

Digital Thread Potential of a Note

Alex Grey
Kelli Howe

GLOBAL PRODUCT DATA INTEROPERABILITY SUMMIT 2023



BOEING is a trademark of Boeing Management Company Copyright © 2023 Boeing. All Rights Reserved
Copyright © 2023 Elysium Inc. All Rights Reserved
Copyright © 2023 Northrop Grumman Corporation. All Rights Reserved
Copyright © 2023 Parker-Hannifin Corporation. All Rights Reserved
Copyright © 2023 PDES. All Rights Reserved

Presenters Bio

Global Product Data Interoperability Summit | 2023

- Kelli Howe
 - Background: Product Standard Tools Architect, Technical Team Lead
 - Education: M.S. in Computer Science
 - Hobbies: board games, singing, sewing, cookies, chasing toddlers
- Alex Grey
 - Background: Structures Design Engineering
 - Current Assignment: Model Based Definition Solution Architect
 - Education: B.S. in Mechanical Engineering
 - Hobbies: video games, cooking, fantasy football

Boeing RROI #23-178814-ETT



Not subject to US Export Administration (EAR), (15 C.F.R Parts 730-774) or US International Traffic in Arms Regulations (ITAR) (22 C.F.R Parts 120-130).

What are Specifications & Standards?

Global Product Data Interoperability Summit | 2023



- **Industry Standards:**

- A set of criteria within an industry relating to the standard functioning and carrying out of operations in their respective fields of production
- The generally accepted requirements followed by the members of an industry
- Standards provide an orderly and systematic formulation, adoption, or application of standards used in a particular industry or sector of the economy
- Standardization serves as a quality check for any industry

<https://definitions.uslegal.com/i/industrial-standards/>

Why are Specifications & Standards Important?

Global Product Data Interoperability Summit | 2023

Why Do We Use Standards?

- Standards promote safety, quality, and consistency in products and processes
- Standards are vital to commerce. They provide the basis for buyer-seller transactions, finances, and contracts.
- For companies to sell their products on foreign markets, they must ensure that their products comply with standards from those foreign countries
- The variety of different standards for different markets means that some manufacturers must create multiple variations of their products, each complying with slightly different standards.
 - Electrical voltages, frequencies, and outlet designs are a good example.

NBSIR 87-3576, "The ABC's of Standards-Related Activities in the United States", National Institute of Standards and Technologies, Gaithersburg, MD 20899, May 1987.

- Reduced Costs
 - Decreased purchasing costs
 - Lower overhead
- Reduced Cycle Time
 - Repeatable processes
 - Sustainable
- Increased Quality
 - Continuous improvements
- Increased Commonality
 - Leverage best practices and industry standards



Evolution and Consumption of Specifications & Standards

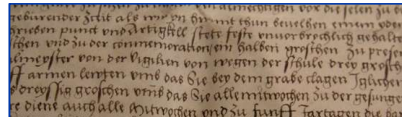
Global Product Data Interoperability Summit | 2023

- **Standards vary from one industry to another**
 - How many standard parts are in an airplane?
 - How many materials with specific finishes, chemical composition, etc.?
 - How many processes are used to assemble airplanes?
- **Model Based Engineering Approach to Standards**
 - Instead of document based standards, create models of the standards
 - Structured & embedded data

- **Consumption of standards is difficult**
 - Complex standards can be hundreds of pages long
 - Content is unstructured
 - Depending on the job role (e.g., procurement, inspector, mechanic), that person may only need a few pages of a given standard
- **Digital Thread & Digital Twin**
 - Standards information provided directly from the model
 - Provides data faster and easier which reduces time and cost



Cave Drawings



Written Word



Hieroglyphs



Printed Word



Digital Representation



Model Based

Boeing RROI #23-178814-ETT



Not subject to US Export Administration (EAR), (15 C.F.R Parts 730-774) or US International Traffic in Arms Regulations (ITAR) (22 C.F.R Parts 120-130).

Use Cases: Specifications, Standards, & Lifecycle

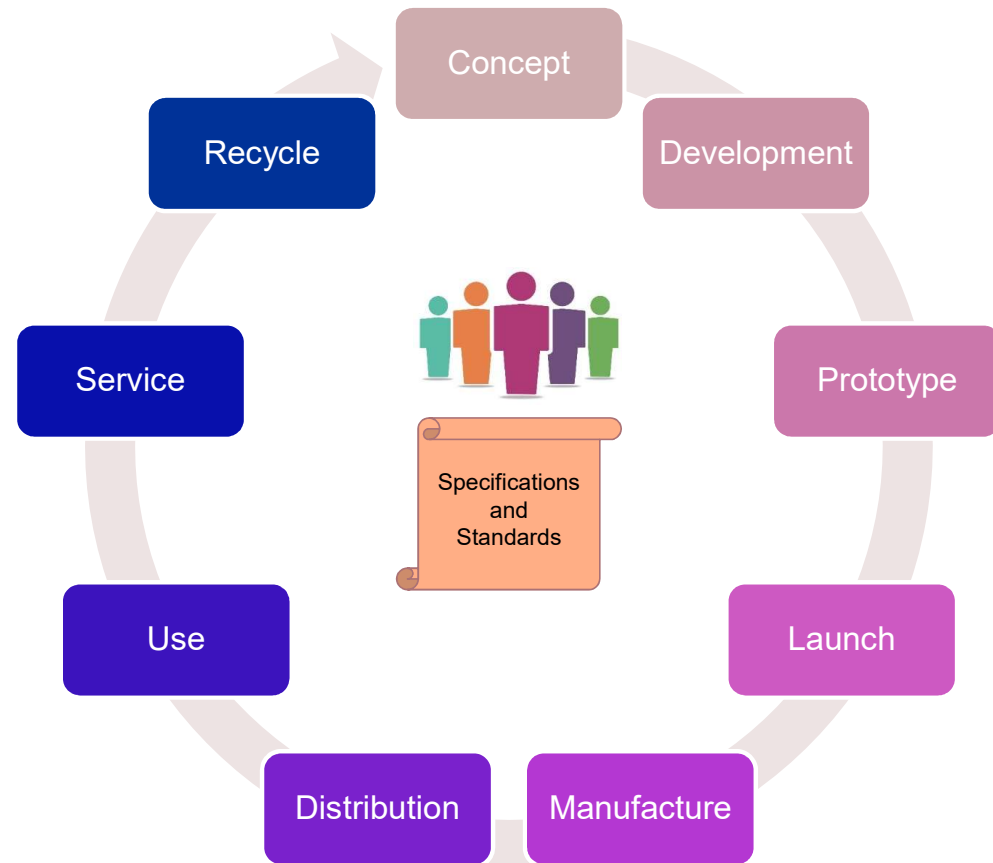
Global Product Data Interoperability Summit | 2023

Specifications and Standards play a role in the lifecycle of all aerospace products

- Research & Development
- Design
- Structural Analysis
- Testing and Validation
- Procurement
- Production / Installations
- Customer Service and Post-Production Maintenance

Different users need to have access to these specifications and standards thru the product lifecycle.

- Engineering (Stress, Testing, Design, Manufacturing)
- Mechanics
- Customer and Maintenance, Repair, and Overhaul (MRO)



Boeing RROI #23-178814-ETT



Not subject to US Export Administration (EAR), (15 C.F.R Parts 730-774) or US International Traffic in Arms Regulations (ITAR) (22 C.F.R Parts 120-130).

“Life of a Note”

Global Product Data Interoperability Summit | 2023

Create Note

Static text

Link(s) to referenced standard items (e.g., a process in a process specification)
May have variable fields

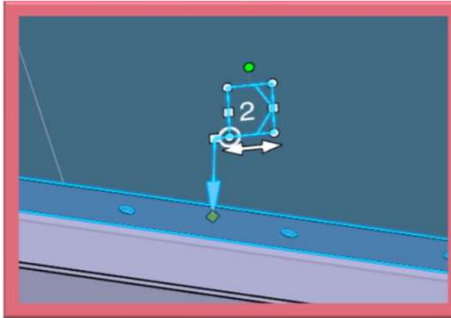
Design

Fill out any variable fields
Apply the note to a part or assembly

Manufacturing

Consume the note text and referenced items to build process plans and work instructions

WHERE EXPOSED TO ELEMENTS,
[SEAL](#) USING [SEALANT TYPE 1 CLASS A GRADE E](#) CURED 15 MINUTES PRIOR TO TORQUE

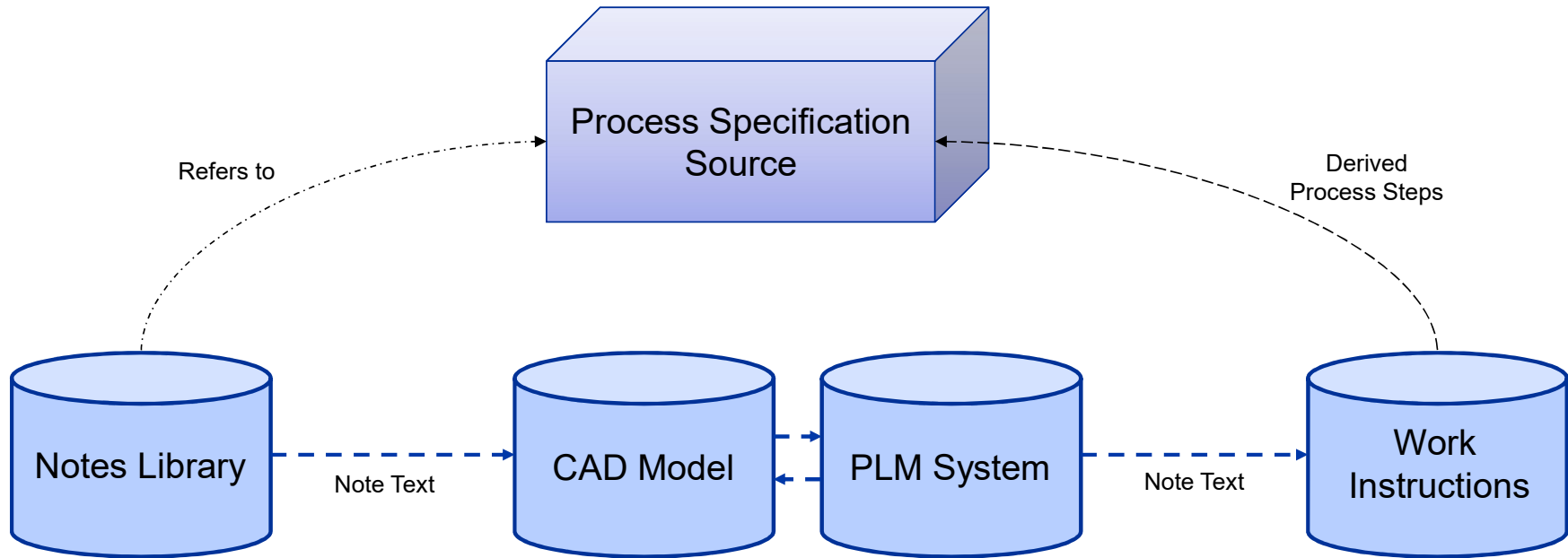


Work Instruction:

- Prep indicated surface with Solvent A
- Apply Sealant Type 1 Class A Grade E to prepared area
- Cure for 15 min.
- Ambient temp must be below 90 deg

Individual Systems

Global Product Data Interoperability Summit | 2023



Import Notes to Design

Global Product Data Interoperability Summit | 2023



Authorized Process Notes

Collapse All Expand All View Document

Find authorized note by:

- Introduction
- Process Specifications
- Process Category
- Appearance
- Bonding Requirement
- Bushing/Sealing Instr Req
- Casting Requirement
- Chem Mtg Requirement
- Cleaning Requirement
- Cold Working Requirement
- Composite Process Req
- Compression Molding Req
- Decam Process Requirement
- Document
- Edge Break Requirement

Note	ID	Usage Considerat:
ALL EDGES SHALL BE FREE OF BURRS PER BAC 5300.	5PR0000000331	
BREAK SHARP EDGES WEDGE BREAK MIN#-EDGE BREAK MAX# PER BAC 5300, EXCEPT AS NOTED, SONIC AREA REQUIREMENTS.	5PR0000002125	
BREAK SHARP EDGES WEDGE BREAK MIN#-EDGE BREAK MAX# PER BAC 5300, EXCEPT AS NOTED.	5PR0000002124	
BREAK SHARP EDGES	5PR0000002123	



Cart Name: New_9

Delete Item Send to CATIA Include Std Notes

Select	Annotation	Process Notes
<input type="checkbox"/>		
<input type="checkbox"/>		5PR0000001115 MARK PARTS PER BAC 5307, CODE M. http://standards.web.boeing.com/hlgw.cgi?app=BAC&spec=BAC5307
<input type="checkbox"/>		5PR0000000968 PENETRANT INSPECT PER BAC 5423.
<input type="checkbox"/>		5PR0000003464 HEMSTITCHING PER BACD2097 IS ALLOWED.



Standard Notes:

- `5SN0000007452`=5SN0000007452 | THE BOEING COMPANY, BOEING COMMERCIAL AIRPLANES, SEATTLE, WASH
- `5SN0000007471`=5SN0000007471 | THE 3D GEOMETRY CONTAINED IN THE CATIA DATASET IS MODELED AT FULL
- `5SN0000010648`=5SN0000010648 | DATA SET PER ASME Y14.41-2012.

Part Notes:

- `5PR0000001115`=MARK PARTS PER BAC 5307, CODE M.
- `5PR0000000968`=PENETRANT INSPECT PER BAC 5423.

Annotation Notes:

- `Annotation Notes:FL 1`=FL1 | 5PR0000003464 | HEMSTITCHING PER BACD2097 IS ALLOWED.

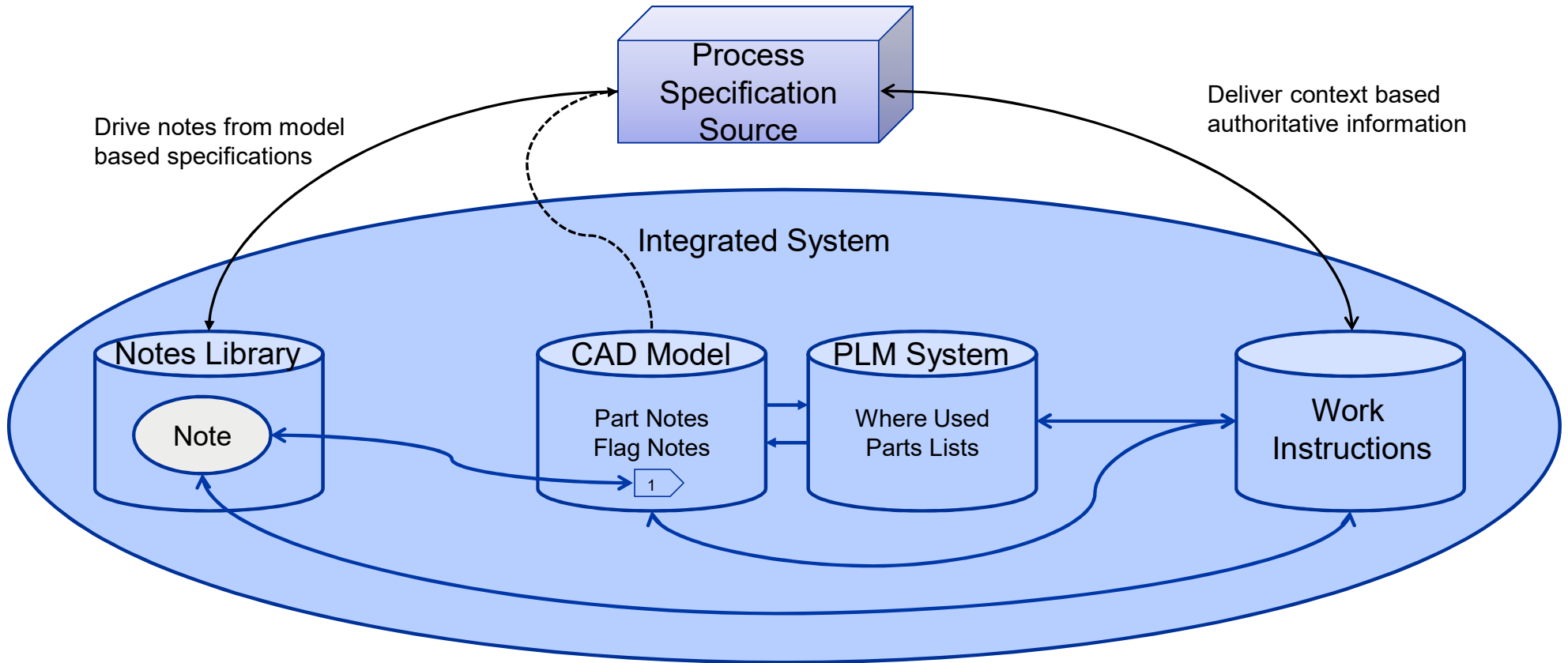
Boeing RROI #23-178814-ETT



Not subject to US Export Administration (EAR), (15 C.F.R Parts 730-774) or US International Traffic in Arms Regulations (ITAR) (22 C.F.R Parts 120-130).

Goal State

Global Product Data Interoperability Summit | 2023



Boeing RROI #23-178814-ETT

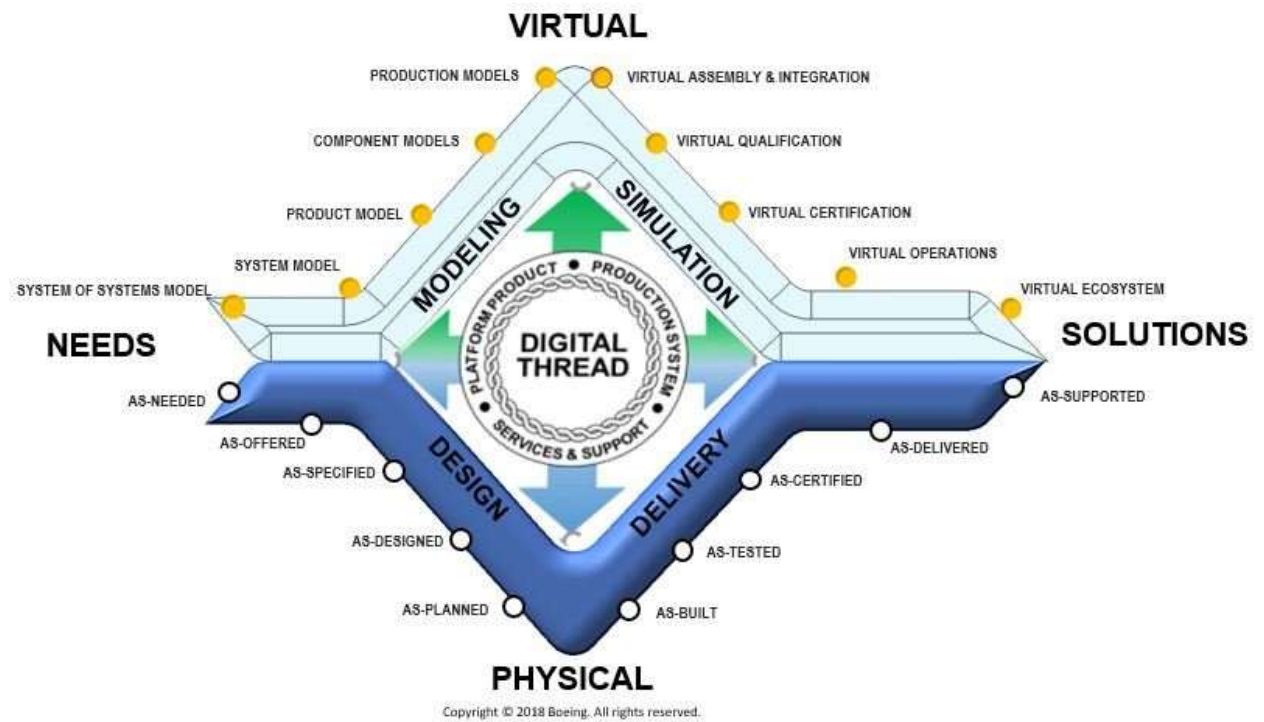


Not subject to US Export Administration (EAR), (15 C.F.R Parts 730-774) or US International Traffic in Arms Regulations (ITAR) (22 C.F.R Parts 120-130).

Benefits

Global Product Data Interoperability Summit | 2023

- Enables the Digital Thread
- Traceability
- Reporting and Analytics
 - Where used, Parts Lists, etc.
- Authoritative information at all points
- Configuration control



Boeing RROI #23-178814-ETT



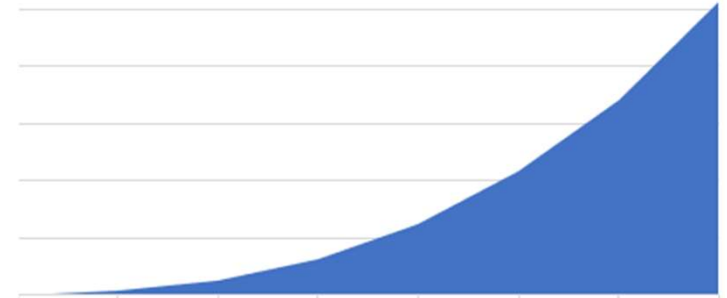
Not subject to US Export Administration (EAR), (15 C.F.R Parts 730-774) or US International Traffic in Arms Regulations (ITAR) (22 C.F.R Parts 120-130).

Challenges

Global Product Data Interoperability Summit | 2023

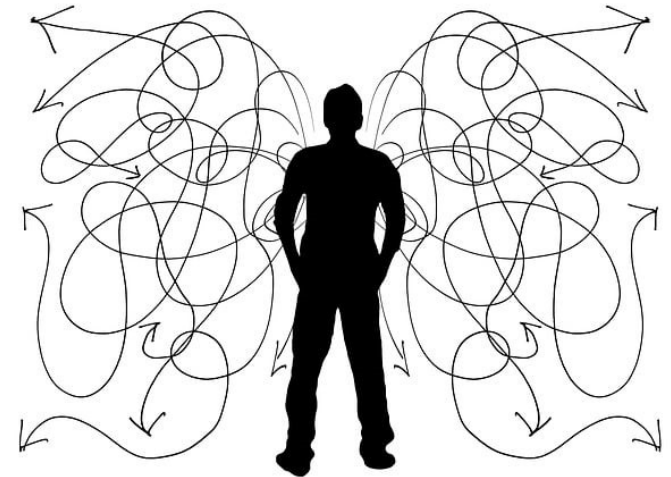
- **Scalability**

- Number of objects and/org relations can scale exponentially without thoughtful consideration of the solution.



- **Implementation**

- Multiple solutions possible, with unique challenges in different systems



Boeing RROI #23-178814-ETT

Summary of Progress

Global Product Data Interoperability Summit | 2023

- **Rewriting process specifications into consumable “chunks”**
- **Defining an ontology, beginning with model based work instructions derived from process specifications**
- **Moving to MarkLogic for underlying structure for standards content**
- **Digital Standards Alliance**
- **Collaboration with software vendor on challenges**
- **Gonzaga University Senior Design Project to develop a Time and Temperature Sensitive (TATS) data model**



Thank
You!

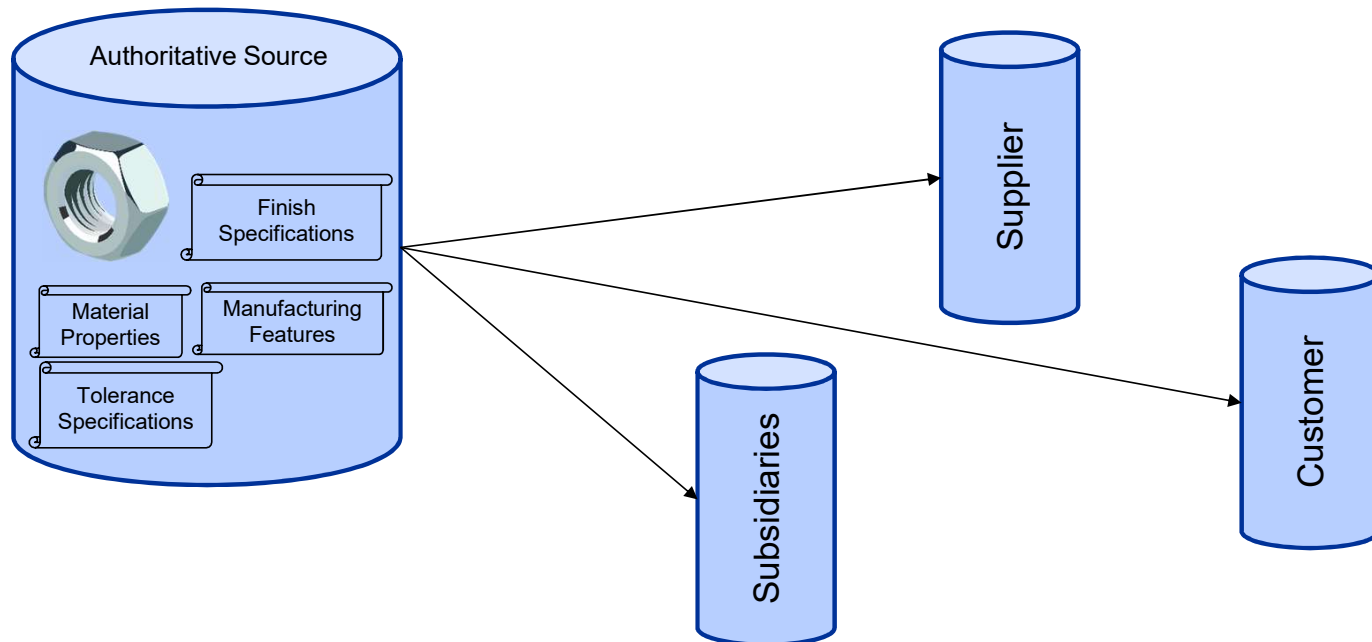
BACKUP: Industry Data Exchange Standard

Global Product Data Interoperability Summit | 2023

Product Data Exchange Specification:

A standard format for encoding all of the information about a product that is necessary for manufacturing purposes (design and planning stages, etc.). PDES describes a complete product, including the geometric aspects of the images as well as manufacturing features, tolerance specifications, material properties, and finish specifications.

[http://printwiki.org/PDES_\(Product_Data_Exchange_Specification\)](http://printwiki.org/PDES_(Product_Data_Exchange_Specification))



BACKUP: Industry Data Exchange Standard

Global Product Data Interoperability Summit | 2023

- Model Based Engineering applied to Specifications and Standards
 - Need to have an industry data exchange standard for an Original Equipment Manufacturer (OEM) to consume digital data from Federal, Industry, and Military Standards and to provide company digital standards data to Suppliers and Customers
- Use the Model Based Engineering approach to achieve

Digital Thread

“...the communication framework that allows a connected data flow and integrated view of the asset’s data throughout its lifecycle across traditionally siloed functional perspectives.”

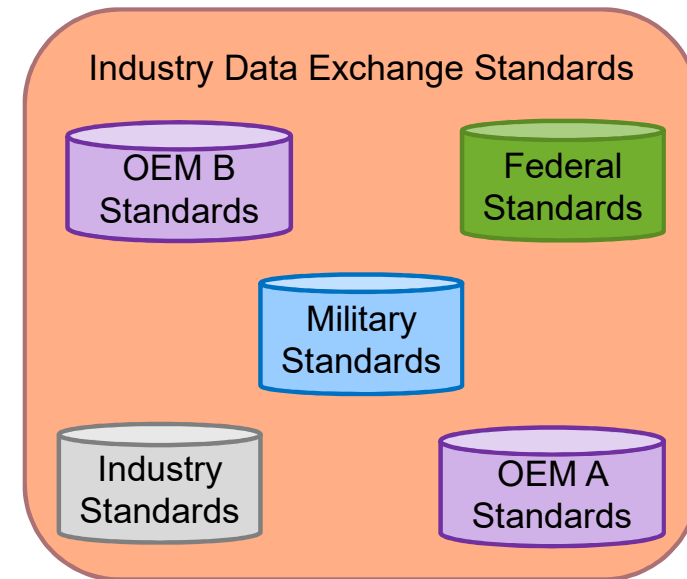
<https://www.ibaset.com/blog/what-is-the-digital-thread/>

to attain

Digital Twin

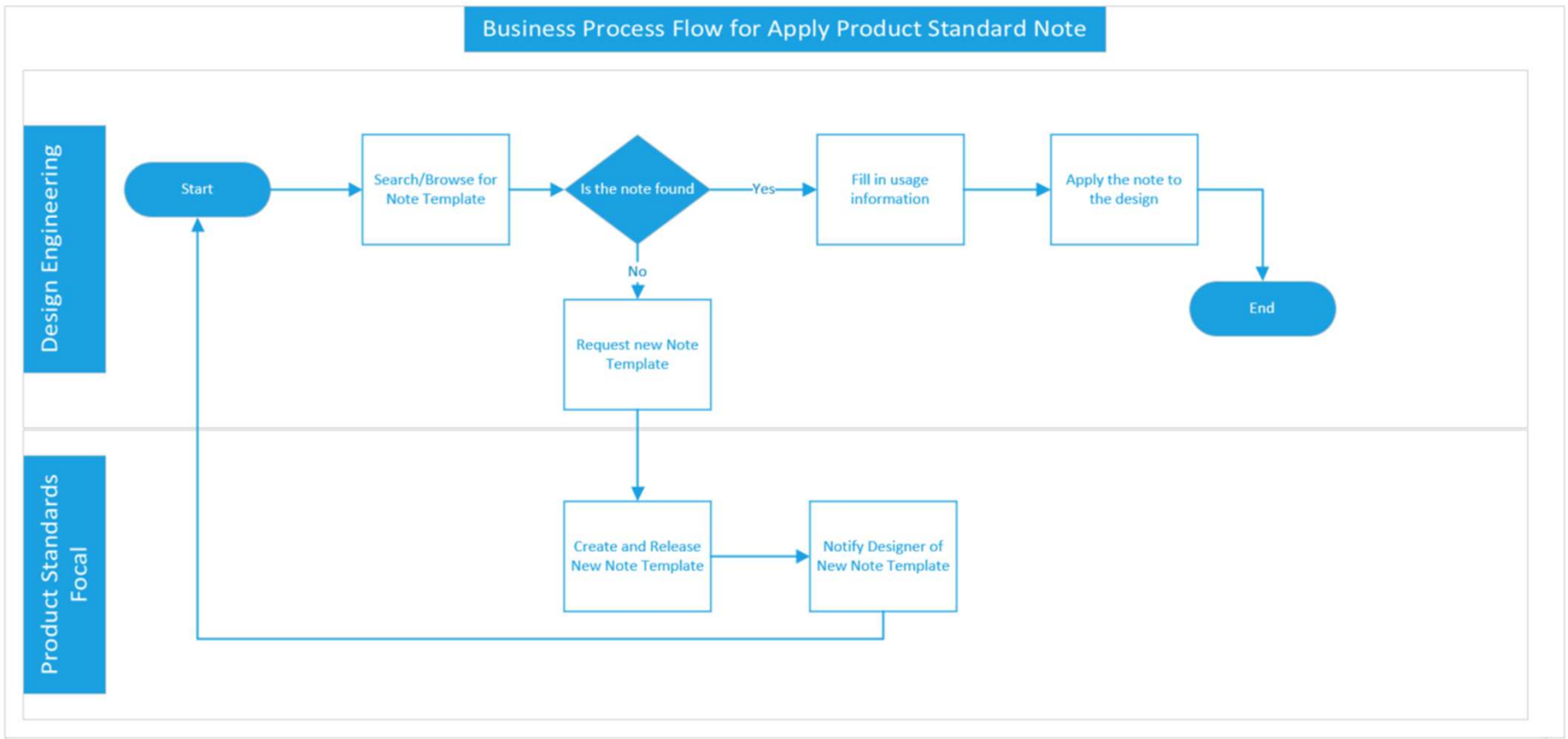
“...virtual replicas of physical devices...”

<https://www.networkworld.com/article/3280225/what-is-digital-twin-technology-and-why-it-matters.html>



Apply Note to Part (General/Part Note)

Global Product Data Interoperability Summit | 2023



Boeing RROI #23-178814-ETT

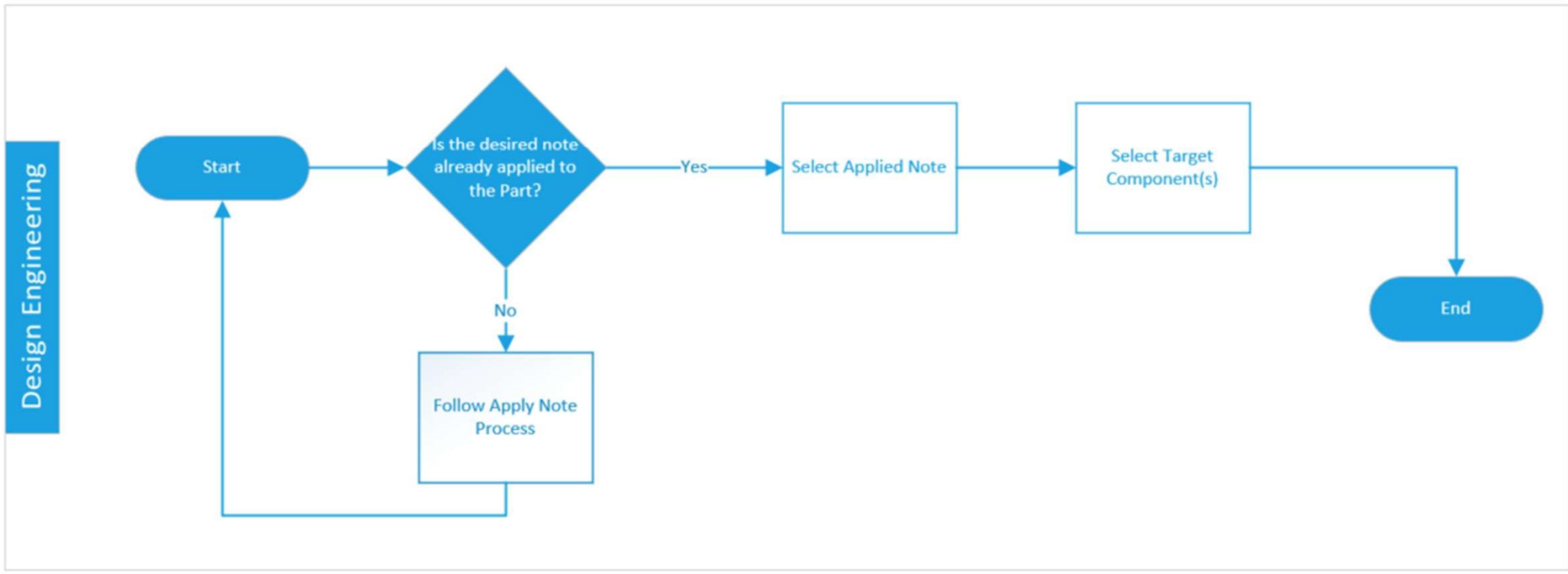


Not subject to US Export Administration (EAR), (15 C.F.R Parts 730-774) or US International Traffic in Arms Regulations (ITAR) (22 C.F.R Parts 120-130).

Limit to Component Instance

Global Product Data Interoperability Summit | 2023

Business Process Flow for Limit Note Applicability to Component



Boeing RROI #23-178814-ETT



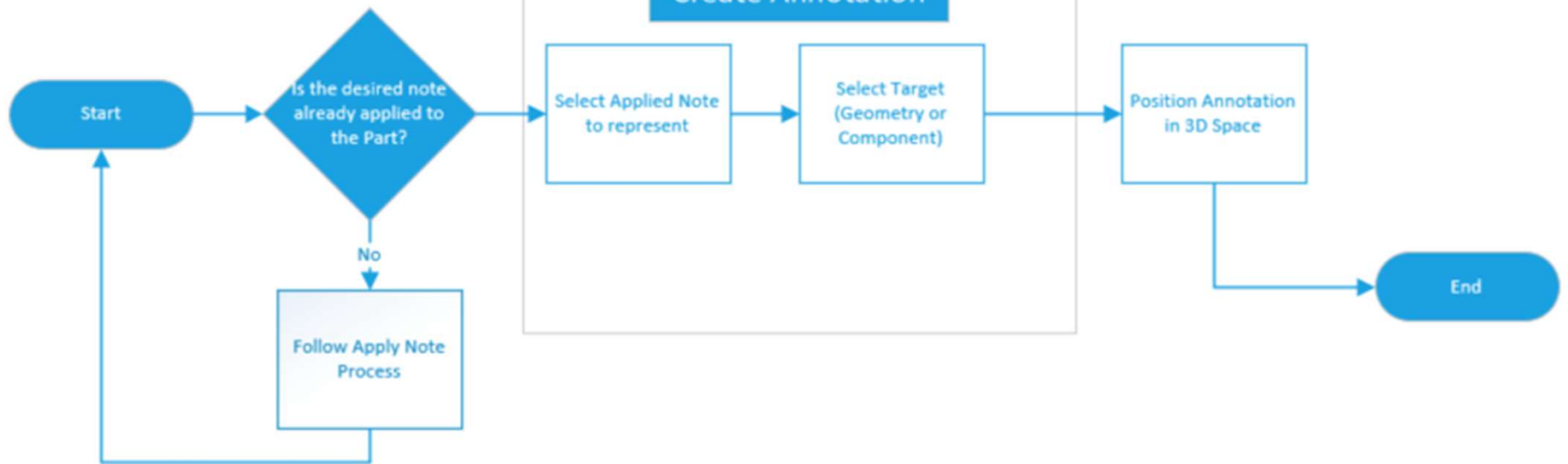
Not subject to US Export Administration (EAR), (15 C.F.R Parts 730-774) or US International Traffic in Arms Regulations (ITAR) (22 C.F.R Parts 120-130).

Create Annotation

Global Product Data Interoperability Summit | 2023

Business Process Flow for Create Flag Note

Design Engineering



Boeing RROI #23-178814-ETT



Not subject to US Export Administration (EAR), (15 C.F.R Parts 730-774) or US International Traffic in Arms Regulations (ITAR) (22 C.F.R Parts 120-130).

• Image Citations

- Tool Cabinet Photo by [jesse orrico](#) on [Unsplash](#)
- Cave Drawing Image by [Klaus Hausmann](#) from [Pixabay](#)
- Hieroglyphs Image by [Alexander Paukner](#) from [Pixabay](#)
- Old German Handwriting Image by [Skyler H.](#) from [Pixabay](#)
- Typewriter Image by [marianaviolante950](#) from [Pixabay](#)
- Laptop Image by [StartupStockPhotos](#) from [Pixabay](#)
- Flowchart Image by [Gerd Altmann](#) from [Pixabay](#)
- Nut (Fastener) Image by [OpenClipart-Vectors](#) from [Pixabay](#)
- Arrows Alternatives Image by [Gerd Altmann](#) from [Pixabay](#)
- Thank You Sticky Note Image by [S K](#) from [Pixabay](#)