Digital Threads through Model-Based Specifications and Standards

GLOBAL PRODUCT DATA
INTEROPERABILITY
SUMMIT
2019

Kelli Howe
TJ Smith
Rafael Soto

Biography

- # Kelli Howe
  - **Background: Technical team lead and business system manager**
  - **Education: M.S. in Computer Science**
  - **Hobbies: Board Gamer, Embroiderer, Singer**

- # TJ Smith
  - **Background: Software development, testing, & deployment**
  - **Education: M.S. in Systems Engineering**
  - **Hobbies: 3 kids under 9, what are hobbies?**

- # Rafael Soto
  - **Background: Structural, testing, and design engineering**
  - **Education: M.S. in System Engineering**
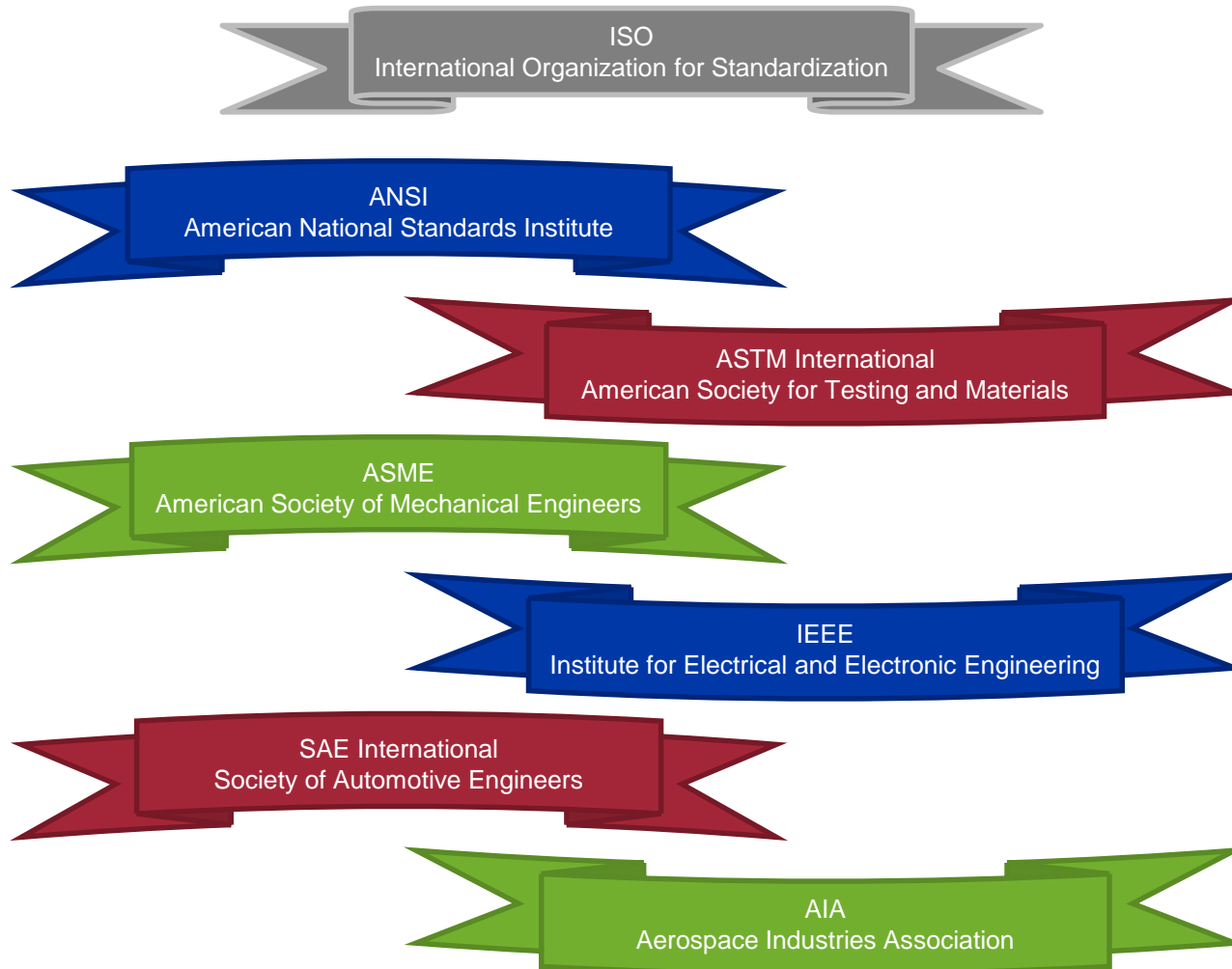 - **Hobbies: Puzzles, Photography, and Tacos**

- **What are Specifications and Standards?**

- **Use Cases**

- **Industry Data Exchange Standard and Challenges**

- **Q&A**

What are Specifications & Standards?

ISO
International Organization for Standardization

ANSI
American National Standards Institute

ASTM International
American Society for Testing and Materials

ASME
American Society of Mechanical Engineers

IEEE
Institute for Electrical and Electronic Engineering

SAE International
Society of Automotive Engineers

AIA
Aerospace Industries Association

- **Standards are called different terms by different industries Standards Developing Organizations (SDOs)**
  - **Example: Parts, Materials, & Processes**
- **Industry Standard Definition: 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?

Why Do We Use Standards?

- Standards promote safety, quality, and consistency in the products and processes
- Standards are vital to commerce. They provide the bases 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 of Specifications & Standards Consumption

- **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?
- **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
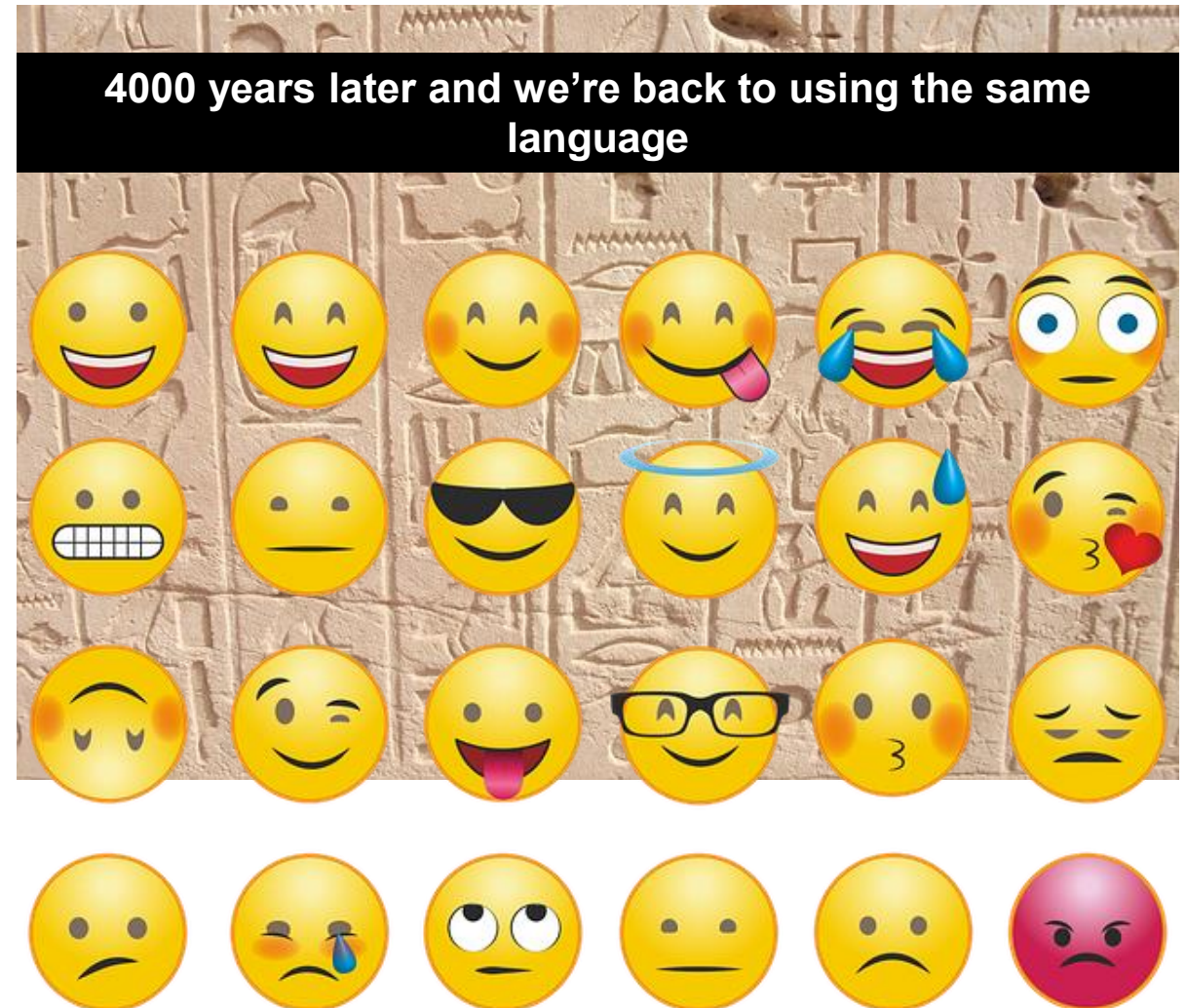
4000 years later and we're back to using the same language

# Evolution of Specifications & Standards Consumption

- **Model Based Engineering Approach to Standards**
  - **Instead of document based standards, create models of the standards**
  - **Structured & embedded data**
- **Digital Thread & Digital Twin**
  - **Standards information provided directly from the model**
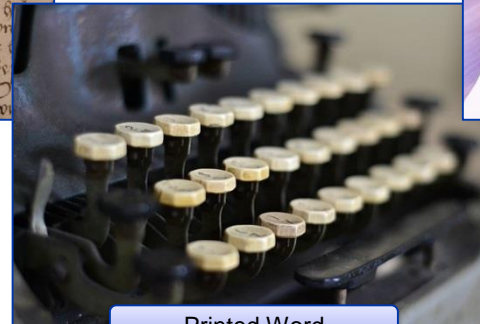 - **Provides data faster and easier which reduces time and cost**
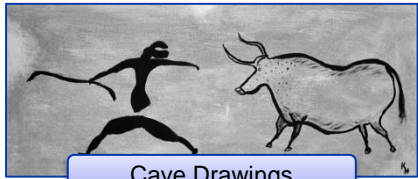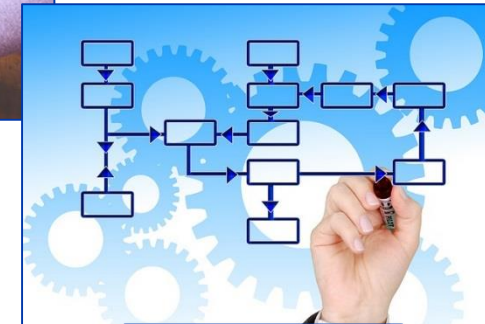

Cave Drawings

Hieroglyphs
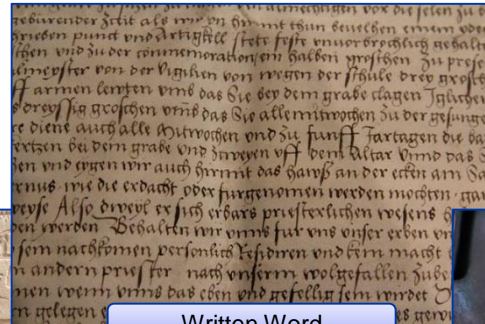
Written Word

Printed Word

Digital Representation

Model Based

Use Cases: Specifications, Standards, & Lifecycle

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
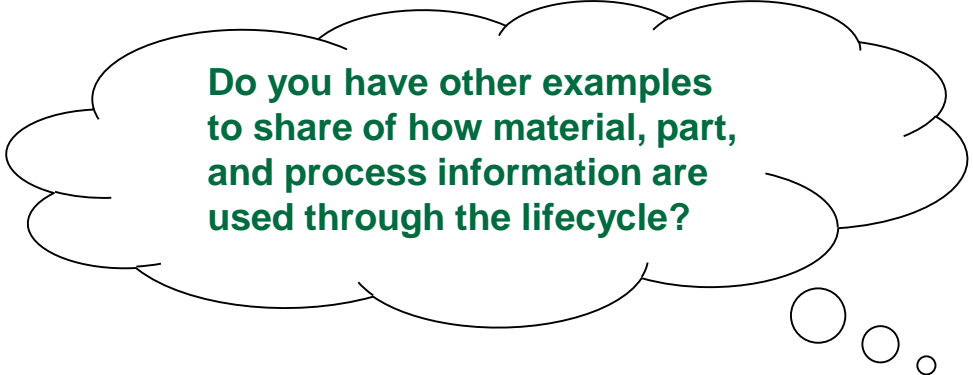- Customer and Maintenance, Repair, and Overhaul (MRO)

Concept

Development

Recycle

Prototype

Service

Specifications and Standards

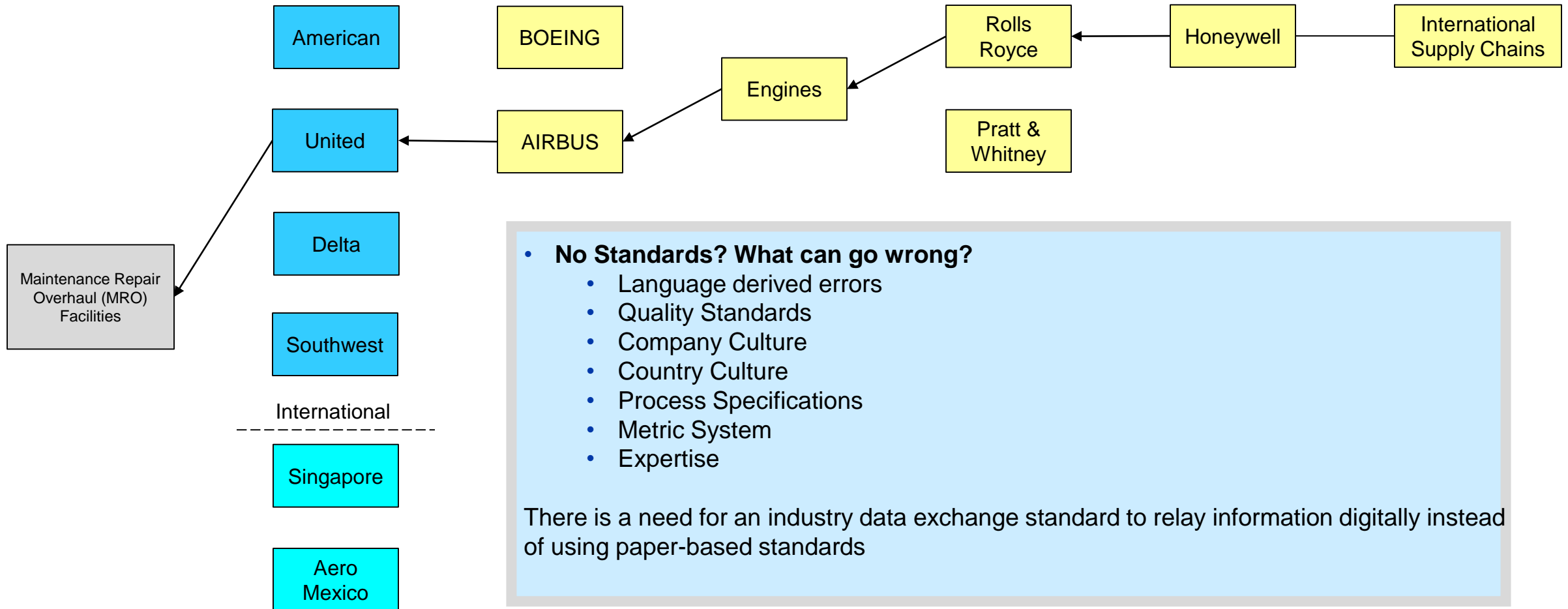Use

Launch

Distribution

Manufacture
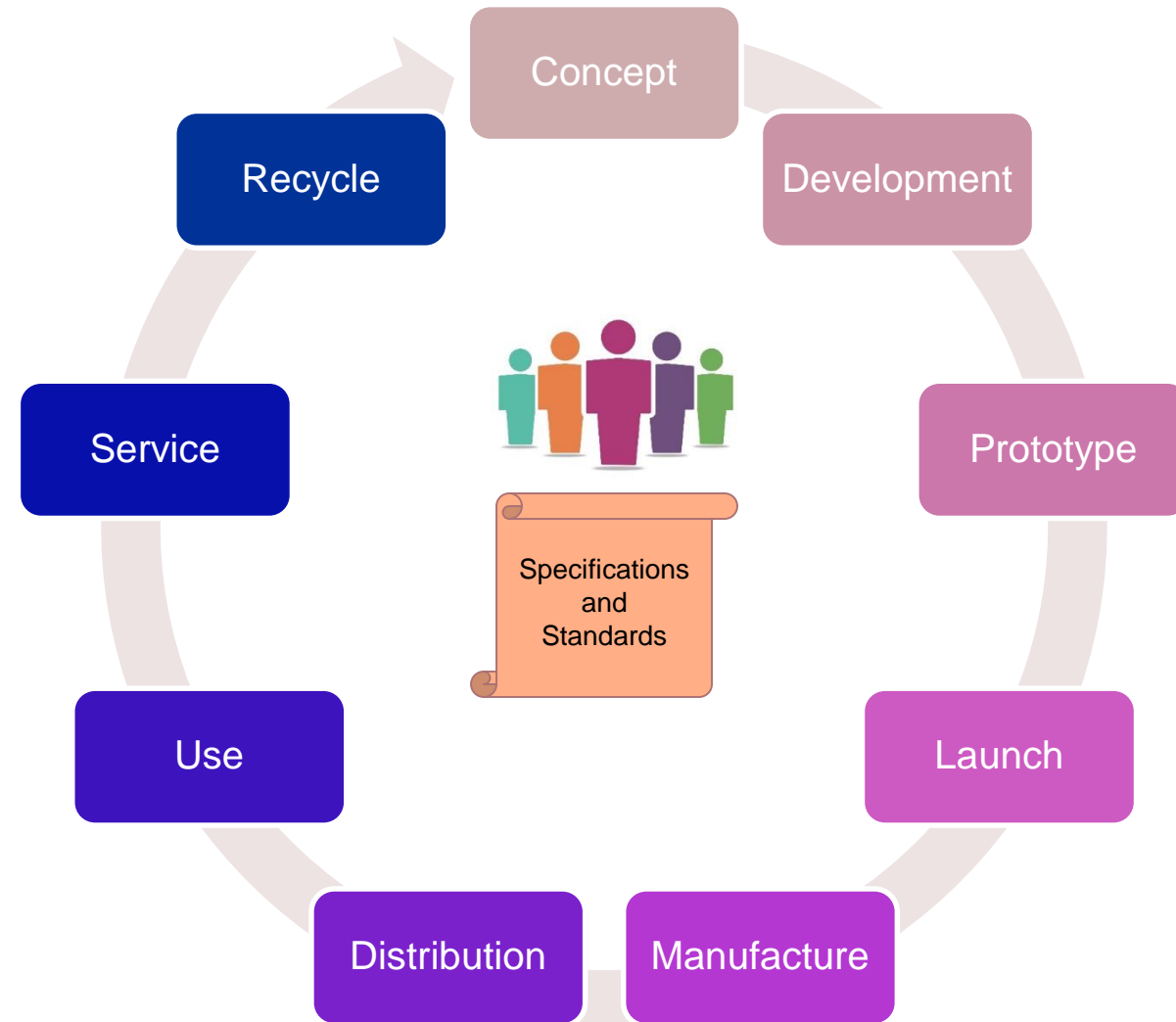
Use Cases

- Example use cases for downstream consumption of standards data / information
  - Material Specifications:
    - Classification and characteristics that are captured to identify materials in a bill of materials
    - Property information for structural analysis
    - Time and Temperature Sensitive requirements

  - Process Specifications:
    - Classification and characteristics that are captured to identify processes in product definition
    - End product requirements and inspection criteria
    - Employee certification information
    - Work steps and instructions

  - Part Standards:
    - Requirements for installation and instructions
    - Weight information about mechanical parts

Do you have other examples to share of how material, part, and process information are used through the lifecycle?
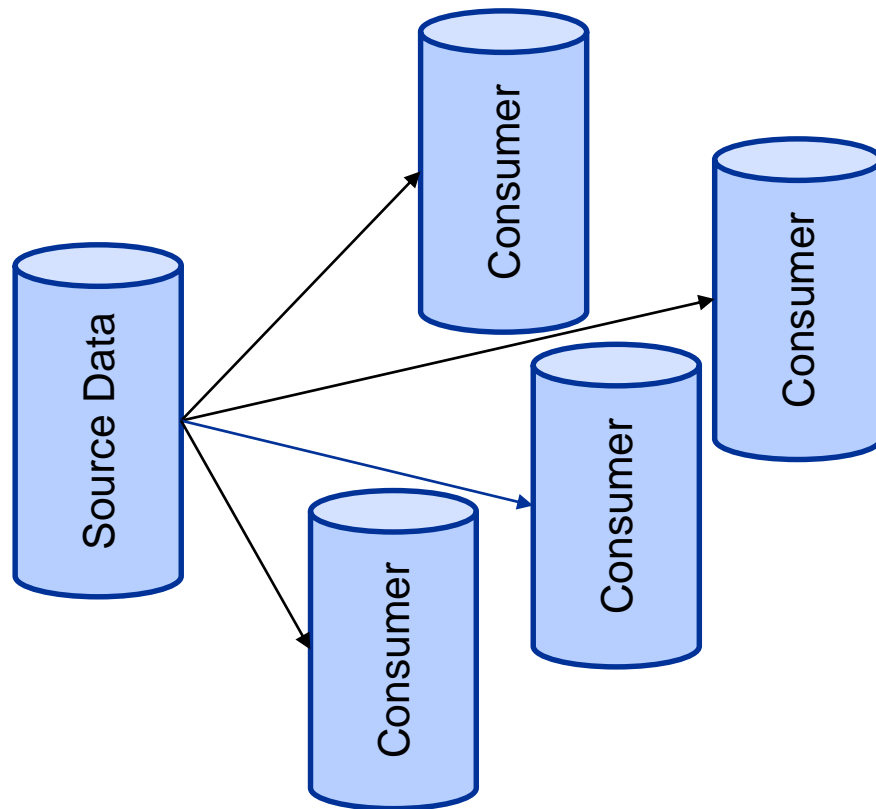
Use Cases: Standards & Industry Interconnectivity

American

BOEING

Rolls Royce

Honeywell

International Supply Chains

Engines

United

AIRBUS

Pratt & Whitney

Maintenance Repair Overhaul (MRO) Facilities

Delta

Southwest

International

Singapore

Aero Mexico

- **No Standards? What can go wrong?**
  - Language derived errors
  - Quality Standards
  - Company Culture
  - Country Culture
  - Process Specifications
  - Metric System
  - Expertise

There is a need for an industry data exchange standard to relay information digitally instead of using paper-based standards

Industry Data Exchange Standard

> **Data Exchange** is the process of taking data structured under a source schema and transforming it into data structured under a target schema, so that the target data is an accurate representation of the source data.
>
> https://en.wikipedia.org/wiki/Data_exchange

> **Electronic Data Interchange** (**EDI**) is the electronic interchange of business information using a standardized format; a process which allows one company to send information to another company electronically rather than with paper. Business entities conducting business electronically are called trading partners.
>
> https://www.up.com/suppliers/order_inv/edi/what_is_edi/

- **A Data Exchange Standard provides a method by which data can be shared across companies or information systems**
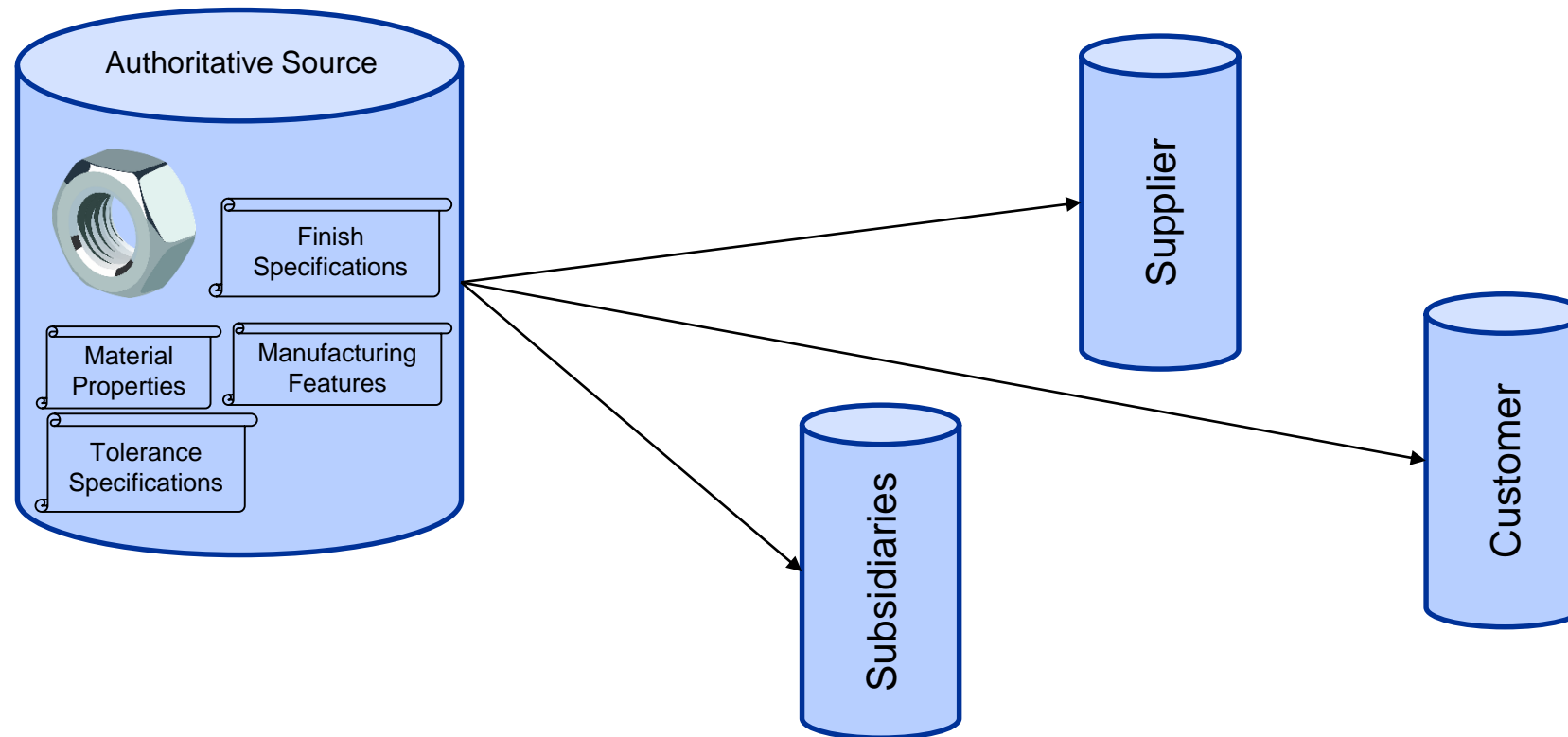
Industry Data Exchange Standard

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)

Authoritative Source

Finish Specifications

Material Properties

Manufacturing Features

Tolerance Specifications

Supplier

Subsidiaries

Customer

- ## 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."
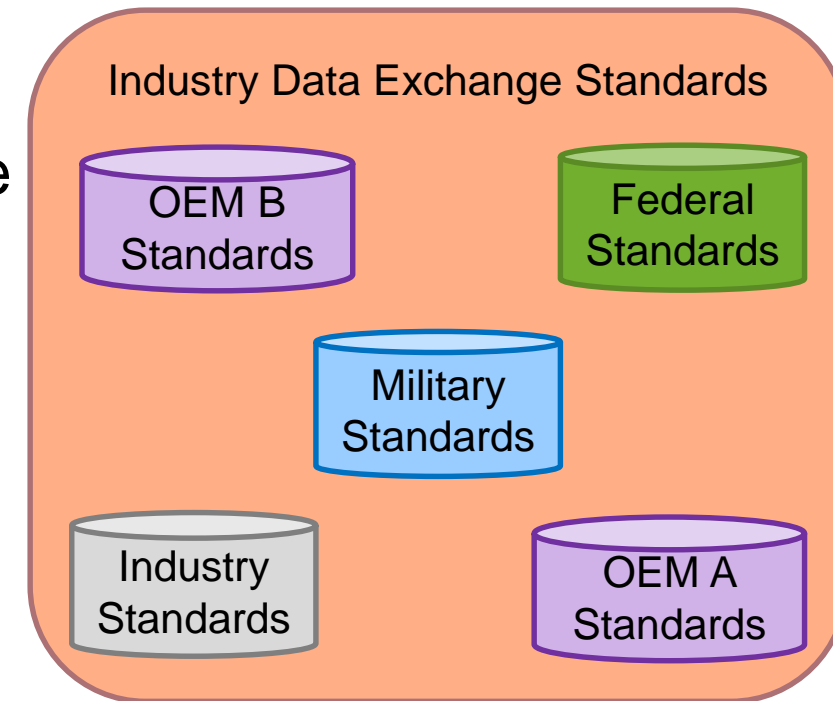
https://www.ibaset.com/blog/what-is-the-digital-thread/

to attain

Digital Twin

"…virtual replicas of physical devices..."
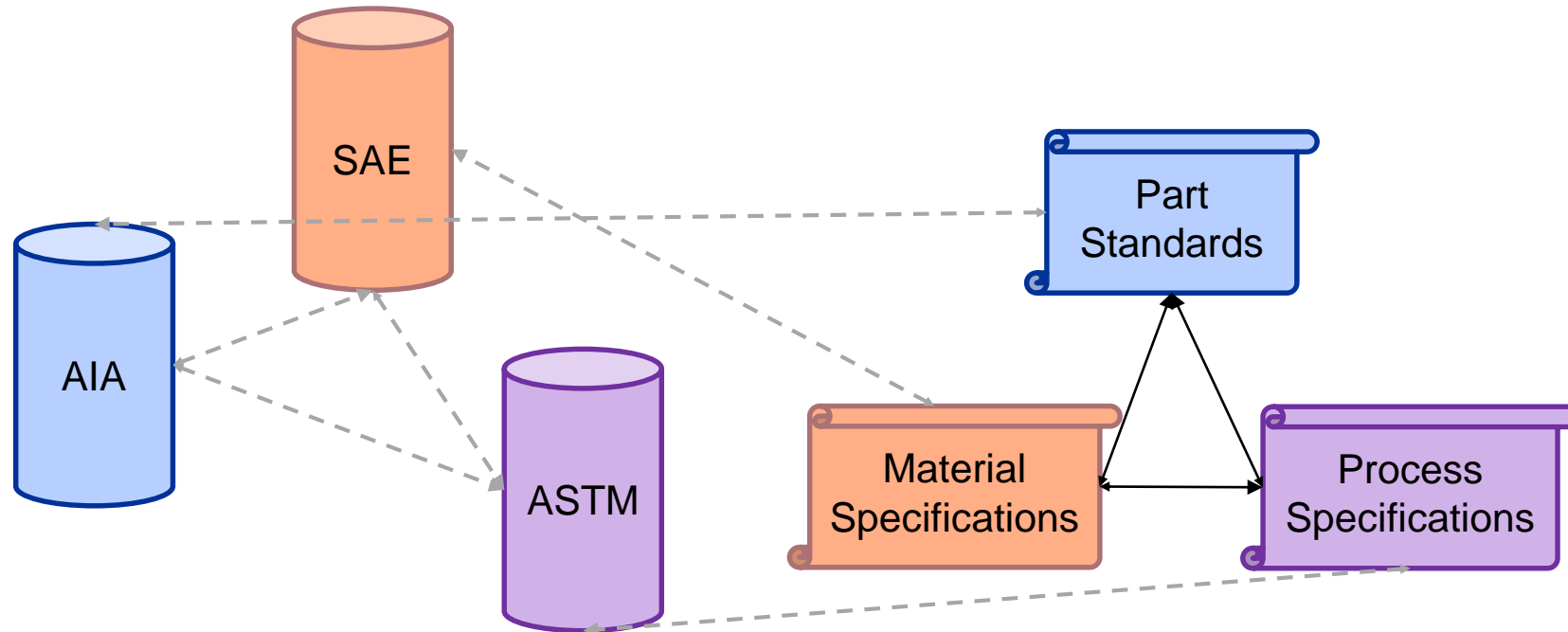
https://www.networkworld.com/article/3280225/what-is-digital-twin-technology-and-why-it-matters.html

Industry Data Exchange Standards

- OEM B Standards
- Federal Standards
- Military Standards
- Industry Standards
- OEM A Standards

- From a document-based world to a digital world
  - **FLAGNOTE1:** Install NAS1801, made from AMS6322.
  - **FLAGNOTE2:** Test AMS6322 to ASTM A751

What if we could connect the Data Exchange Standards?

- ## What's been done so far?
  - ISO (International Organization for Standardization) standards
  - STEP: "**St**andard for the **E**xchange of **P**roject model data"
    - ISO 10303: standard for the computer representation and exchange of product modeling information
    - A goal of a complete, unambiguous, computer-readable definition of the physical and functional characteristics of a product through its lifecycle.

- ## Challenge of semantics
  - **Context is a big deal**
  - **Many definitions for the same term**

- ## What is a BOLT?

PDES, Inc.
An international consortium of industry, government, and university members who are dedicated to developing and implementing standards for product data exchange

- **Spark Questions:**
  - How do other organizations want to access our standards data?

  - What do you want to have exposed for digital consumption?

  - What are people looking for?

  - What are others doing in this space?

  - Where do we still need to go?

  - How can we find common ground?

  - Can you have a digital thread without a data exchange standard?

Conclusion

No easy answers

Working together, we can put it together piece by piece

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