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HOW TDPS AND QIF MOVE DOD DATA ACQUISITION TOWARDS AUTOMATION

Jennifer Herron, 4/17/2024

Jennifer Herron, Founder & CEO

FOUNDER & CEO

Jennifer Herron (She/Her)

EXPERTISE

B.S. in Mechanical Engineering

M.S. in Computer Engineering

- Advised **180+** organizations
- Strategic MBD and MBE Implementation Coaching
- MBD and MBE Solution Architecture
- MBD Pilot Planning
- MBD Modeling Standards and Best Practices
- Multi-CAD MBD and GD&T Authoring and Publishing
- MBD Supply Chain Readiness Coaching
- MBD-related software tool testing

CREDENTIALS

- Board Member, Digital Metrology Standards Consortium (DMSC), QIF
- ASME Y14 Series, Voting Member
- ASME Y14.46 Additive Manufacturing Product Definition Vice-Chair
- ISO 10303 TC 184, DMSC Liaison
- AIAG TDP, Voting Member
- Dare to Lead Certified
- Certified Scrum Product Owner®, Scrum Alliance
- Patent for Toroidal Propulsion and Steering System (Snake)
- 15 years of Spacecraft Design and Unmanned Ground Vehicles

PUBLICATIONS

- *Re-Use Your CAD: The Model-Based CAD Handbook* – 2nd Ed. & 1st Ed.
- Industry Blogs
- OSCAR Creator and content author

QUOTE

If you are going to CHANGE the results of your business, you have to change the WAY you do business.

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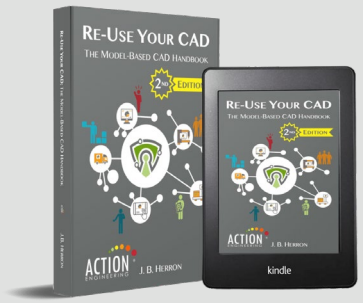
ACTION ENGINEERING

Coaching & Training Manufacturers Through 3D Data Transformations

Mission

To foster the adoption of 3D Data while inspiring a modern workforce.

ACTION ENGINEERING 15 YEARS 2008 - 2023



Team of Experts

Engineering + Adoption + User Experience

- Guided over 180 medium and large organizations, including many of the largest defense contractors in the world
- Published 3 textbooks on MBD and MBE
- Active members of over 10 national and international standards committees, assisting in standard development
- Specialties in writing organization specific Modeling and Best Practices

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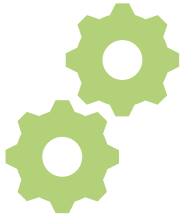
Topics

Why is 3D Technical Data Important?

What are the 3D Technical Data Adoption Challenges?



Use Case

3D TDP with QIF for

DOD to Supplier 3D Technical Data Exchange

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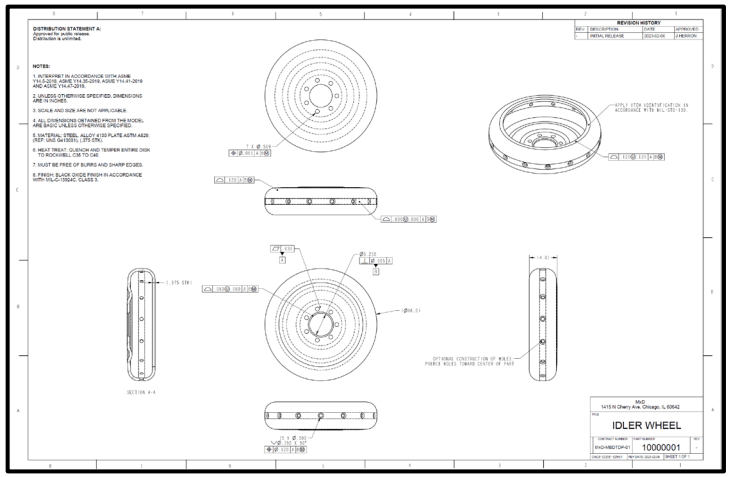
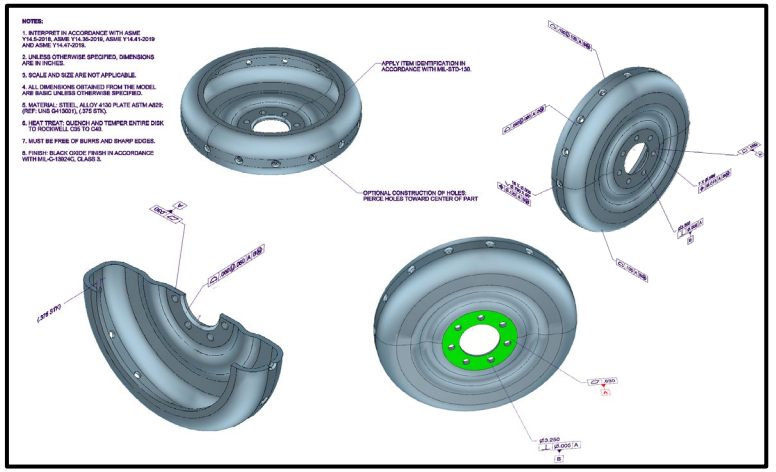
Why is 3D Technical Data Important?

Why 3D Technical Data?

3D Technical Data is digital-ready. 2D Drawings are not.



Only Human Interpretable



Human Interpretable and Machine Consumable

Current State

- **2D** drawing-based **Definition**
- Human-based **Security**
- Human-based **Availability**
- Uncontrolled **Accessibility** (hard to trace)

Future State

- **3D Model-Based Definition (MBD)**
- Cyber-based **Security**
- Credential-based **Availability** (who)
- Controlled **Accessibility** (when and where)

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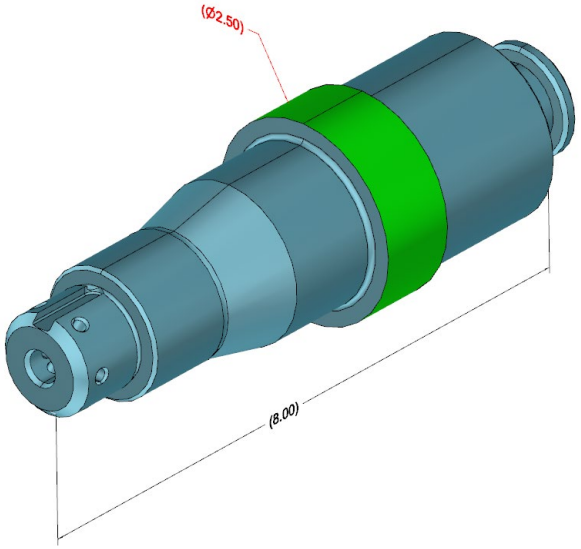
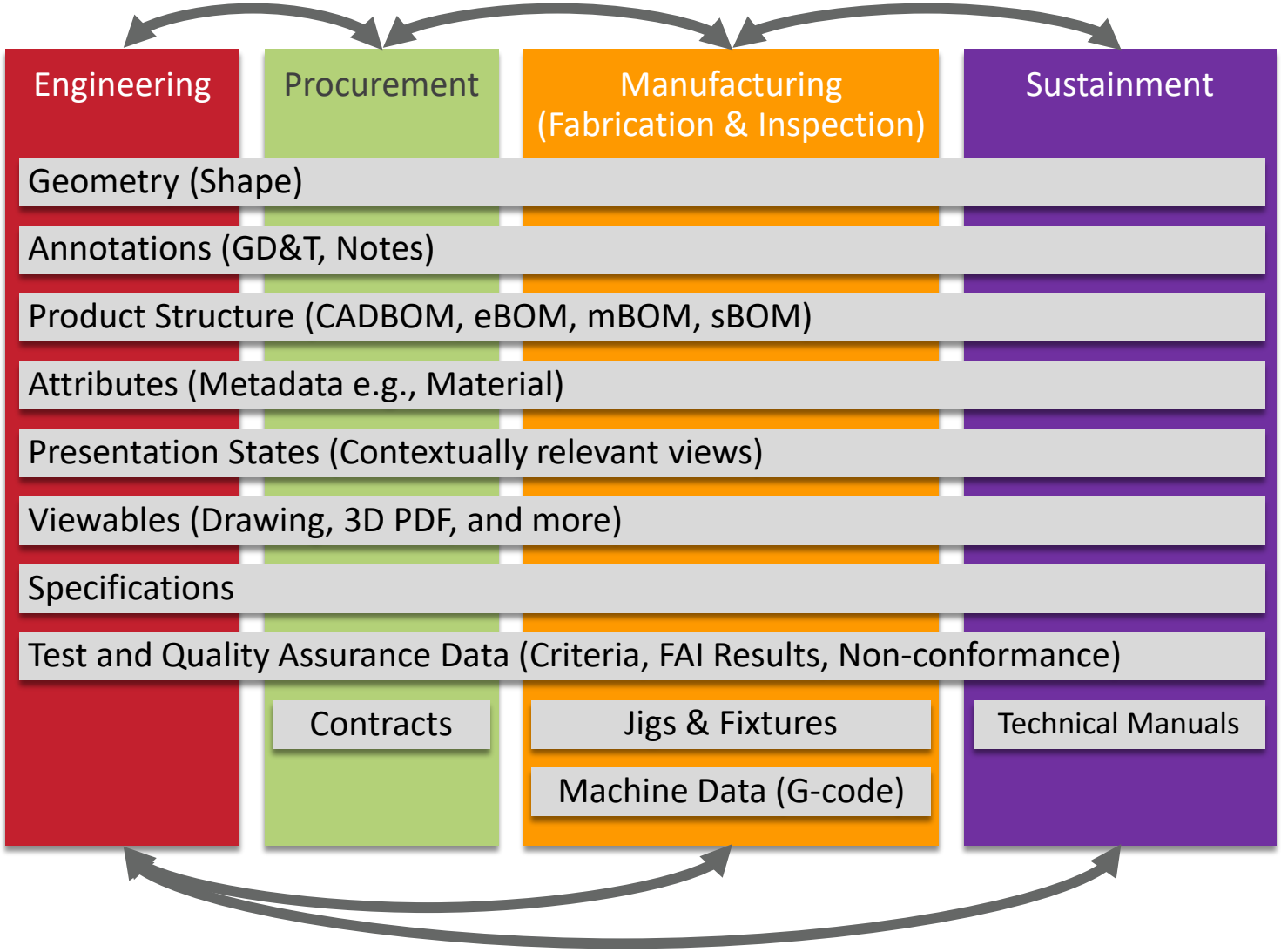
What is Technical Data?





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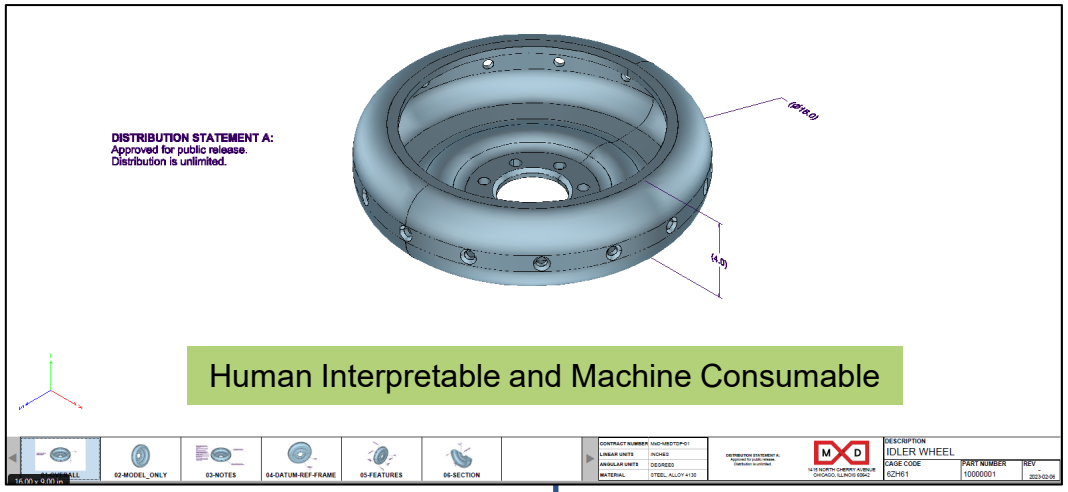
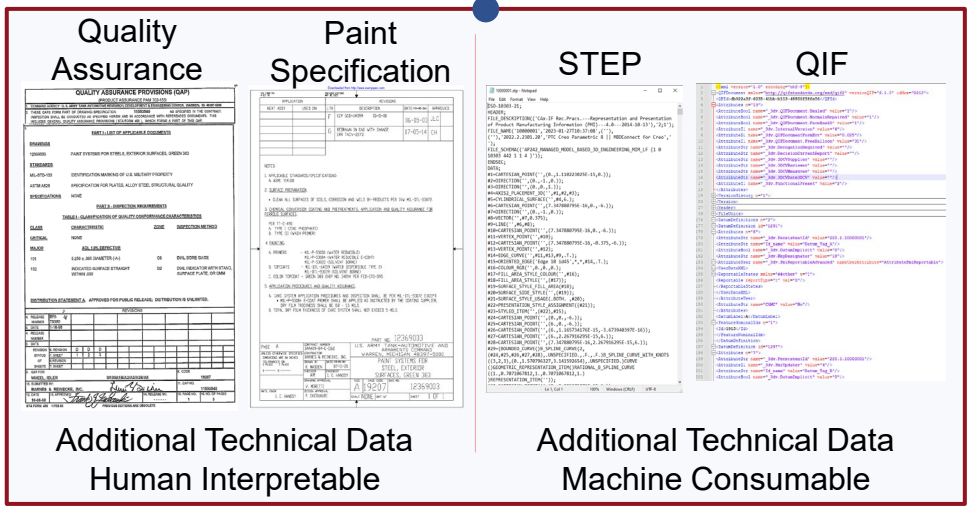
Future Target

The DOD must acquire technical data that is complete, interoperable, connected, and controlled such that the workforce trusts it.

Interoperable Technical Data





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DOD Mandates: 2018 Digital Engineering Strategy

Formalize the development, integration, and use of models to inform enterprise and program decision-making

Provide an enduring, authoritative **source of truth**

Incorporate **technological innovation** to improve the engineering practice

Establish a **supporting infrastructure** and environments to perform activities, collaborate, and communicate across stakeholders

Transform the **culture and workforce** to adopt and support digital engineering across the lifecycle

- Forma
  mode
  activi
  across
- Forma
  and cu
- Use m
  engin
  decisi
  lifecyc

3D Technical Data

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METHODS | PROCESSES | TOOLS | TECHNOLOGY | DATA | PEOPLE

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DOD Mandates: 2023 DoDI 5000.97 Digital Engineering

Digital Twin

A computerized representation (integrated set of models) that serves as the real-time digital counterpart of a physical object or process

Digital Model

- Requir

3D Technical Data

- Networks
- Tools
- Workforce

- Development
- Testing
- Manufacturing

Methods

- Model-Based Systems Engineering (MBSE)
- Modeling Languages

Practices

- DevSecOps

Digital Artifacts

- Specifications
- Technical drawings
- Design Documents
- Interface Management Documents
- Analytical Results

Digital Thread

- Requirements Analysis
- Architecture Development
- Design & Cost Trades
- Design Evaluations & Optimizations
- System, Subsystem, and Component Definition & Integration
- Cost Estimations
- Training Aids & Devices Development
- Developmental & Operational Tests
- Product Support

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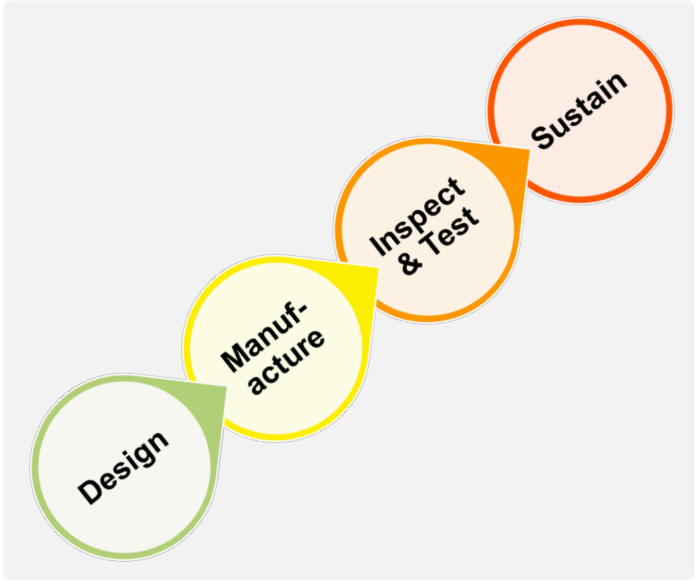
What are the 3D Technical Data Adoption Challenges?

1. Digital Data is Complex
2. 3D Digital Data Interoperability is Complex
3. People are Hard

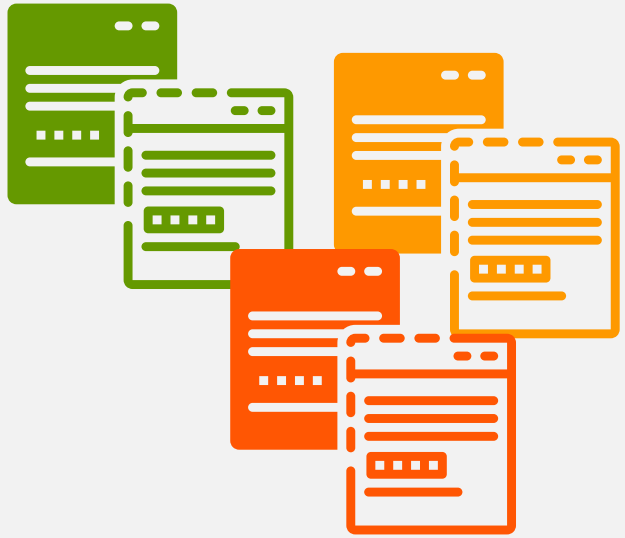
3D Digital Data Interoperability is Complex



4 Lifecycle Stages

AUTODESK® INVENTOR®
SOLIDWORKS MBD
SIEMENS NX
creo®
CATIA
SOLID EDGE

6 CAD Systems



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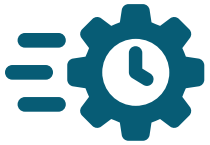
Importance of Digital Standards for Technical Data

Consistently structured, repeatable data



Efficient assembly & universal data exchange

Human:Machine Rosetta Stone

Standards provide a common language, ensuring interoperability, safety, and quality while driving innovation and market growth.

Michael Johnson, ASME Chief Strategy Officer

Repeatable processes & reliability

Accountable data authors

Streamline & ensure data integrity

Alleviate risks

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Leadership Readiness

BENEFITS

OPERATIONAL

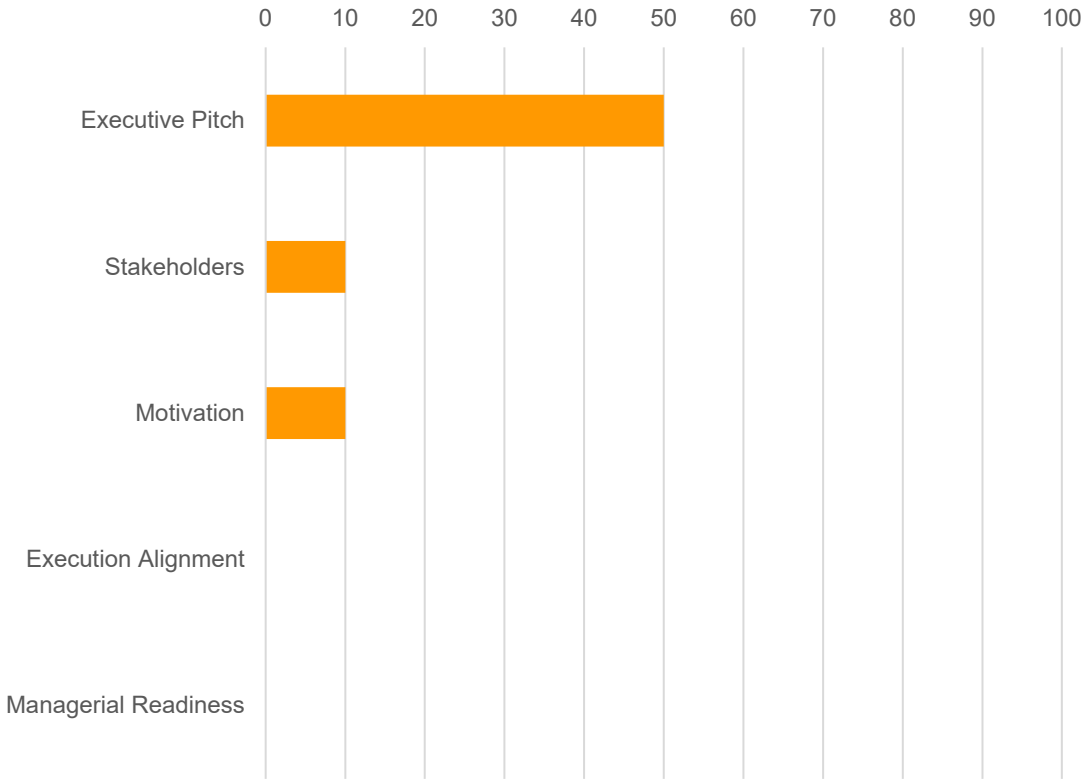
LEADERSHIP

DATA

CULTURE

BUDGET

SCHEDULE



EXECUTIVE PITCH

Executive pitch is defined and regularly presented and aligned

STAKEHOLDERS

Stakeholders are identified and core team members have presented elevator pitches to their leadership

MOTIVATION

Core Team and leadership are aware of motivators and motivators are part of communication planning

EXECUTION ALIGNMENT

Communication planning for leaders is defined and implemented

MANAGERIAL READINESS

Leaders have received converser-level training

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BENEFITS

OPERATIONAL

LEADERSHIP

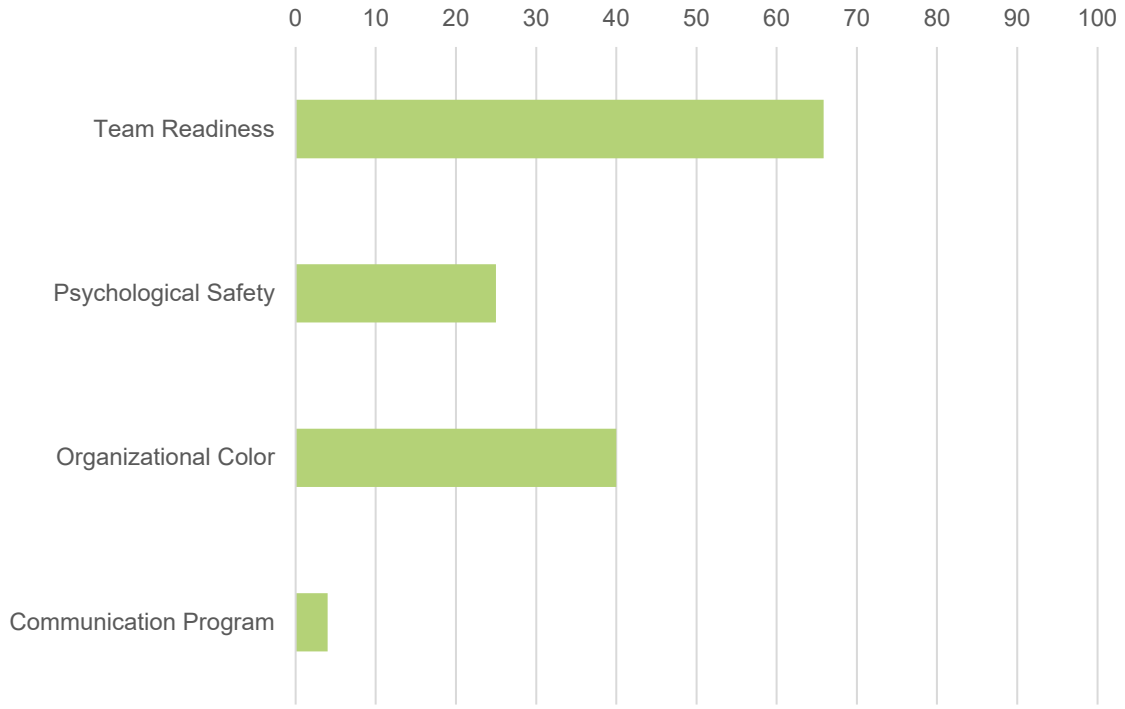
DATA

CULTURE

BUDGET

SCHEDULE

Cultural Readiness



TEAM READINESS

Expands to additional teams as rollout and adoption are expanded

PSYCHOLOGICAL SAFETY

Level of psychological safety in place

ORGANIZATIONAL COLOR

Organizational level of transparency, agility, and empowerment

COMMUNICATION PROGRAM

Beginning with elevator pitches, this is a full scheduled and coordinated messaging program

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USE CASE: 3D TDP WITH QIF

A Future State for 3D Digital Technical Data Acquisition to Improve Part Procurement

Courtesy of LMI Project

Objectives

Vision

To improve the exchange of product definition and effective data access between DOD and Suppliers during the bid and award phase.

Goals

- To demonstrate technical data access and collaboration activities using 3D data in the Cloud (e.g., review, comment, and feedback)
- To create machine-readable standards-compliant 3D technical data that can be leveraged throughout the Digital Thread

(with skilled 3D Data practitioners)

Metrics

Increase Technical Data interoperability	30%
Documented feedback loops and data traceability	90%
Manufacturing Automation Improvements	30%

Reduce Current Pain Points

- Reduce communication gap between Design Contractor, DOD Service, and Supplier
- Improve technical data acquisition review process
- Reduce design interpretation errors and omissions

Business Objectives

Modernizing Technical Data	Real-world 3D data is authored to be digital ready for fabrication and inspection
Enabling the Digital Thread	With digital ready 3D data, expanded business objectives may be achieved

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3D TDP Scenario: Technical Data Exchange & Collaboration between DOD Service & Supplier

PART NUMBER 10000004 **DESCRIPTION** SUPPORT ASSEMBLY

TDP = Technical Data Package
TPP = Technical Procurement Package
ECP = Engineering Change Proposal

3D TDP Capabilities

- MBD Assembly
- Verification of Native MBD
- 3D Interactive Viewable (3DIV)
- 3D Interactive Parts List
- Bill of Characteristics (BoC)
- First Article Inspection Report (FAIR)
- Derivative Validation
- Commenting

3D TDP Elements

Item	Item Description
Native Creo	10000004.prt
3D PDF	10000004.pdf
STEP AP-242	10000004.stp
QIF	10000004.qif includes the BoC
FAIR (AS9102B)	10000004 FAIR.xls
AnarkCollaborate	Cloud HTML

	Activity	Who	Input	Output
REVIEW	**Receive** and **Review** the model from the Design Contractor	Army	Native Creo	Comments and Corrections
	Feedback is provided to the Design Contractor	Army	Comments and Corrections	Native Creo
	Corrections made and resubmits to the Army	Design Contractor	Native Creo	Native Creo
	Publish to 3D PDF and STEP	Army	Native Creo and 3D PDF Army Template	3D PDF STEP QIF and FAIR
RELEASE	**Submit** ECP to Configuration Management	Army	ECP	ECP
	Create the TPP	Army	Native Creo 3D PDF STEP QIF and FAIR	.zip
	Review and **Approve** by Configuration Control Board	Army	TPP	TPP
PROCUREMENT	**Receive** and **Post** to Suppliers	DLA	TPP	TPP
	Supplier Downloads and Bids	Supplier	TPP	Quote
	Award Contract	DLA	Contract	PO
	Supplier manufactures parts, tests, and delivers	Supplier	Final part and Quality results	Final part QIF Results and Completed FAIR

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RE-ENGINEERED NSNS

Dist D data sets were created

Dist A data sets were created from the Dist D data with modified shape, dimensions, tolerances, notes, and materials

Courtesy of a MxD and LMI Projects

Idler Wheel

Courtesy of MxD Project

NOTES:

1. INTERPRET IN ACCORDANCE WITH ASME Y14.5-2018, ASME Y14.35-2019, ASME Y14.41-2019 AND ASME Y14.47-2019.

2. UNLESS OTHERWISE SPECIFIED, DIMENSIONS ARE IN INCHES.

3. SCALE AND SIZE ARE NOT APPLICABLE.

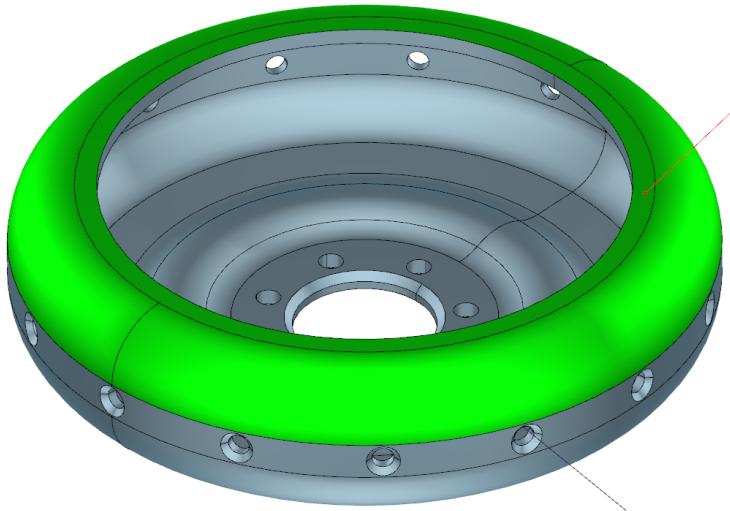
4. ALL DIMENSIONS OBTAINED FROM THE MODEL ARE BASIC UNLESS OTHERWISE SPECIFIED.

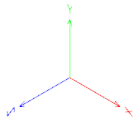
5. MATERIAL: STEEL, ALLOY 4130 PLATE ASTM A829; (REF: UNS G413001), (.375 STK).

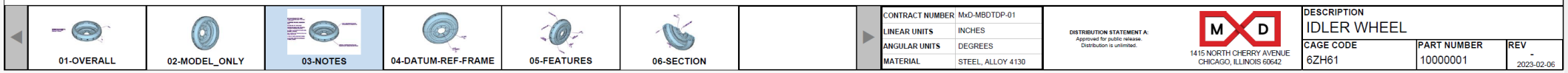
6. HEAT TREAT: QUENCH AND TEMPER ENTIRE DISK TO ROCKWELL C35 TO C40.

7. MUST BE FREE OF BURRS AND SHARP EDGES.

8. FINISH: BLACK OXIDE FINISH IN ACCORDANCE WITH MIL-C-13924C, CLASS 3.







CONTRACT NUMBER	MxD-MBDTDP-01
LINEAR UNITS	INCHES
ANGULAR UNITS	DEGREES
MATERIAL	STEEL, ALLOY 4130

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M D
1415 NORTH CHERRY AVENUE
CHICAGO, ILLINOIS 60642

DESCRIPTION: IDLER WHEEL

CAGE CODE	PART NUMBER	REV
6ZH61	10000001	- 2023-02-06

Attachments

Name

- 10000001 FAIR.xlsx
- 10000001.qif
- 10000001.stp
- MIL-C-13924C.pdf

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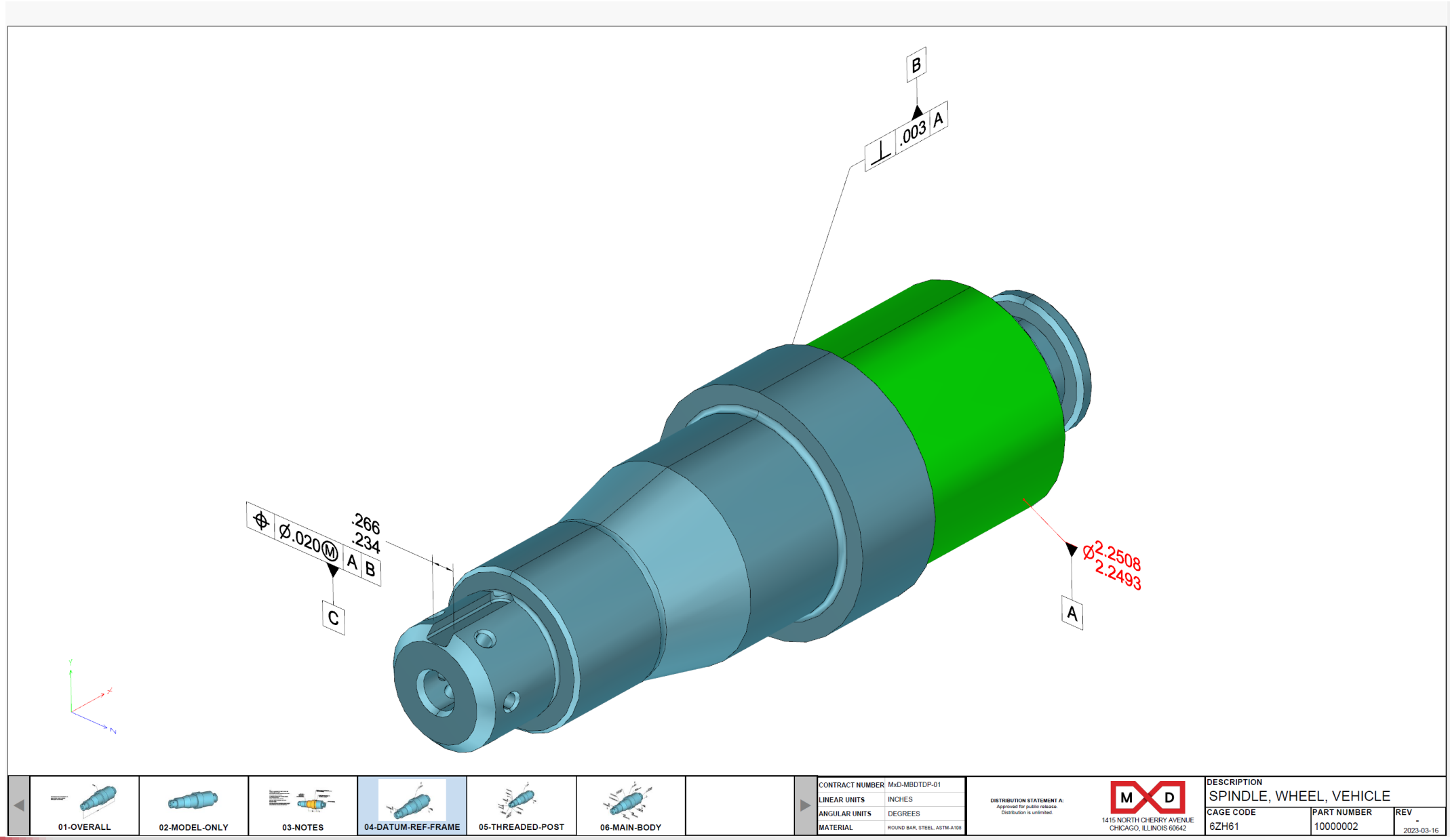
Spindle

Courtesy of MxD Project



Attachments

Name

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- 10000002.qif
- 10000002.stp
- MIL-STD-130_NOTICE-1.pdf
- MIL-STD-130N_CHG-1.pdf

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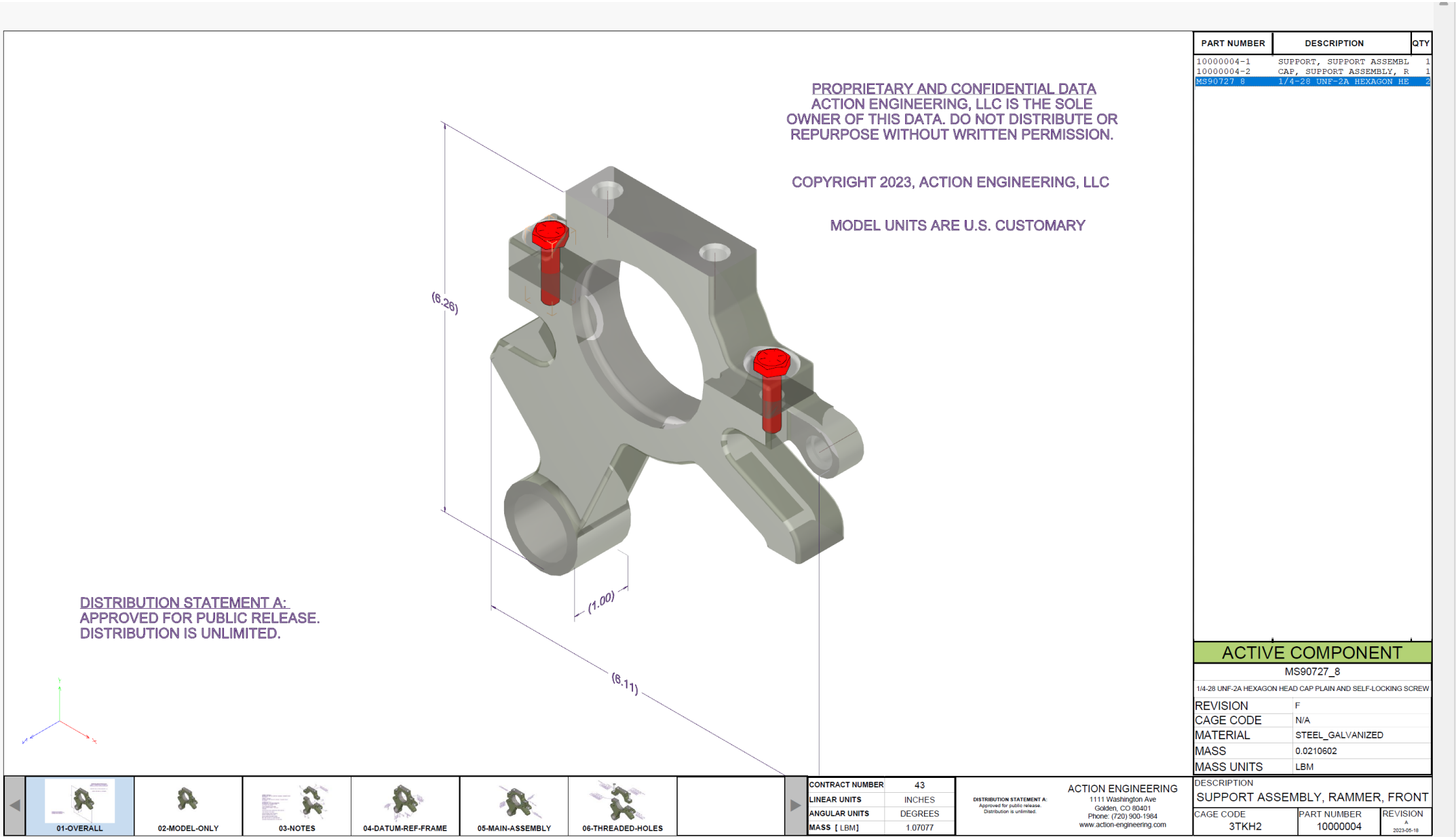
Support Assembly

Courtesy of LMI Project



Attachments

Name

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- 10000004-rammer_support.qif
- 10000004-support_prt.stp
- Drawing_12369004.pdf

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Data Elements That Make Up the 3D TDP of an Assembly

3D TDP Capability	MBD Assembly	Verification of Native MBD	3D Interactive Viewable (3DIV) and 3D Interactive Parts List	Bill of Characteristics (BoC) and First Article Inspection Report (FAIR)	Derivative Validation	Commenting
Possible File Formats	Creo (.asm & .prt) STEP (.stp)	Creo (.asm & .prt)	3D PDF (.pdf) HTML	QIF (.qif) Excel (.xlsx) HTML	3D PDF (.pdf) HTML	HTML

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Software Tool Options for Accomplishing the 3D TDP Capabilities

3D TDP Capability	MBD Assembly	Verification of Native MBD	3D Interactive Viewable (3DIV) and 3D Interactive Parts List	Bill of Characteristics (BoC) and First Article Inspection Report (FAIR)	Derivative Validation	Commenting
Software Tool Options	creo 8	3DCS Variation Analyst creo ModelCHECK GD&T ADVISOR CETOL 6σ Elysium 3DxSUITE ITI CADIQ a wipro company	ANARK Workstation Elysium 3DxSUITE	CAPVIDIA	Elysium 3DxSUITE ITI CADIQ a wipro company	ANARK Collaborate COLAB

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3D TDP Capabilities, Software Tool

3D TDP Capability	MBD Assembly	Verification of Native MBD	3D Interactive Viewable (3DIV) and 3D Interactive Parts List	Bill of Characteristics (BoC) and First Article Inspection Report (FAIR)	Derivative Validation	Commenting
Software Tool Opions	creo 8	3DCS Variation Analyst creo ModelCHECK GD&T ADVISOR CETOL 6σ Elysium 3DxSUITE ITI CADIQ	ANARK Workstation Elysium 3DxSUITE	CAPVIDIA	Elysium 3DxSUITE ITI CADIQ	ANARK Collaborate COLAB
Possible File Formats	Creo (.asm & .prt) STEP (.stp)	Creo (.asm & .prt)	3D PDF (.pdf) HTML	QIF (.qif) Excel (.xlsx) HTML	3D PDF (.pdf) HTML	HTML

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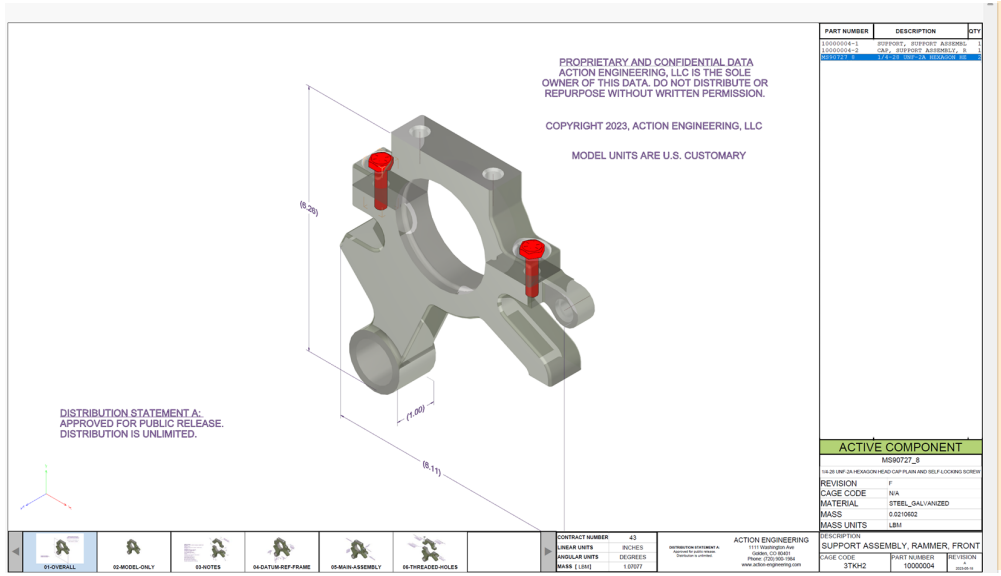
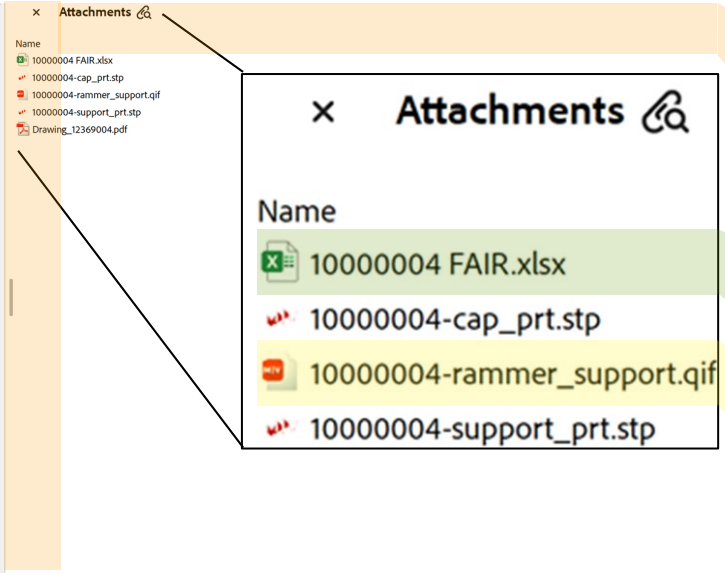
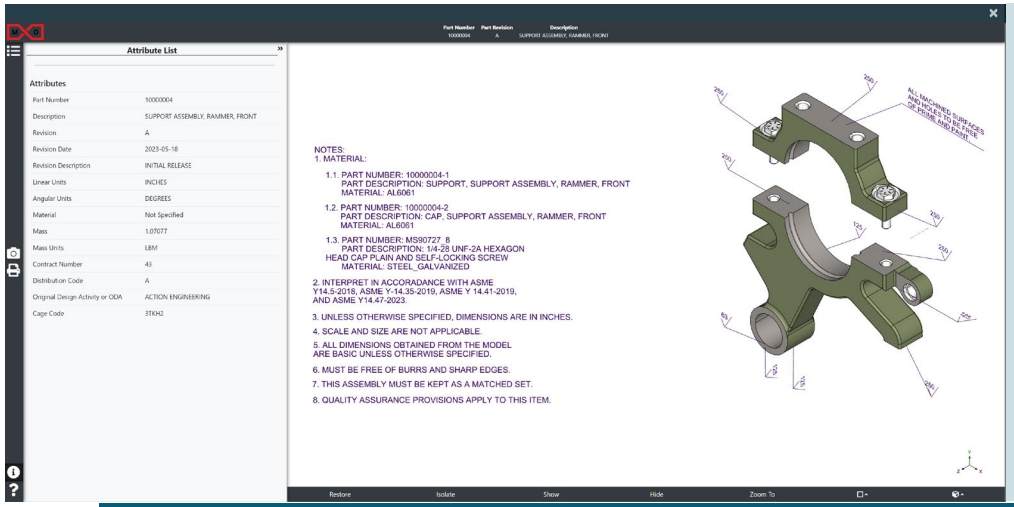
Support Assembly







3D TDP Capabilities

- 3D Interactive Viewable (3D PDF)
- First Article Inspection Report (FAIR)
- Bill of Characteristics (BoC)
- Commenting

Creo .asm is published to 3D PDF and AnarkCollaborate from the same source

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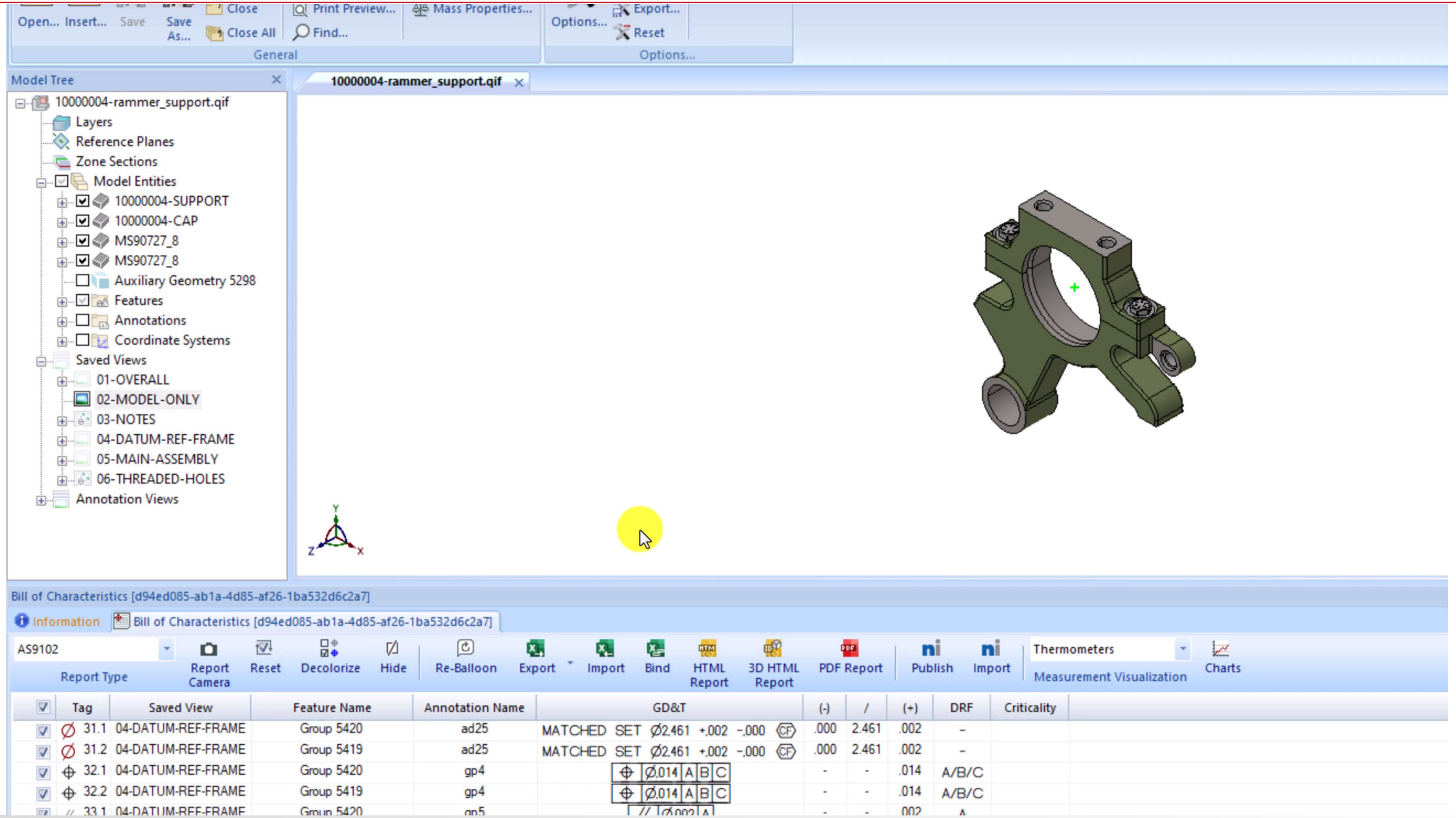
QIF Viewing and Reporting



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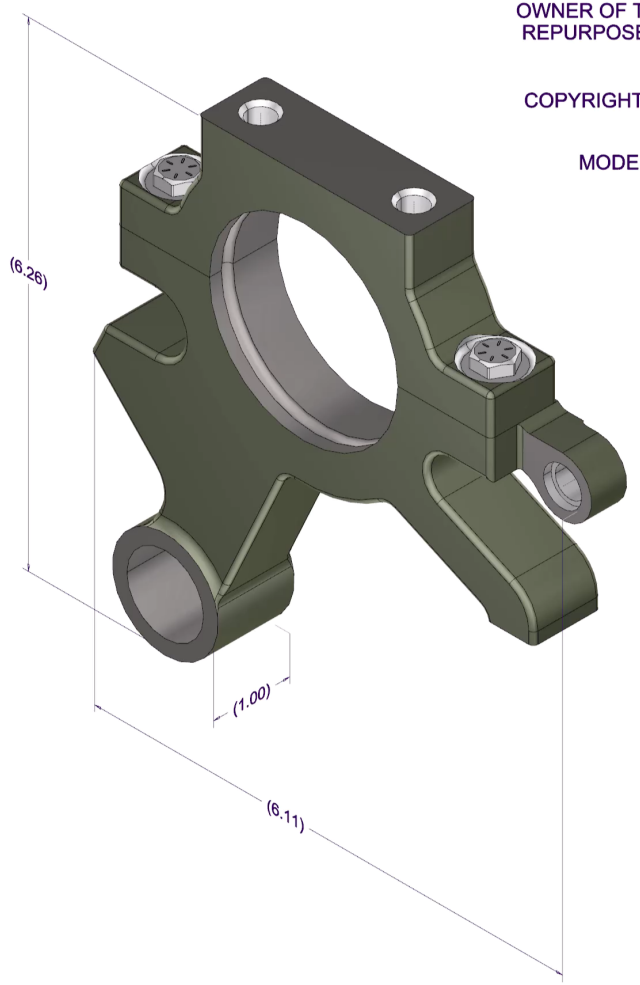

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10000004-2	CAP, SUPPORT ASSEMBLY, R	1
MS90727_8	1/4-28 UNF-2A HEXAGON HE	2

ACTIVE COMPONENT

REVISION	
CAGE CODE	
MATERIAL	
MASS	
MASS UNITS	

01-OVERALL | 02-MODEL-ONLY | 03-NOTES | 04-DATUM-REF-FRAME | 05-MAIN-ASSEMBLY | 06-THREADED-HOLES

CONTRACT NUMBER	43
LINEAR UNITS	INCHES
ANGULAR UNITS	DEGREES
MASS [LBM]	1.07077

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CAGE CODE	PART NUMBER	REVISION
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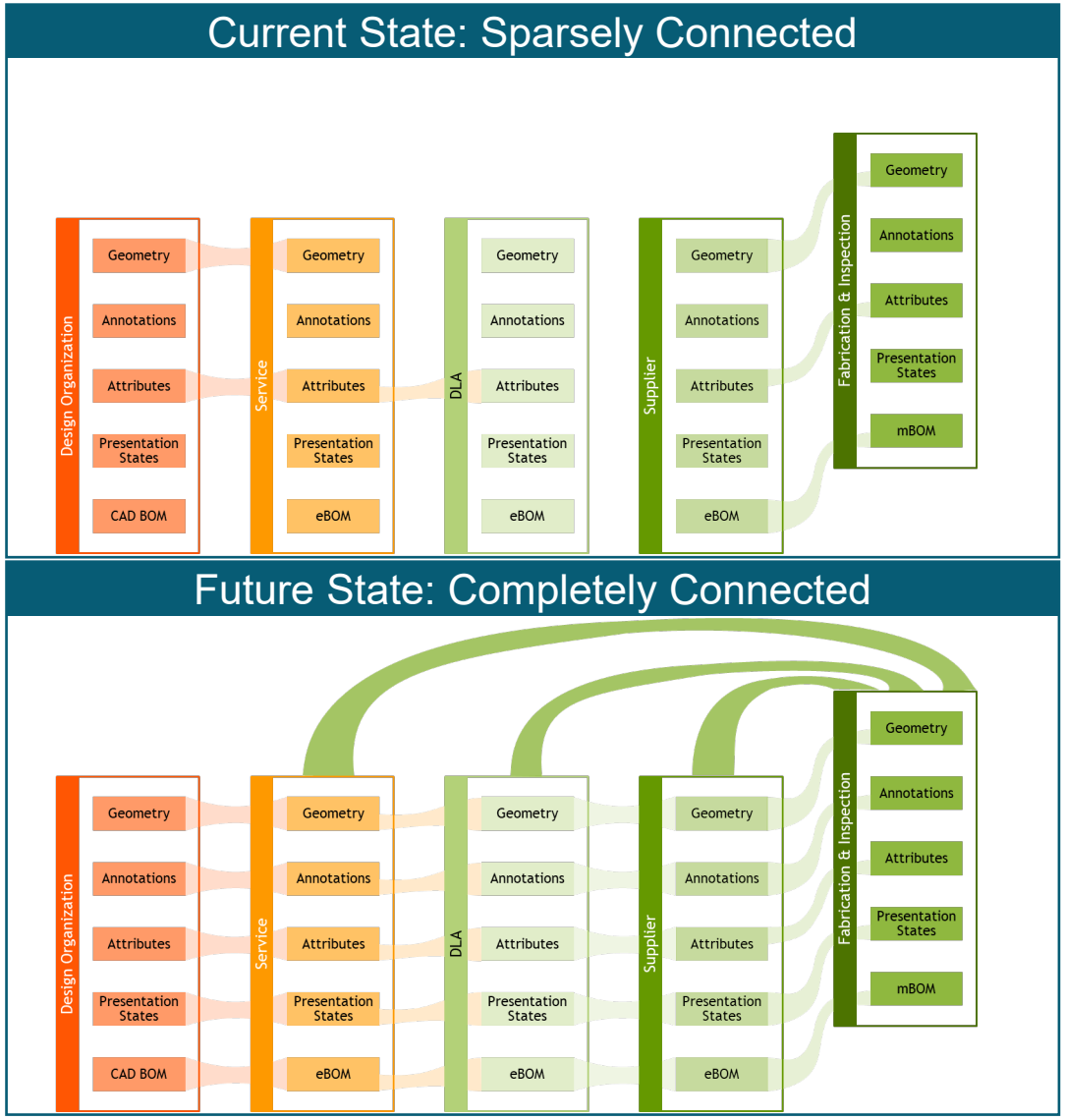
In Conclusion

The State of the Production-Level Digital Thread



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System Descriptions as Observed by Industry Literature

System	RMS	PDM	PLM	MRP / MPM	MES	QMS	ERP	MIM	DXS
System Name	**Requirements Management System**	**Product Data Management**	**Product Lifecycle Management**	**Manufacturing or Material Resource or Requirements Planning**	**Manufacturing Execution System**	**Quality Management System**	**Enterprise Resource Planning**	**Material Information Management**	**Data Package Exchange System**
What is its purpose?	Manage As-Defined data	Manage As-Designed data	Manage As-Built data	Manage As-Planned data	Manage During Build data	Manage As-Inspected data	Manage As-Routed data	Manage Material data	Manage supplier and procurement communications
What data does it manage?	Authoritative Source for requirements records	Authoritative Source for: • CAD + Attributes • CAD BOM • File Revision	Authoritative Source for: • eBOM • Changes • Package and File Revision for each lifecycle stage • Design deviations • Usage • Record of Assembly (ROA)	Authoritative Source for: • mBOM	Authoritative Source for: • Execution records • Record of Assembly • Record of Non-Conformance • Record of Dimensional Inspection	Authoritative Source for: • Quality records	Authoritative Source for: • Schedule • Who is the Producer • What is the cost? • Supply Change Management (SCM)	Authoritative Source for all things Material Science	Authoritative Source for: • Data are given and received from the supplier • Communication threads
Notable	Currently disconnected from most production-level systems	Small manufacturers use PDMs, rather than a PLM to reduce cost	Many PDM functions reside inside a larger PLM system	MPM (Manufacturing Process Management) is not the most common term	MES captures real-time data and is a central focus of Industry 4.0	QMS recording of 3D data is limited	ERP manages more organization data beyond the manufacturing data analyzed in this study	Very important system to complete digital technical data definition.	The focus of documentation of back-and-forth collaboration efforts.

Courtesy of a Honeywell KCP Project

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Takeaways

- **Metadata Crosses all Systems and Should be Standardized:** Metadata are a key data element that spans all industries, business activities, and domains.
- **Data Element-Level Interfaces are Needed:** To connect systems, the primary focus must be on the data element-level interfaces between each system.
- **Standardized TDPs are Needed:** Standards-based TDPs enable collaboration, data sharing, and tool flexibility.
- **Testing for Interoperability is Needed:** Use cases, certified software tools, and codified standards are needed.
- **Policies Need Updating:** Achieving trusted, interoperable data exchange over the systems used in Product Realization is hindered by security and business policies

Courtesy of a Honeywell KCP Project

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Questions?

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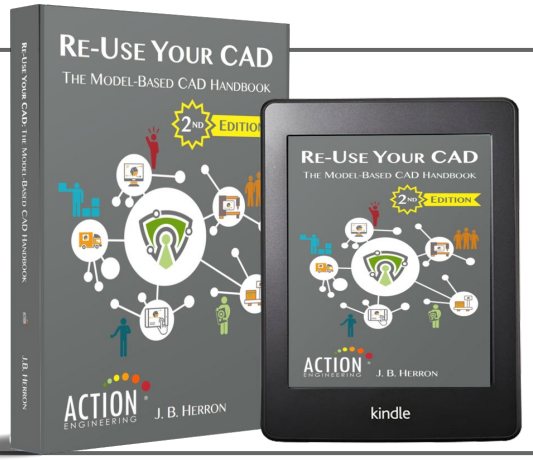
ActionEngineeringMBD



OSCAR™
Bringing MBD Within Reach

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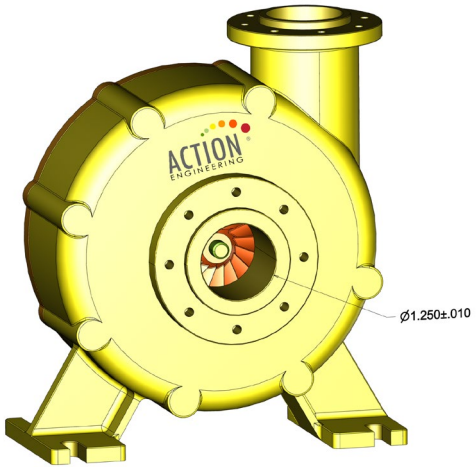
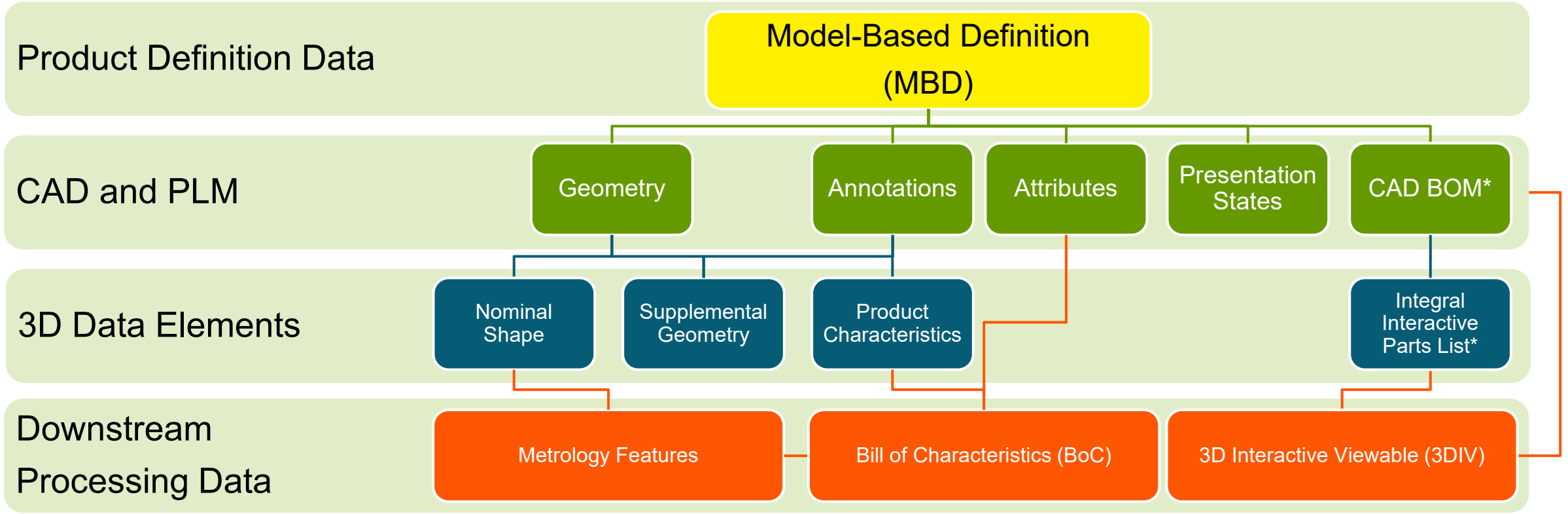
MBD Definition

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. [ASME Y14.47]





*Assembly-only

Dictionary at dictionary.action-engineering.com

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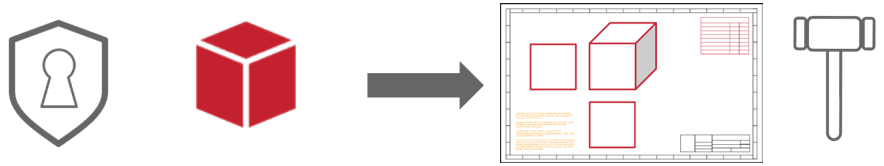
MBD Data Set Types

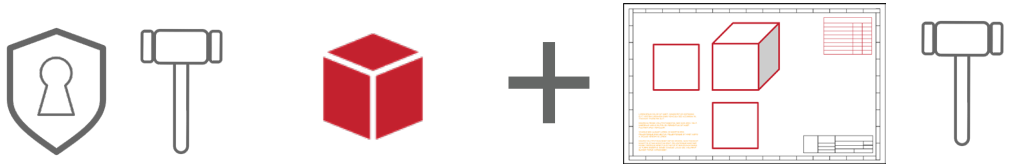
MASTER AUTHORATATIVE DRAWING GEOMETRY MBD COMPONENT

Class 1 Drawing only

Class 2 Model & Drawing

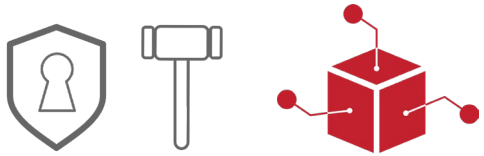


Class 3 Model & Simplified Drawing



Class 4 Model & Fully Detailed Drawing

Class 5 Model-Only



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