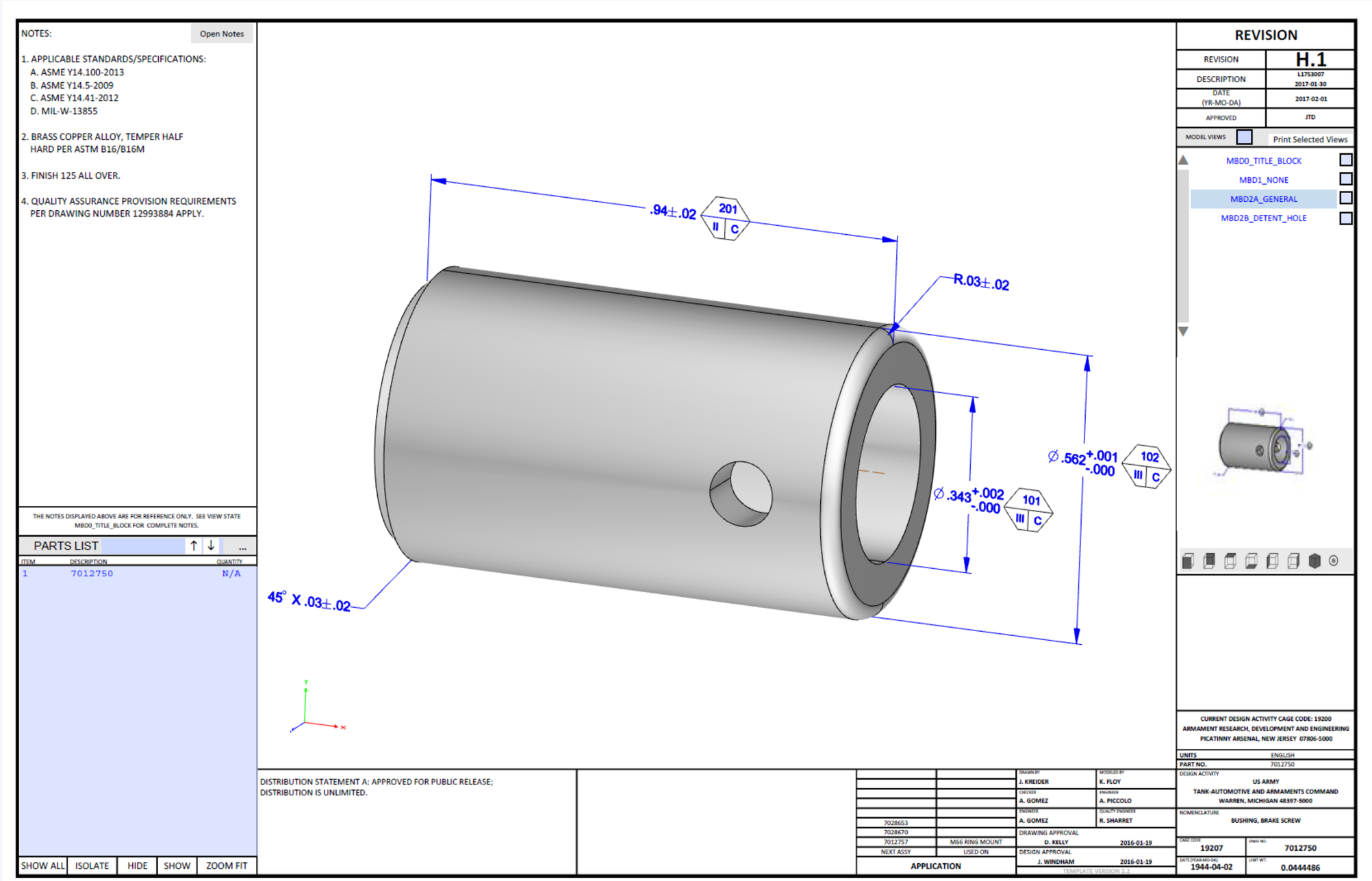
The “39” Data Elements Required by DLA

- 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

Solution Recommended by DLA

PDF[1,2] with embedded 3D geometry and ancillary files attached as necessary.



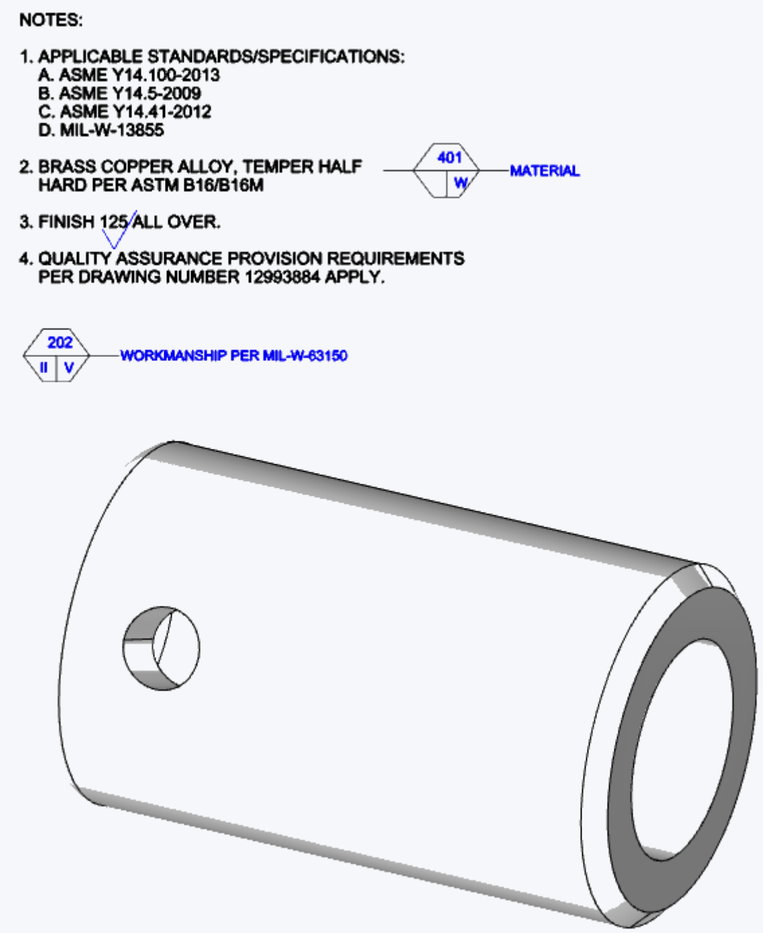
1 Concept of Operations for DLA Procurement of Weapon System parts Using 3D Technical Data, LMI Report DL309T1, September 2014
2 ISO 32000-1:2008 Document management -- Portable document format -- Part 1: PDF 1.7

Solution Recommended by DLA

PDF[1,2] with embedded 3D geometry and ancillary files attached as necessary.

PDF document can be read using Adobe Reader

- 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



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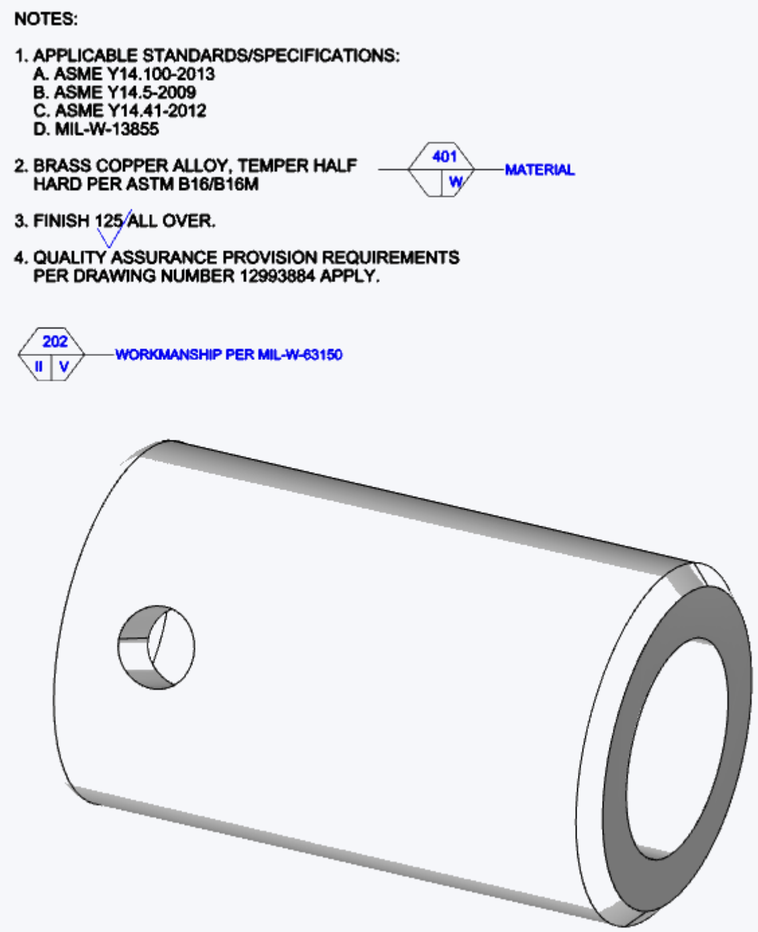

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3 ISO 14739-1:2014 Document management -- 3D use of Product Representation Compact (PRC) format -- Part 1: PRC 10001

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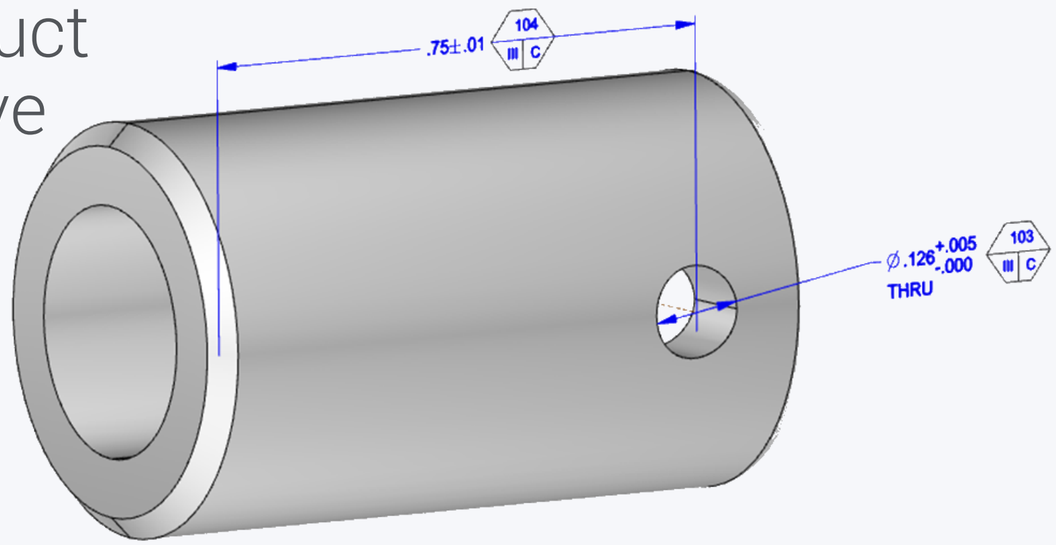

Neutral file solution for shape data and when available PMI data[4]

- Provides full product definition
- Includes shape definition that can support system engineering, modeling & simulation, and manufacturing
- Meets TDP 'publishing' requirements
- Is a stand-alone product

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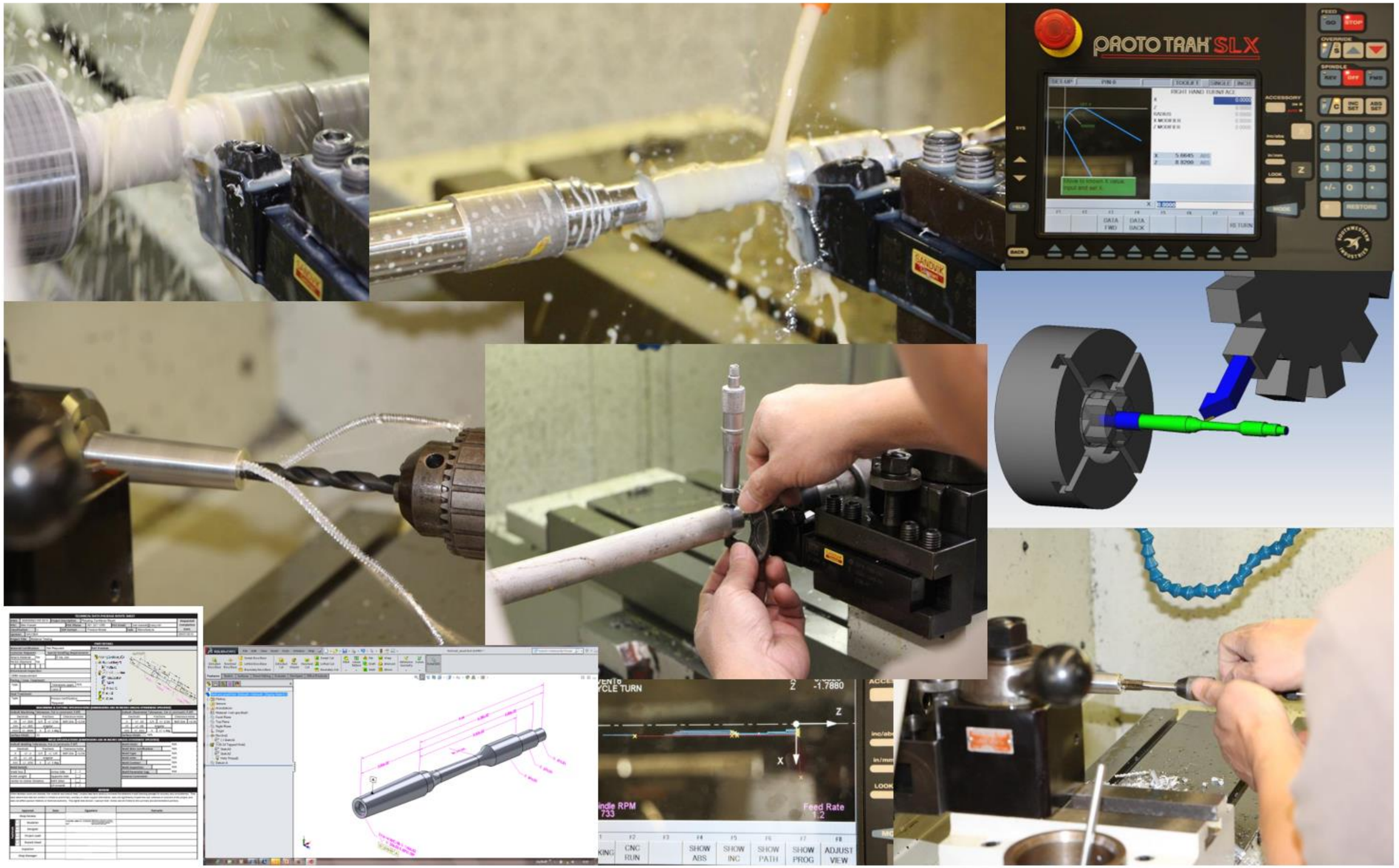
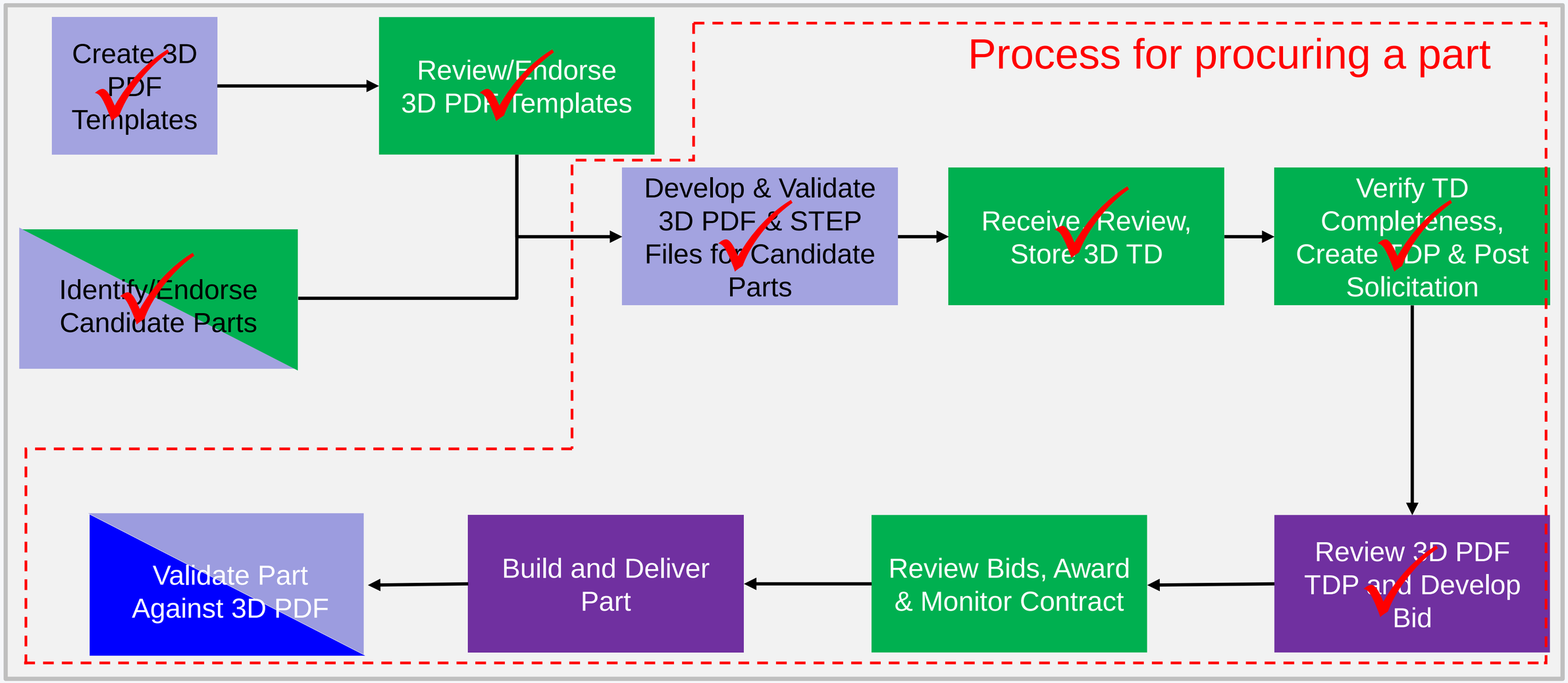
1 Concept of Operations for DLA Procurement of Weapon System parts Using 3D Technical Data, LMI Report DL309T1, September 2014
2 ISO 32000-1:2008 Document management -- Portable document format -- Part 1: PDF 1.7
3 ISO 14739-1:2014 Document management -- 3D use of Product Representation Compact (PRC) format -- Part 1: PRC 10001
4 ISO 10303-242:2014 Industrial automation systems and integration -- Product data representation and exchange -- Part 242: Application protocol: Managed model-based 3D engineering

3D PDF Demo: What it Tested



DLA Operationally Tested the 3D PDF Solution



Key

- ESA
- DLA
- DCMA
- Supplier

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

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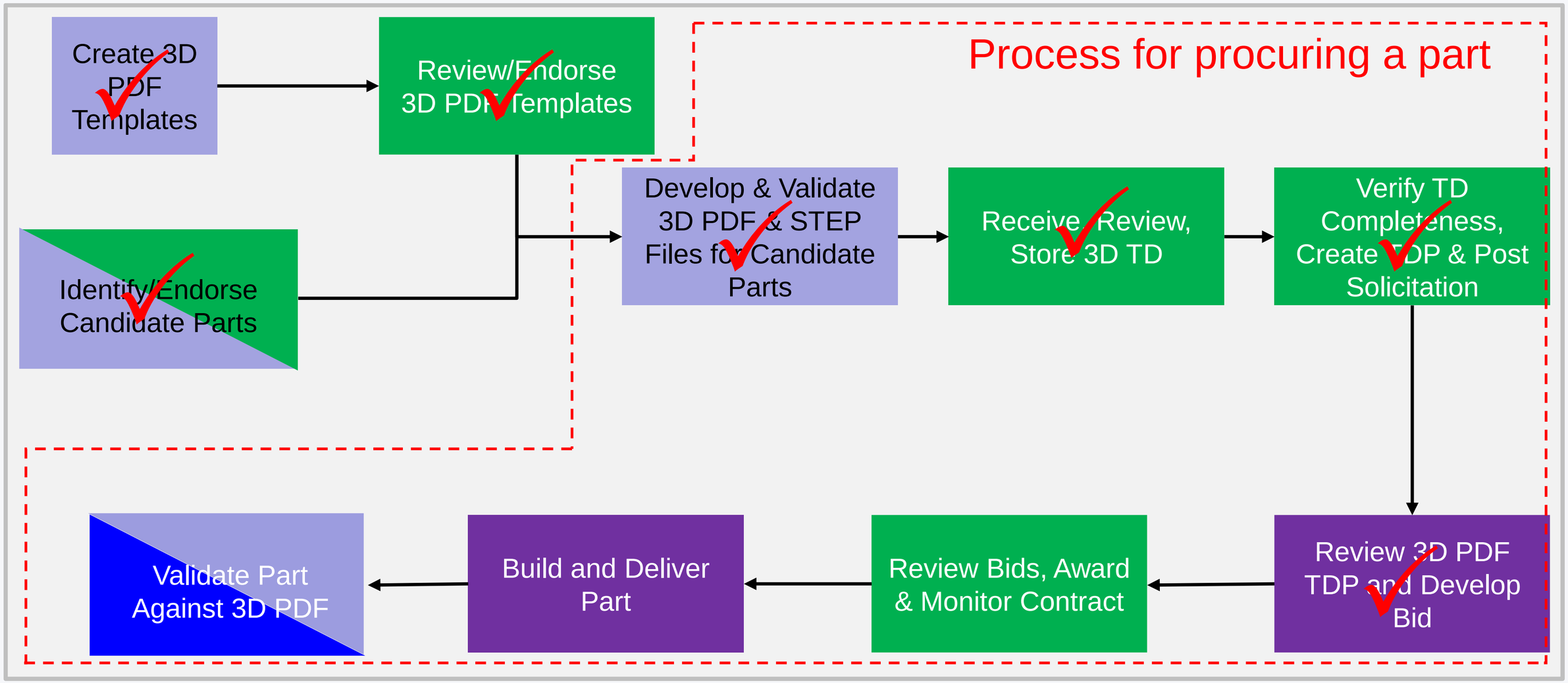
DLA Operationally Tested the 3D PDF Solution



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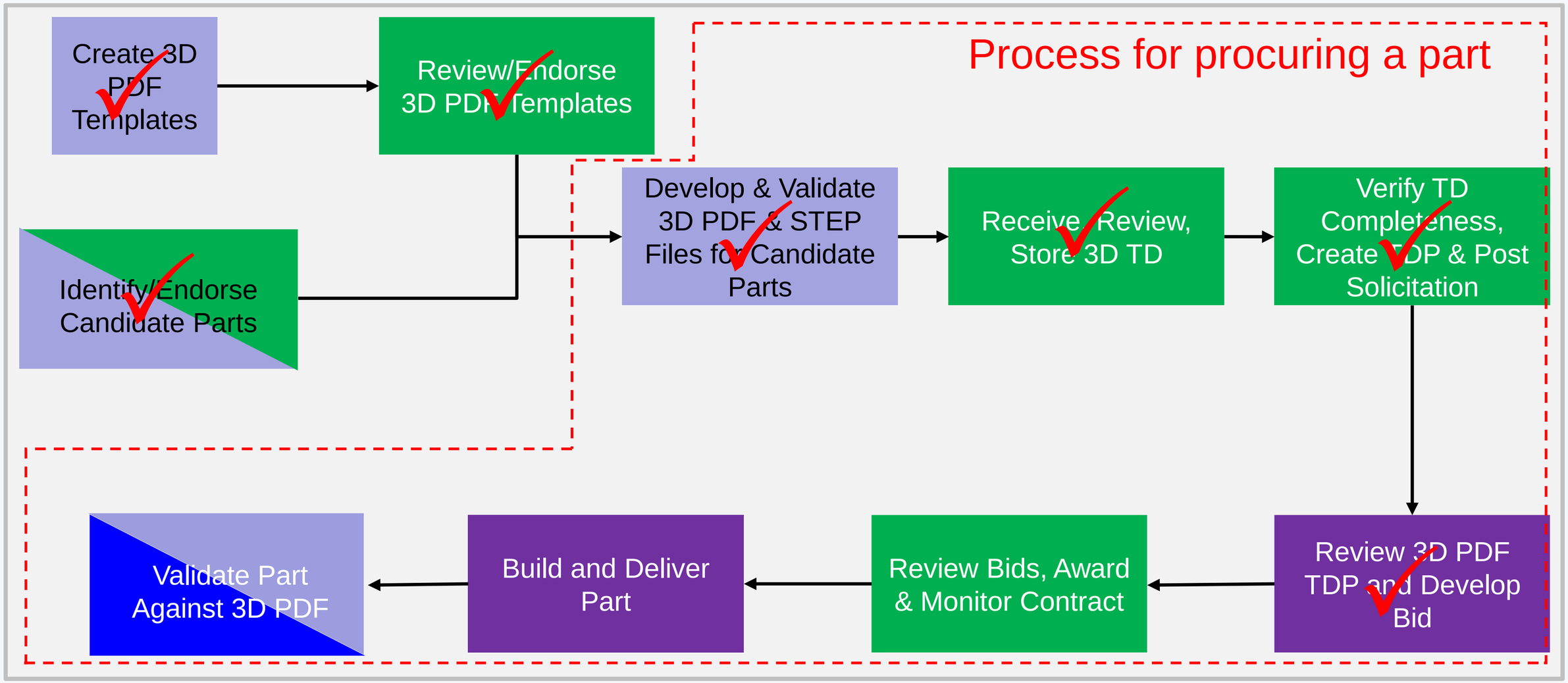
Three different DLA Supply Chains

- Troop Support; Industrial Hardware (Philadelphia)
- Land & Maritime (Columbus)
- Aviation (Richmond)

DLA Operationally Tested the 3D PDF Solution



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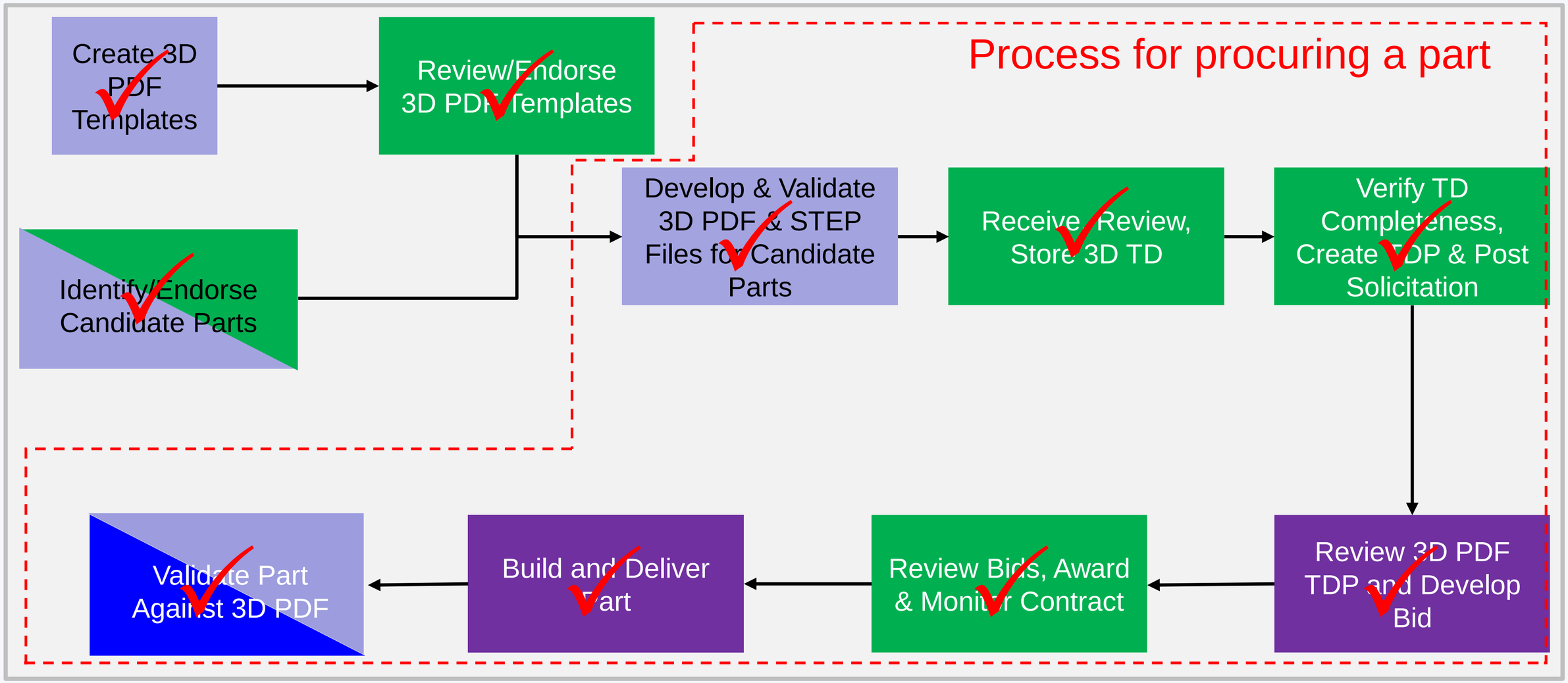
Three different ESAs

- NAWC Lakehurst (Navy)
- ARDEC Rock Island (Army)
- Warner Robins (Air Force)

DLA Operationally Tested the 3D PDF Solution



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Demo proved the viability of a 3D Technical Data Package using PDF!

Results of three demonstration projects

Cable Sheave Guide

- Small Midwest fabrication shop used 3D PDF file to build part
- Test articles delivered to NAWC Lakehurst
- Validated to the PDF data

Brake Shoe Cam

- Picatinny Arsenal used 3D PDF file and STEP to build part
- STEP file used for nominal geometry
- PDF used to obtain PMI
- Validated to the PDF data

Retaining Bearing Plate

- Small Western hardware manufacturing company
- Manufacturer cancelled the contract.
- The Technical Data Package was not an issue

Conclusions from 3D PDF Demo R&D Project

- *DLA can use PDF 3D Technical Data Packages and STEP files in daily procurement operations*
- *Suppliers can use PDF 3D Technical Data Packages and STEP files for bid preparation, project planning and parts manufacture*
- The use of templates and strict adherence to process rules are necessary to generate 3D Technical Data Packages that comply with DLA requirements from the authoritative model based definition.
- No process changes are required for transfer of *PDF 3D Technical Data Packages and STEP files* from ESA to DLA
- No procurement process changes are required for DLA use of *PDF 3D Technical Data Packages and STEP files*

3D PDF Solution Works!!!

Summary: Key Take Aways

- System designers/modelers need to consider and include data needs of many different life cycle users when building models
- Need human-readable formats for most downstream users
- Need comprehensive and fully annotated models to support generation of 3D PDF documents
- DoD Policy/Standards need to be updated
- Contracts with OEMs/builders must require applicable data in appropriate formats
- DLA R&D is conducting 3D TD projects in FY18 – FY19 and seeking partners

Next Step

Help us, help you!!!

DLA is seeking partners for identifying and testing 3D PDF and other neutral format solutions.

- ISO 14306:2017 Industrial automation systems and integration -- JT file format specification for 3D visualization
- ISO 10303-242:2014 Industrial automation systems and integration -- Product data representation and exchange -- Part 242: Application protocol: Managed model-based 3D engineering
- ISO/IEC 19775-1:2013 Information technology — Computer graphics, image processing and environmental data representation — Extensible 3D (X3D) — Part 1: Architecture and base components
- HTML 5.2 World Wide Web: the Hypertext Markup Language (HTML)

Points of Contact

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