



# 3D Data Exchange Project

6 December 2018 | Defense Manufacturing Conference 2018



Distribution Statement A: Approved for public release; distribution unlimited



# Agenda



- Project Participants
- CH-53K Program Introduction
- 3D Data Exchange Project Introduction
- Solution
- Key Points
- Next Steps



# Project Participants



- NAVAIR PMA-261
  - Customer and end user
- Anark Corporation
  - 3D PDF and DLA package publisher
- ITI – International TechneGroup Inc
  - CAD enhancement, STEP generation, and validation/verification
- Razorleaf Government Solutions
  - Process and 3DEXPERIENCE + ENOVIA integration
- NSAM – Naval Shipyard and Advanced Manufacturing Center of Excellence
  - Project Management for ONR (Office of Naval Research)



# CH-53K Program Introduction PMA-261



- **CH-53K is the DoD's most powerful helicopter ever**
  - Designed as a new-build helicopter
  - Will expand the fleet's ability to move more material, more rapidly throughout the area of responsibility
  - Designed using proven and mature technologies
  - Designed to lift nearly 14 tons at a mission radius of 110 nautical miles in high/hot environments
  - Designed to lift triple the baseline CH-53E lift capability
  - Designed for equivalent logistics shipboard footprint
  - Designed for lower operating costs per aircraft
  - Designed for less direct maintenance man hours per flight hour



# CH-53K Program Introduction PMA-261



CH-53K will be able to get more fighters into the air.



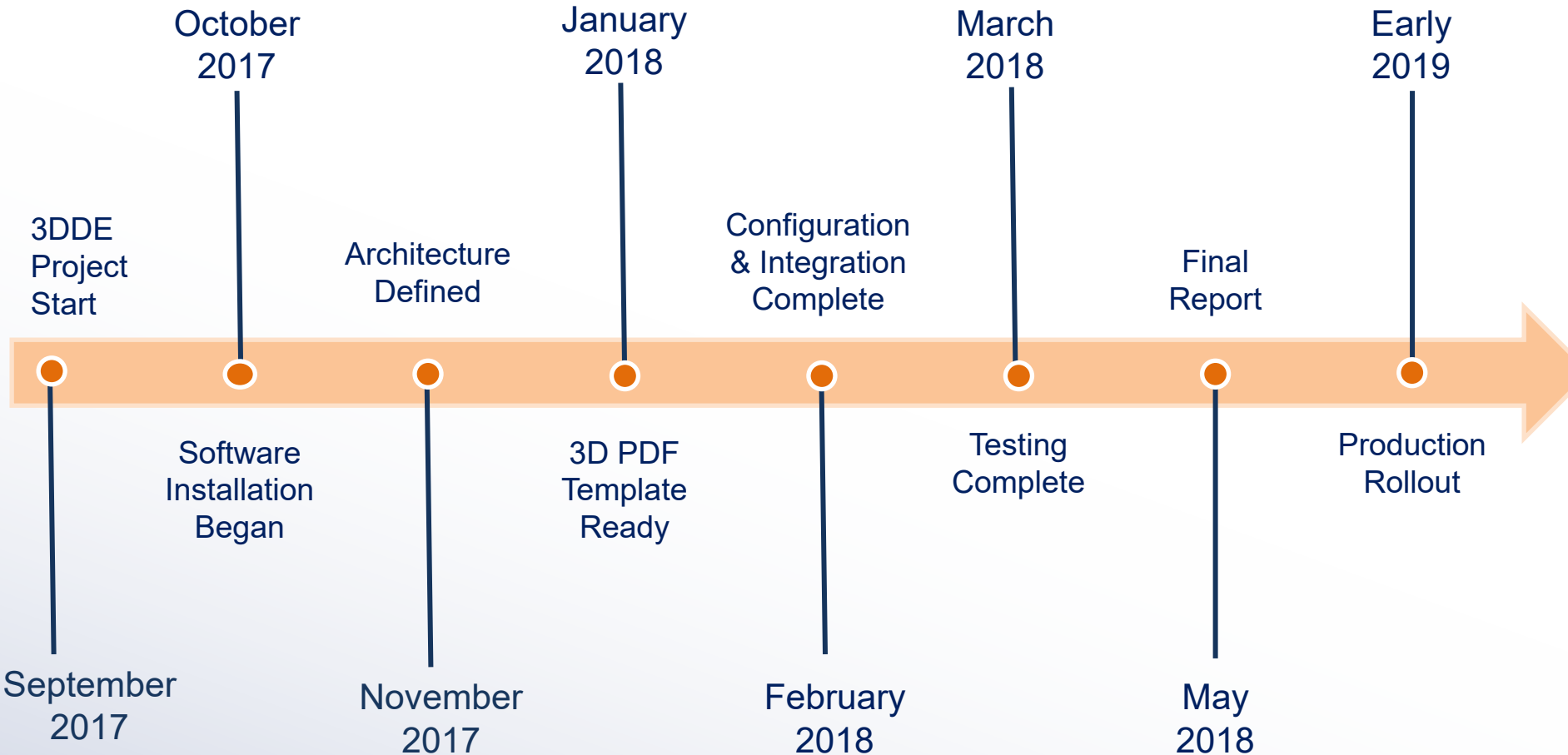
# 3D Data Exchange Project Introduction



- **3D Model to 3D PDF conversion capability provides production-quality model-based documents and Technical Data Packages (TDP) for down-stream users**
  - Single configuration controlled data set, thereby accelerating response times, reducing cost, increasing aircraft availability and safety of flight
  - Verifying/validating thousands of complex 3D models in a short time period
- **Benefits of a secure 3D Data Exchange system (3DDE) are numerous**
  - Reduce the Amount of Reverse Engineering Requirements
  - Reduce Labor for Translation and Healing of CAD Data
  - Reduce the Amount of Rework Due to Incorrect Technical Data
  - Reduce Requirements for TDP DLA 339s Caused by Programs Using Full Model Based Definition In Lieu of 2D Drawing
  - NAVSUP/DLA ability to provision using 3D PDFs in lieu of native CAD Models in up to 15 different software sets



# 3D Data Exchange Project Introduction





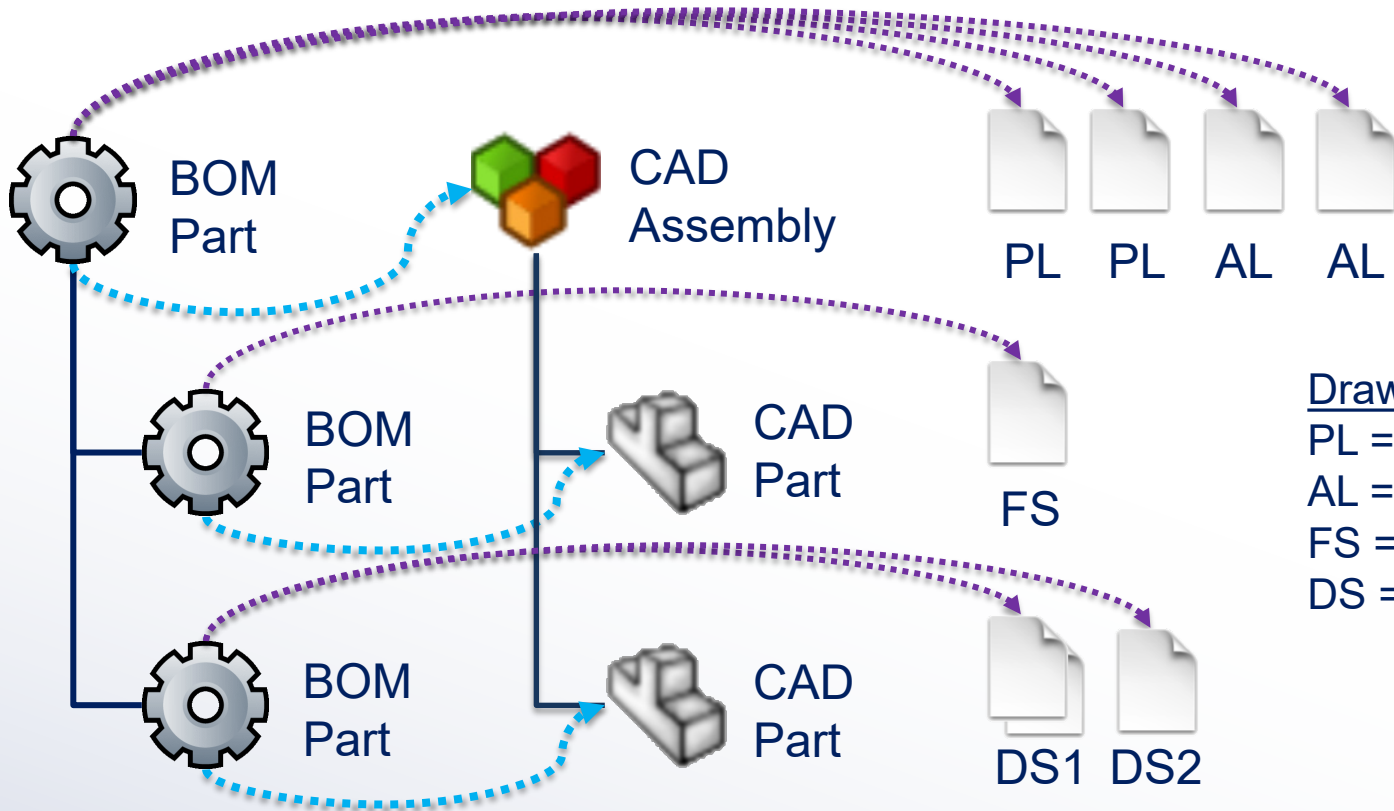
# Solution: Tech Data Profile



- Technical data package overview
  - CATIA V5 MBD + associated lists in TIF & PDF
  - Ambiguous Engineering BOMs in Excel
  - Heterogeneous standards/norms
  - Many data domains (sheet metal, composite, tubing, etc.)
  - Many observable “patterns”
  - Data set not “PLM-ready”



# Solution: Tech Data Structure

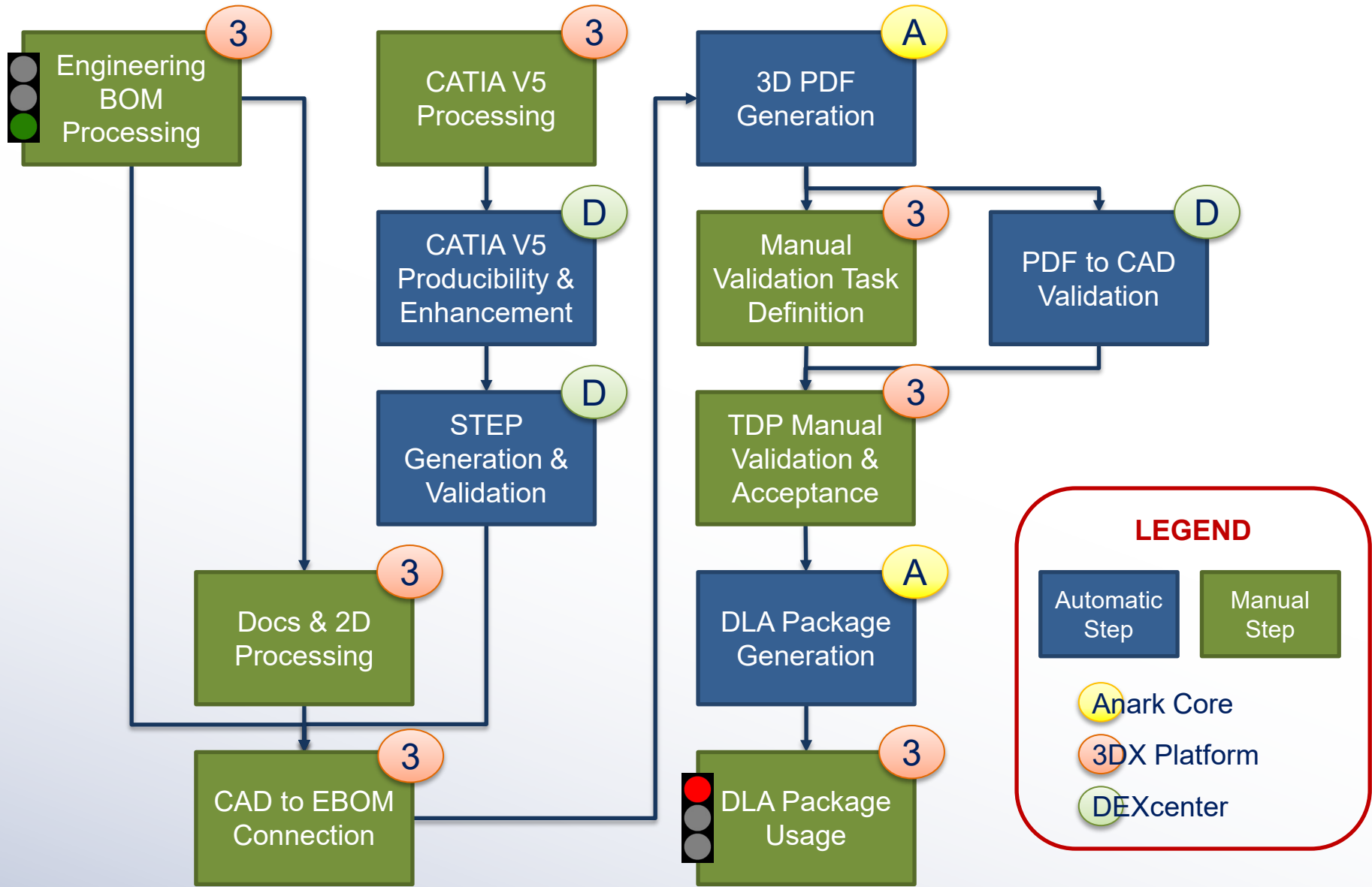


Drawing Prints:  
PL = Parts List  
AL = Application List  
FS = Field Sheet (2D Dwg)  
DS = Data Sheet (Text Dwg)

\* Some of the related documents shown may not be present or required



# Solution: TDP Ingestion Process





# Solution: 3DDE Micro Processes



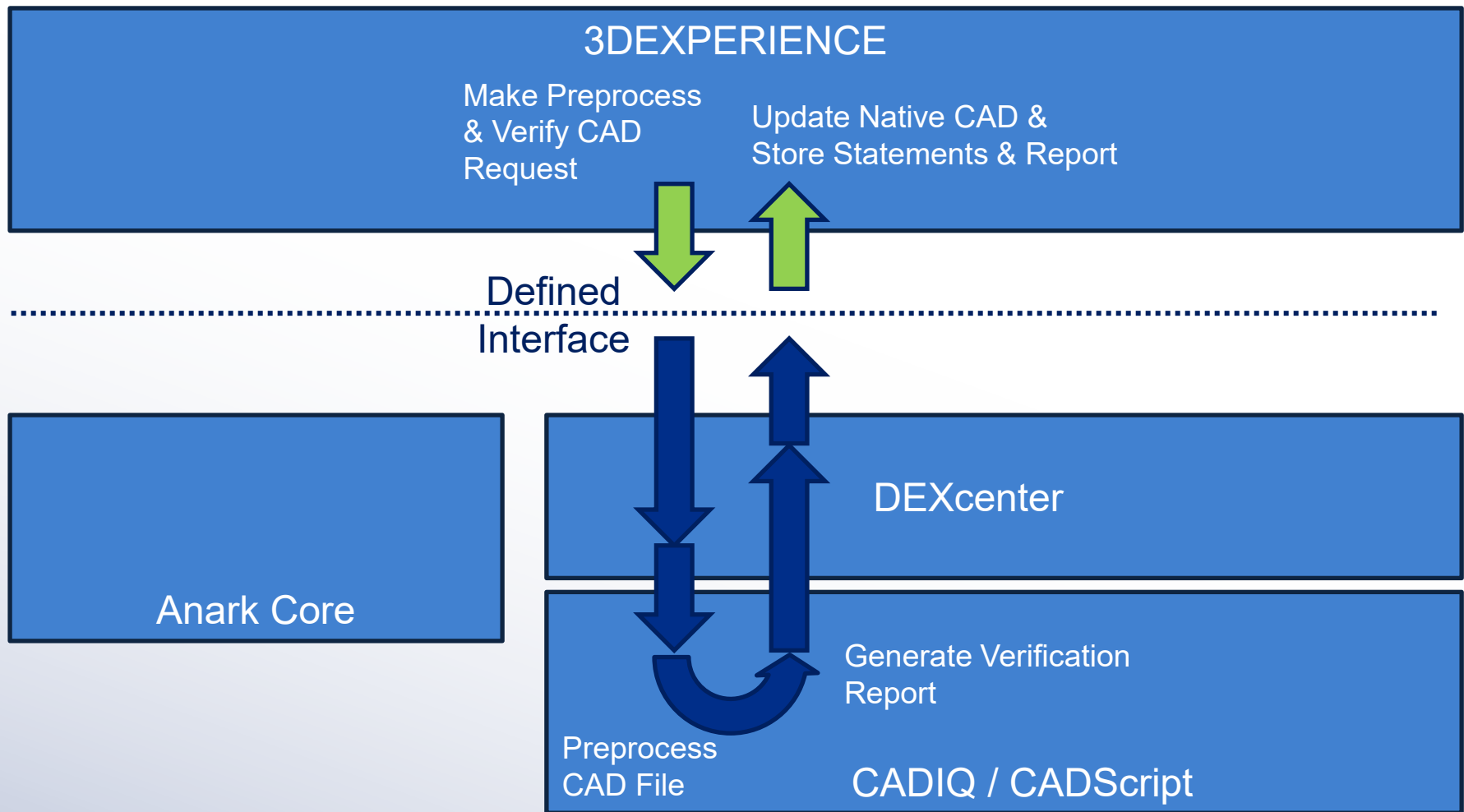
- **The 3DDE system is broken down into a group of 5 sequential micro-processes**
  - CATIA Preprocessing & Verification
  - STEP Generation and Validation
  - 3D PDF Generation
  - 3D PDF Validation
  - DLA Package Assembly & Publishing
- **This allows individual micro-processes developed, managed, and maintained independently of one another**
- **Process Interface and Data Schema control are critical**



# Solution: 3DDE Micro Processes

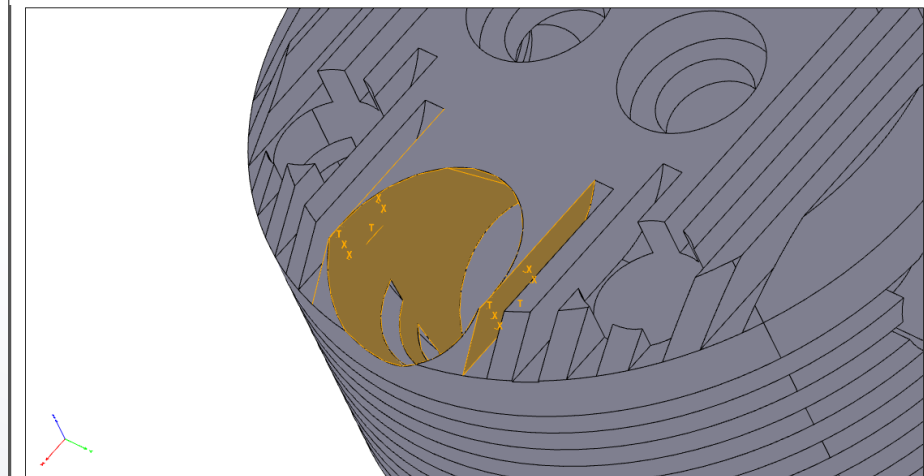
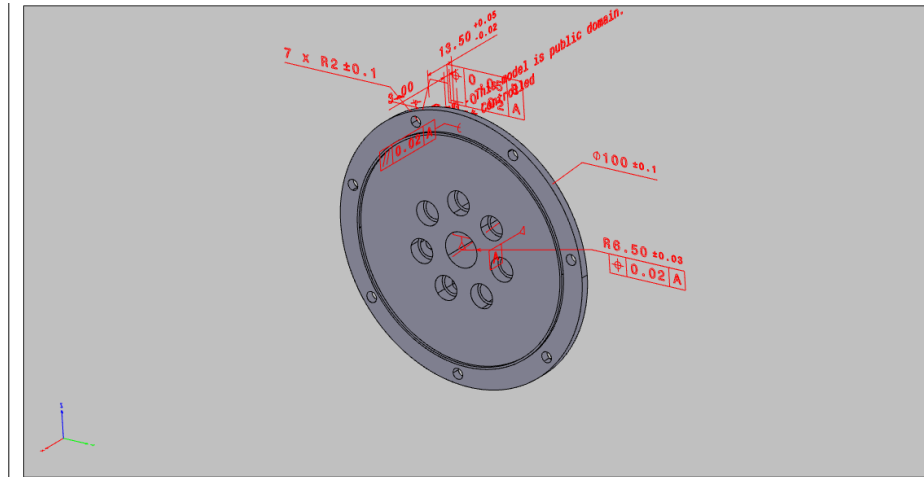


Preprocess = Extract Statements & Optimize Model for Publishing



# Solution: Preprocessing & Verification

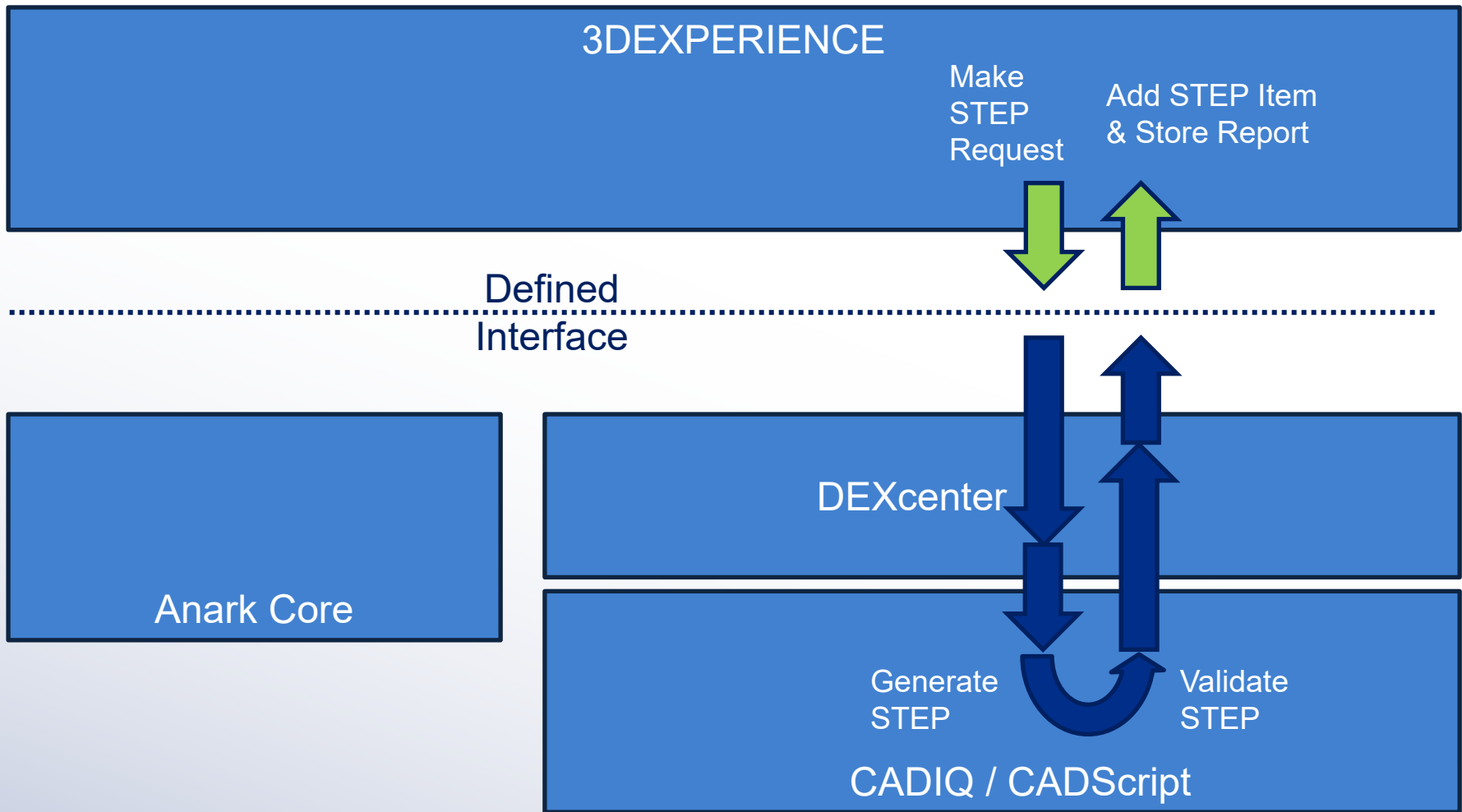
- Native CATIA preprocessing for optimized publishing
  - Rights Statements extraction
  - Visibility management
- Verification of native CATIA models
  - Geometry
  - PMI
  - Attributes
  - Product Structure
  - Model Views



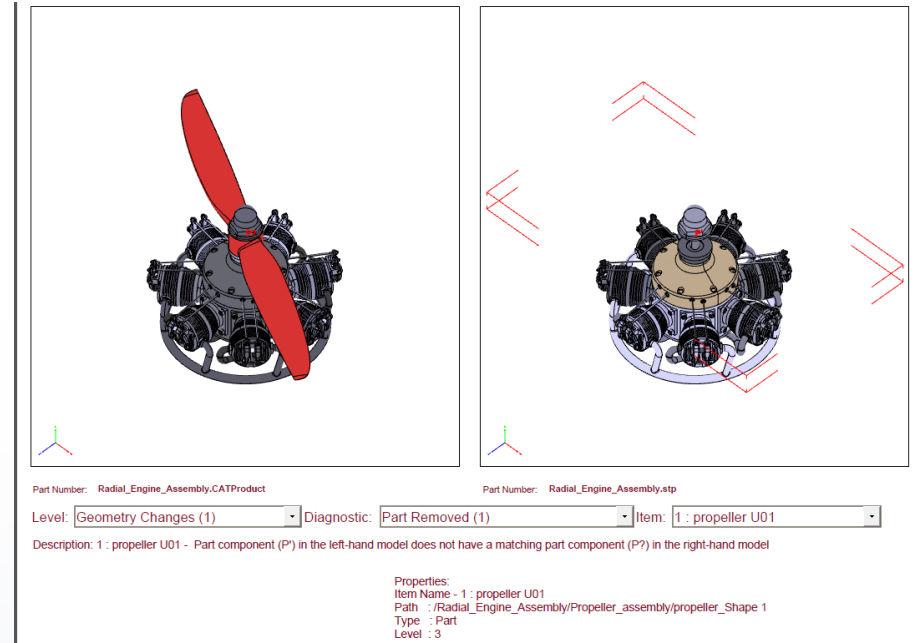
Part Number: 41\_cylinder\_head.CATPart  
Custom View: Thin Solid Volume  
Description: Hole feature leaves a thin wall near the cooling fin groove.  
Properties:  
Level: Geometry Defects  
Diagnostic: Thin Solid Volume  
Item: 1 : 0.00167109  
Item: 2 : 0.00167109



# Solution: 3DDE Micro Processes



- Generation of STEP AP242 file from native CATIA (AP203 currently)
- Validation of STEP models relative to native CATIA models
  - Geometry
  - PMI
  - Attributes
  - Product Structure
  - Model Views





# Solution: 3DDE Micro Processes



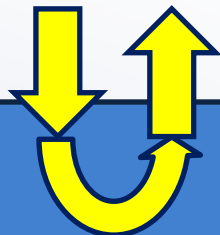
## 3DEXPERIENCE

Make  
3DPDF  
Request

Add 3DPDF  
Item



Defined  
Interface



Generate  
3DPDF

Anark Core

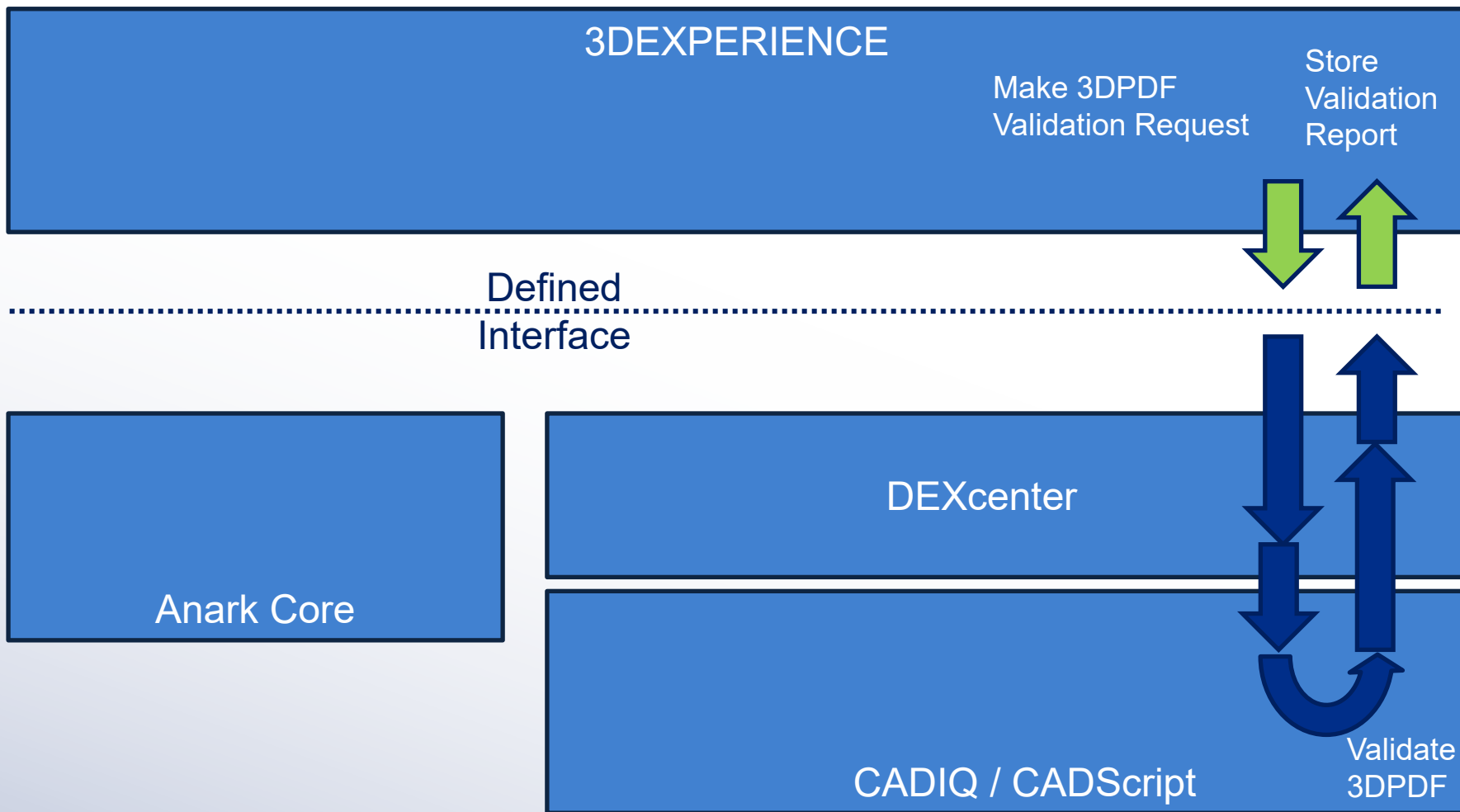
DEXcenter

CADIQ / CADScript





# Solution: 3DDE Micro Processes

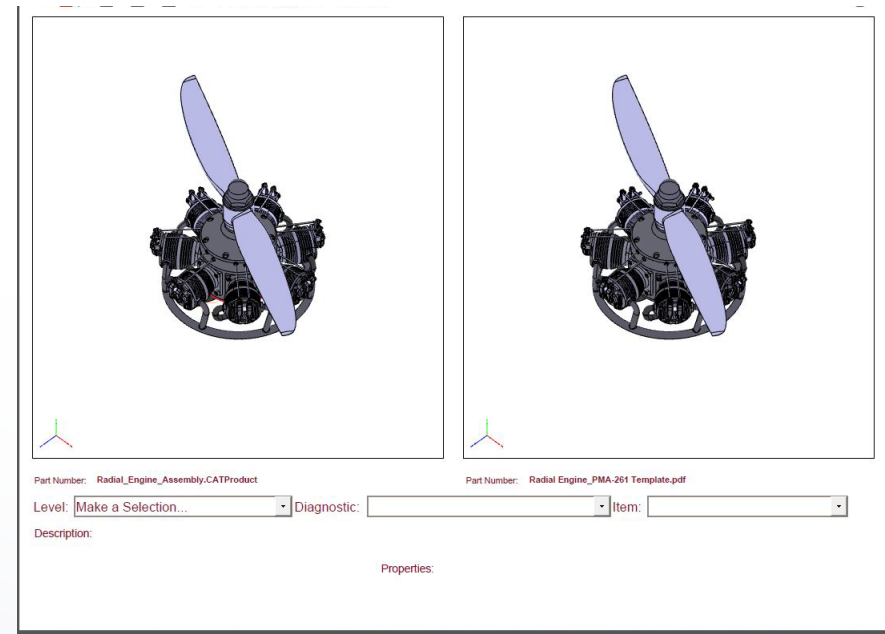




# Solution: Anark 3D PDF / Validation



- Validation of 3D PDF documents relative to native CATIA models
  - Geometry
  - PMI
  - Attributes
  - Product Structure
  - Model Views

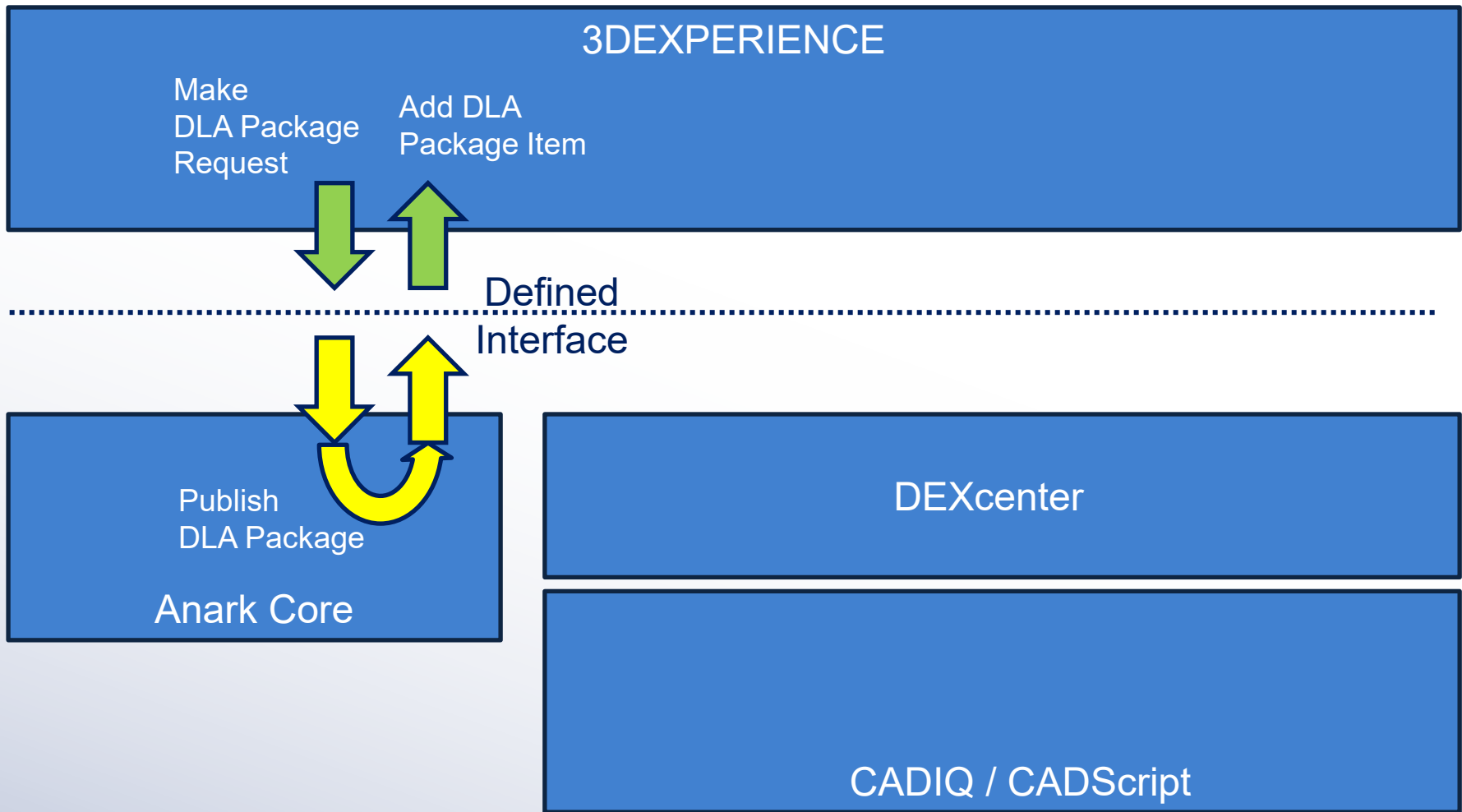




# Solution: 3DDE Micro Processes



DLA Package = Attaching validated STEP File / adding Approval





# Solution: 3D PDF Document Layout

## Anark Core automated mapping of CATIA V5 MBD content along with BOM, Part/Application Lists, Field and Text Sheets – Sheet 1 of N

**CATIA V5 Model-Based Definition**

**BOM**

**Notes & Statements**

**VIEW FOR REFERENCE ONLY**

**PAGE 1**

DEPARTMENT OF THE NAVY  
NAVAL AIR SYSTEMS COMMAND  
PATUXENT RIVER, MD 20670

CLASSIFICATION: UNRESTRICTED  
CORE ITEM(Y/N): YES

DESIGN CAGE: 11221  
DESIGN REV: C  
DESIGN MODIFICATION DATE: 2017-02-17

NOMENCLATURE: RADIAL ENGINE ASSEMBLY

PART OR IDENTIFICATION NUMBER: Radial Engine Assembly  
EST WT: 174.311lbs

NAVAL DOC NUMBER: 223123-04-05  
DOCUMENT APPROVAL: [Signature] James Martin  
APPROVAL DATE: 2018-01-01  
CAD PROGRAM: CATIA V5

NOTES:  
UNLESS OTHERWISE SPECIFIED:  
•ALL BELOW NOTES HAVE NO MEANING AND ARE AN EXAMPLE ONLY.  
•DIMENSIONING AND TOLERANCEING SHALL BE INTERPRETED IAW ASME Y14.5-2009.  
•PRODUCT DEFINITION DATA SET (PDDS) TO BE INTERPRETED IAW ASME Y14.41-2012.  
•DIMENSIONS ARE IN INCHES.  
•PARTS ARE MODELED AT THE NOMINAL DIMENSIONAL CONDITION. IF A NOMINAL CONDITION DOES NOT EXIST, THE PART SHALL BE MODELED AT THE MEDIAN DIMENSIONAL CONDITION.  
•THE TRUE GEOMETRY OF THE PART DEFINES THE THEORETICALLY EXACT SIZE, PROFILE, ORIENTATION, OR LOCATION OF A FEATURE OR FEATURE SET. IT IS THE BASIS FROM WHICH DIMENSIONAL VARIATIONS ARE ESTABLISHED BY APPLIED TOLERANCES.  
•REMOVE BURRS AND BREAK ALL SHARP EDGES.  
•ALL SURFACES IN THIS MODEL THAT APPEAR TO BE INTERSECTING AT RIGHT ANGLES SHALL HAVE IMPLIED 90 DEGREE INTERSECTION ANGLES. THE ALLOWABLE TOLERANCE ON THESE ANGLES SHALL BE AS SPECIFIED ON THE DRAWING.

REVISION NOTES:  
A. 12June2016 initial design  
B. 19Dec2016 for next phase prototyping purposes  
C. 17Mar2017 initial manufacturing prototyping revision  
END OF STATEMENT

DISTRIBUTION STATEMENT:  
DISTRIBUTION UNLIMITED AS THIS IS NOT A REAL PRODUCT WITH REAL DATA

EXPORT CONTROL:  
This is not a real model or a product and thus, there are no export controls on any information in this document.

CRITICALITY STATEMENT:  
Criticality is a part identified as critical by the design approval authority during the product type validation process, or otherwise by the reporting authority. Typically, such components include parts for which a replacement time, inspection interval, or related procedure is specified in the Airworthiness Limitations section or certification

DATA RIGHTS:  
This is not a real model or a product and thus, there are no data rights on any information in this document.

LICENSE AGREEMENT:  
There is no licensing needed to open this and all 3D PDF documents

MISC MARKING:  
No markings have been applied but, automated watermark creation and updating is possible with type of document

QTY	DESIGN CAGE	PART OR IDENTIFICATION NUMBER	NOMENCLATURE	MATERIAL	SPECIFICATION
1	11221	Radial_Engine_A	RADIAL ENGINE ASSEMBLY		
1	13256	Exhaust_intake	EXHAUST INTAKE PIPES		
1	43789	Gear_assembly	GEAR ASSEMBLY	Titanium Grade 11	ASME SB-338
7	12749	Piston_assembly	PISTON ASSEMBLY	316Ti Plate	ASTM S30415
1	12639	Propeller_assem	PROPELLER ASSEMBLY	Carbon Fiber	AMS 2980A
1	52745	crank-case-asse	ROCKER ARM ASSEMBLY	PH13-8Mo	AMS 5629, Type 1
1	13453	backplate-assy	BACKPLATE ASSEMBLY	PH13-8Mo	AMS 5629, Type 1
1	52745	crank-case-asse	CRANK CASE ASSEMBLY	PH13-8Mo	AMS 5629, Type 1
1	13994	crank-shaft-assy	CRANK SHAFT ASSEMBLY	321 Plate	ASTM S30415
7	45367	cylinder	ENGINE CYLINDER	Titanium Grade 9	AMS 4943
1	24619	front-housing-a	FRONT HOUSING ASSEMBLY	316Ti Plate	AISI 316
-----END OF LIST-----					

Sheet 1 of 2

Sheet Size: B



# Solution: 3D PDF Document Layout

## Anark Core automated mapping of CATIA V5 MBD with selectable BOM List driving a dynamic 3D PDF MBD View – Sheet 2 of N

**Selectable BOM**

**Interactive BOM Cross-Highlighting**

**Title Block**

**PAGE 2**

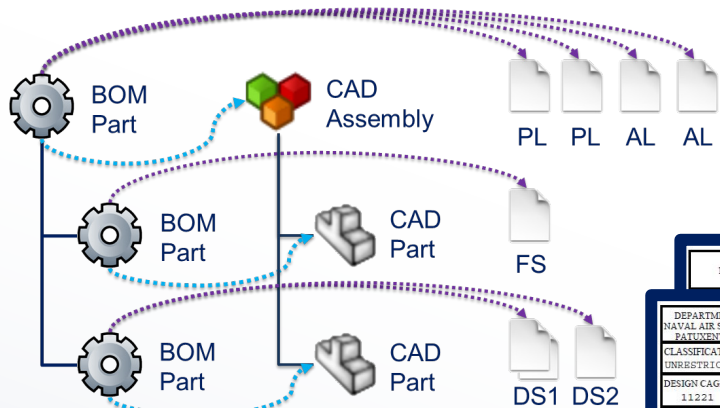
DEPARTMENT OF THE NAVY NAVAL AIR SYSTEMS COMMAND PATUXENT RIVER, MD 20670			
DESIGN CAGE: 11221	DESIGN REV: C	DESIGN MODIFICATION DATE: 2017-02-17	
NOMENCLATURE: RADIAL ENGINE ASSEMBLY			
PART OR IDENTIFICATION NUMBER: Radial Engine Assembly		EST WT: 174.31 lbs	
PARTS LIST FOR REFERENCE ONLY			
QTY	DESIGN CAGE	PART OR IDENTIFICATION NUMBER	NOMENCLATURE
1	11221	Radial_Engine_A	RADIAL ENGINE A
1	13256	Exhaust_Intake_	EXHAUST INTAKE
1	43789	Gear_assembly	GEAR ASSEMBLY
7	12749	Piston_assembly	PISTON ASSEMBLY
1	12639	Propeller_assem	PROPELLER ASSEM
7	65878	Rocker_arm_asse	ROCKER ARM ASSE
1	13452	Backplate Assy	BACKPLATE ASSEM
1	52745	crank-case-asse	CRANK CASE ASSE
1	13994	crank-shaft-ass	CRANK SHAFT ASS
7	45367	cylinder	ENGINE CYLINDER
1	24619	front-housing-a	FRONT HOUSING A
-END OF LIST-			



# Solution: 3D PDF Document Layout



## Anark Core automated appending of Part/Application Lists, Field Sheets, and Data Sheets – Sheet 3+ of N



Associated Lists

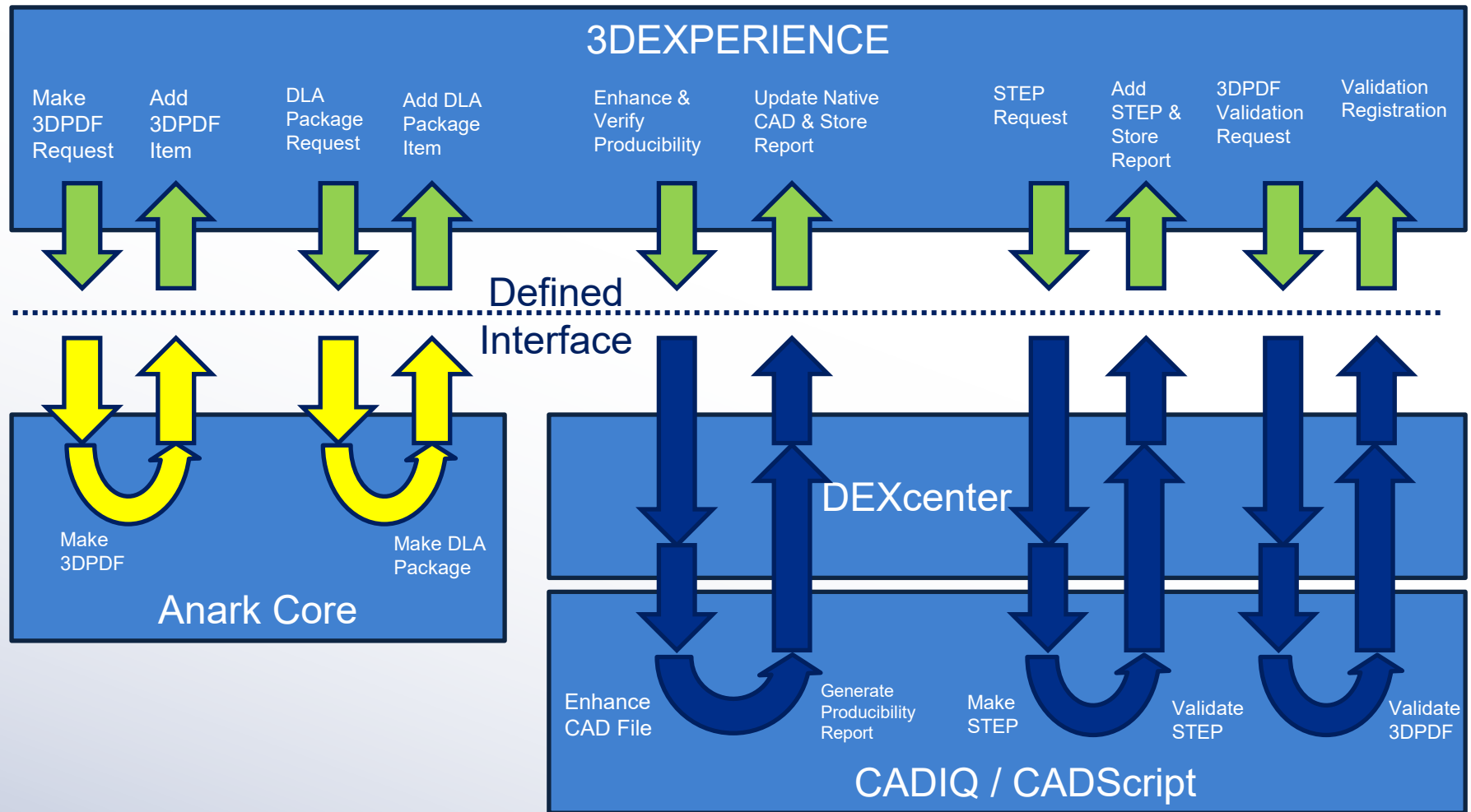
DEPARTMENT OF THE NAVY NAVAL AIR SYSTEMS COMMAND PATUXENT RIVER, MD 20670		PMA-26T 4417 George Road Building 612 Patuxent River, MD 20670	
CLASSIFICATION: UNRESTRICTED		CORE ITEM(Y/N): YES	
DESIGN CAGE: 11221	DESIGN REV: C	DESIGN MODIFICATION DATE: 2017-02-17	
NOMENCLATURE: RADIAL ENGINE ASSEMBLY			
PART OR IDENTIFICATION NUMBER: Radial Engine Assembly		EST WT: 174.311lbs	
NAVAIR DOC NUMBER: 223123-04-05			
DOCUMENT APPROVAL: James Martin			
APPROVAL DATE: 2018-01-01			
CAD PROGRAM: CATIA V5			
NOTES: UNLESS OTHERWISE SPECIFIED: •ALL BELOW NOTES HAVE NO MEANING AND ARE AN EXAMPLE ONLY. •DIMENSIONING AND TOLERANCING SHALL BE INTERPRETED IAW ASME Y14.5-2009. •PRODUCT DEFINITION DATA SET (PDDS) TO BE INTERPRETED IAW ASME Y14.41-2012. •DIMENSIONS ARE IN INCHES. •PARTS ARE MODELED AT THE NOMINAL DIMENSIONAL CONDITION. IF A NOMINAL CONDITION DOES NOT EXIST, THE PART SHALL BE MODELED AT THE MEDIAN DIMENSIONAL CONDITION. •THE TRUE GEOMETRY OF THE PART DEFINES THE THEORETICALLY EXACT SIZE, PROFILE, ORIENTATION, OR LOCATION OF A FEATURE OR DATUM. IT IS THE BASIS FROM WHICH PERMISSIBLE VARIATIONS ARE ESTABLISHED BY APPLIED TOLERANCING. •REMOVE BURRS AND BREAK ALL SHARP EDGES. •ALL SURFACES IN THIS MODEL THAT APPEAR TO BE INTERSECTING AT RIGHT ANGLES SHALL HAVE IMPLIED 90 DEGREE INTERSECTION ANGLES. THE ALLOWABLE TOLERANCE ON THESE ANGLES SHALL BE AS SPECIFIED ON THE			
REVISION NOTES: A. 12June2016 initial design B. 19Dec2016 for next phase prototyping purposes C. 17Mar2017 initial manufacturing prototyping revision -----END OF STATEMENT-----			
DISTRIBUTION STATEMENT: DISTRIBUTION UNLIMITED AS THIS IS NOT A REAL PRODUCT		EXPORT CONTROL: This is not a real model of a product and thus, there are no controls on any information in this document.	
CRITICALITY STATEMENT: Criticality is a part identified as critical by the holder during the product type validation process, or by exporting authority. Typically, such components include a replacement time, inspection interval, or reliability specified in the Airworthiness Limitations section of the			
DATA RIGHTS: This is not a real model of a product and thus, there are no rights on any information in this document.			
LICENSE AGREEMENT: There is no licensing needed to open this and all 3D			
MISC MARKING: No markings have been applied but, automated watermarking is possible with type of document			
QTY	DESIGN CAGE	PART OR IDENTIFICATION NUMBER	NO
1	11221	Radial_Engine_A	RADIAL ENGINE ASSEMBLY
1	13256	Exhaust_intake	EXHAUST INTAKE PIPES
1	43789	Gear_assembly	GEAR ASSEMBLY
7	12749	Piston_assembly	PISTON ASSEMBLY
1	12639	Propeller_assem	PROPELLER ASSEMBLY
7	65878	Rocker_arm_asse	ROCKER ARM ASSEMBLY
1	13453	backplate-assy	BACKPLATE ASSEMBLY
1	52745	crank-case-asse	CRANK CASE ASSEMBLY
1	13994	crank-shaft-ass	CRANK SHAFT ASSEMBLY
7	45367	cylinder	ENGINE CYLINDER
1	24619	front-housing-a	FRONT HOUSING ASSEMBLY

Data Sheet: 00000-00000-000 Rev ---		Page 1 of 2
Data Sheet: 00000-00000-000 Rev ---		Page 1 of 2
Data Sheet	REL AUTH	
PART NUMBER	PART NOMENCLATURE	PART REV ---
ORIGINATING CONTRACT NUMBER		ORIGINAL RELEASE AUTHORITY
DESIGNER		DESIGN SUPERVISOR
*** THIS DOCUMENT GENERATED FROM CATIA. REFER TO CATIA FILE DATA. ***		
FLIGHT SAFETY CRITERIA		
TABLE OF CONTENTS		
ORIGINAL RELEASE STATUS	UNLESS OTHERWISE SPECIFIED	
FLIGHT SAFETY CRITERIA	NOTES	
TABLE OF CONTENTS	FINISH REQUIREMENTS	
REVISION STATUS	INSPECTION REQUIREMENTS	
KEY CHARACTERISTICS		

PAGE 3+



# The 3DDE Solution





# Key Points



- **PMA-261**
  - Solution available for non-CAD users to consume MBD content
- **Anark**
  - Automated generation of validated standards-based 3D-PDF-based MIL-STD-31000 documents and Technical Data Packages (TDPs), with lifecycle-appropriate document markings, is a repeatable process from any PLM system





# Key Points



- **ITI**
  - Manipulate data for optimum publishing
  - Provide validated derivative data for trusted content publishing
- **Razorleaf Government Solutions**
  - Develop an architecture for a broad information delivery solution applicable to any PLM or CAD system
  - In a model-based world, 3D PDFs are great “fit-for-purpose” communication tools, but the volume of supporting data has to be managed



# Next Steps

- Implementing in NAVAIR data center for production use
- Explore modularizing solution for application to other PLMs and CADs
- Extend capability to other programs



# Close



- Thanks
  - Brent Gordon
    - 301-342-1128, [brent.gordon@navy.mil](mailto:brent.gordon@navy.mil)
  - Jim Merry
    - 240-674-5547, [jim.merry@anark.com](mailto:jim.merry@anark.com)
  - Asa Trainer
    - 508-904-7880, [asa.trainer@iti-global.com](mailto:asa.trainer@iti-global.com)
  - Jonathan Scott
    - 443-356-6846, [jonathan.scott@razorleaf.com](mailto:jonathan.scott@razorleaf.com)
- Questions?