Case Study: Modeling Critical Digital Threads between Authoritative Source of Truth (ASoT) Systems

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GLOBAL PRODUCT DATA INTEROPERABILITY SUMMIT 2024

BOEING ELYSIUM NORTHROP GRUMMAN Parker PDES, Inc.® Connecting the Digital Enterprise

Presenters Bio – Dennis Beeson

Dennis Beeson

Consulting Systems Engineer

Northrop Grumman

Contributions

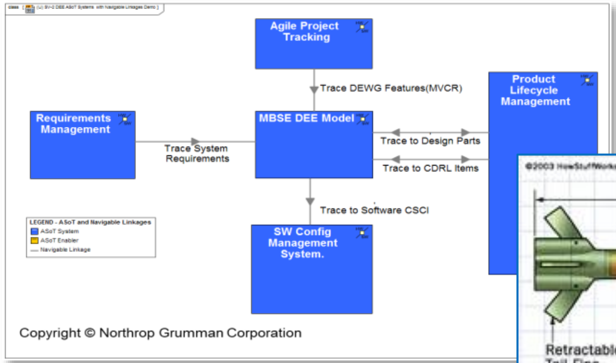
- 1st – Comprehensive Digital Engineering Environment (DEE) Architecture Model
- 1st - F/A-18 Bunker Buster Desert Storm
- 35th – Certified Software CMM Level 4 Org.
- 89A to 12C F/A-18 Operational Flight Program Avionics Upgrades

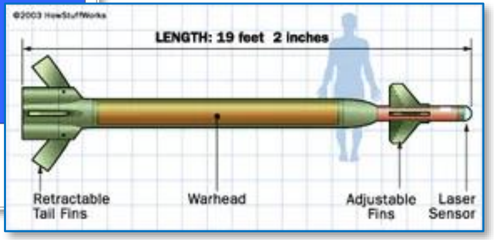
Work Experience

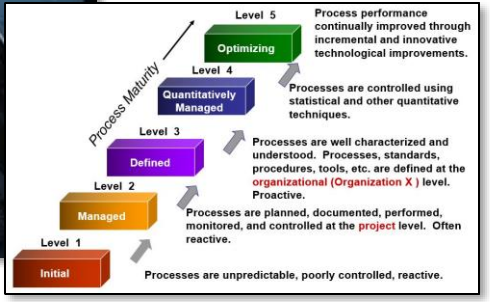
38 years - Software & System Engineering

Education & Certifications

- UCLS Executive Leadership Program
- MIT MBSE, SAFe ARCH, 6-Sigma, Covey
- BS. Computer Science Clarke College







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Agenda

- **Scope –** What are the possible critical digital threads? *(Operational vs Analytical Data)*
- **ASoTs –** Where is the product configuration baseline managed and controlled?
- **Use Cases** – How will digital threads be used?
- **Digital Thread –** What is linked together to create the product baseline?
- **Summarize –** Lessons learned

MBSE diagrams are simplified to highlight topic of modeling digital threads

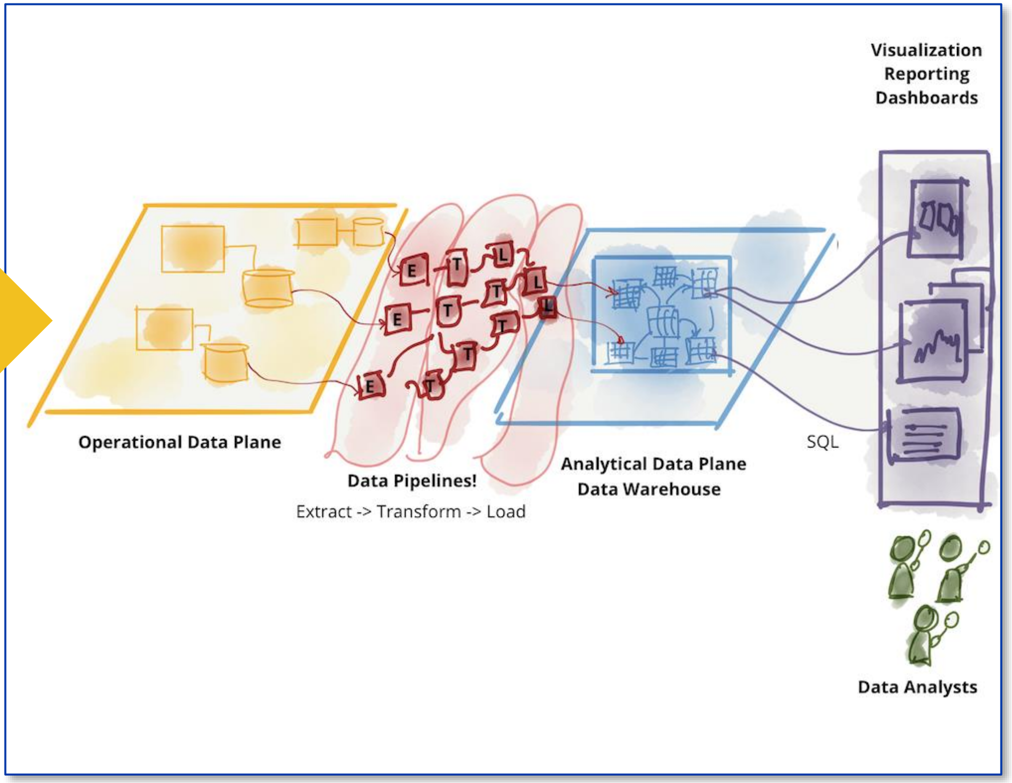
Scope – What are the possible critical digital threads? *(Operational Data vs Analytical Data)*

- **Data Mesh –** “focuses on analytical data versus operational data.” …

- **Operational Data –** “sits in database as of microservices and keeps the current state of the business with transaction integrity.” …

- **Analytical Data –** “is the historical, integrated, and aggregate view of data created as a byproduct of running the business. It is maintained and used by OLAP (online analytical processing) systems.

In short, analytical data is used to optimize the business and user experience. This is the data that fuels the organizations; AI and analytics aspirations.” …



Reference: Data Mesh Delivering Data Driven Value at Scale, ISBN 978-1-098-11276-9, Page (11-12)

This presentation will focus on Operational Product Data Digital Threads

Scope - What are the possible Critical Digital Threads? (*Examples: Operational Data vs Analytical Data)*

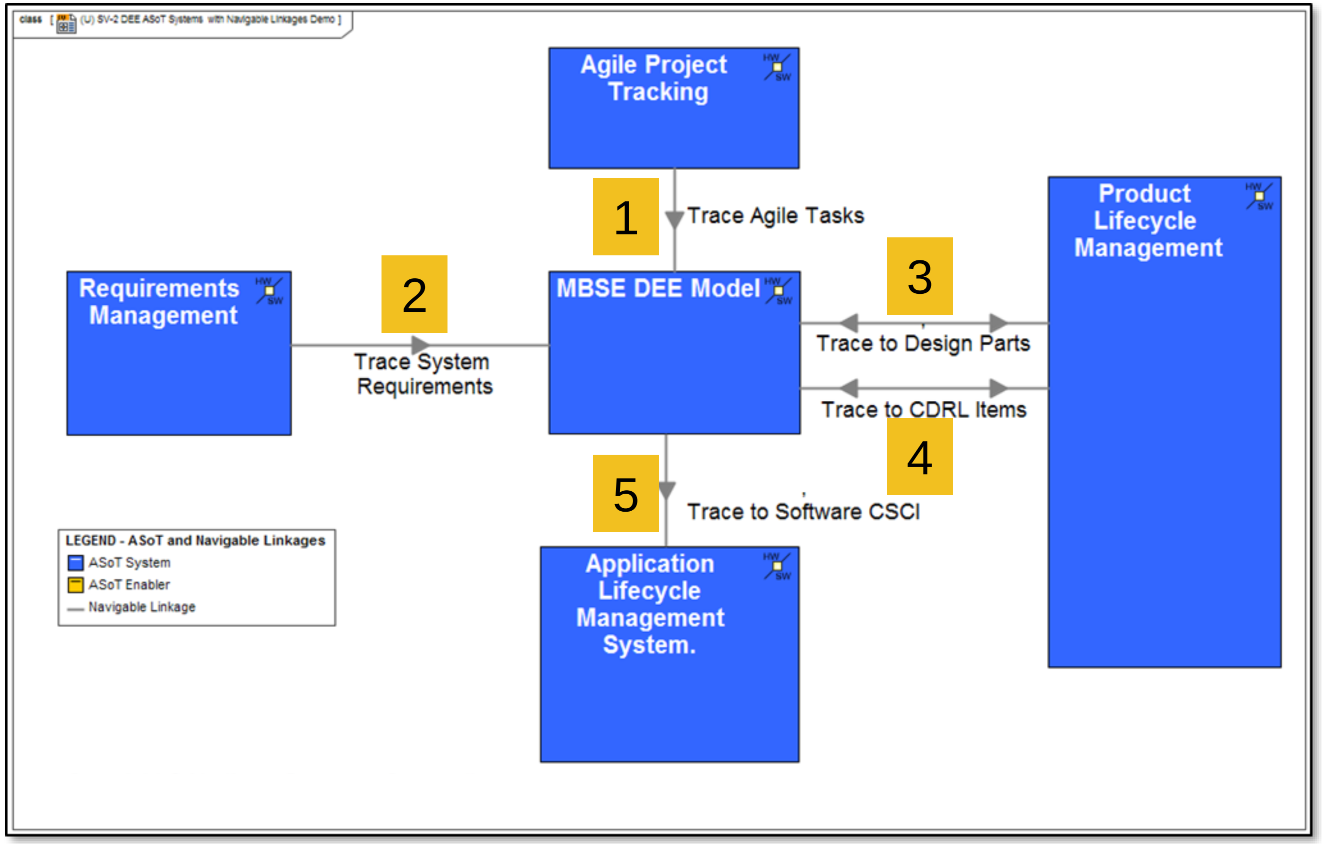
	Operational Data	Analytical Data
Business	**SAP** – Customer Data, Sales Data. Marketing Events,	• Identify market trends by contract trends in DoD industry …
Finance	**SAP** – General Ledger Entries, Invoices, Receipts, …	• Impact assessment of marketing, sales, profit margin …
Engineering	**CM/DM** – Change Request, Change Notices **Requirement Mgmt.** – Baseline Control **System Design** – MBSE Design **Structural Design** – Mathematic Models **Mechanical** - PLM CAD Design **Electrical** – PLM Electrical Design **Facilities** – Revit CAD Design	• Determine CR / CN thruput for planning • Identify improvement to requirement defects • Identify common causes of defect injection in system design • Analysis of structural design improvements • Identify common defect injection in mechanical engineering • Identify improvement to electrical design process • Identify improvement to facilities design process
Manufacturing	**Shop Floor** – Shop floor manufacturing plan, shop floor instructions **Corrective Action** Tracking (CATS) – Defect and corrective tracking (plan to actual) …	• Determine manufacturing thruput capability • Root cause analysis of common defects identified in manufacturing • Identify improvements to manufacturing based on CATS
Logistics	**Logistic BOM** - As-Built BOM **Replenishment** – Spares / Repairs **Repairs** – (Plan to Actuals) **Training** – (Plan to Actuals)	• Logistics Part Failure mode analysis • Analysis of common failures in fields system • Analysis of life expectancy of fielded system • Determining how many spares to provide in operations and replenishment cycle

This presentation will focus on Engineering Product Data Digital Threads

ASoT Systems – Where is the product configuration baseline managed and controlled?

Engineering Operational Digital Threads:

1. ***Trace Agile Tasks*** ***to identify progress of System Design***
2. ***Trace System Requirements*** ***to allocation System Design***
3. ***Trace to Design Parts*** ***to System Bill of Materials (BOM)***
4. ***Trace to CDRL Items*** ***to System Documentation***
5. ***Trace to Software CSCI*** ***to allocation System Design to Software Components***

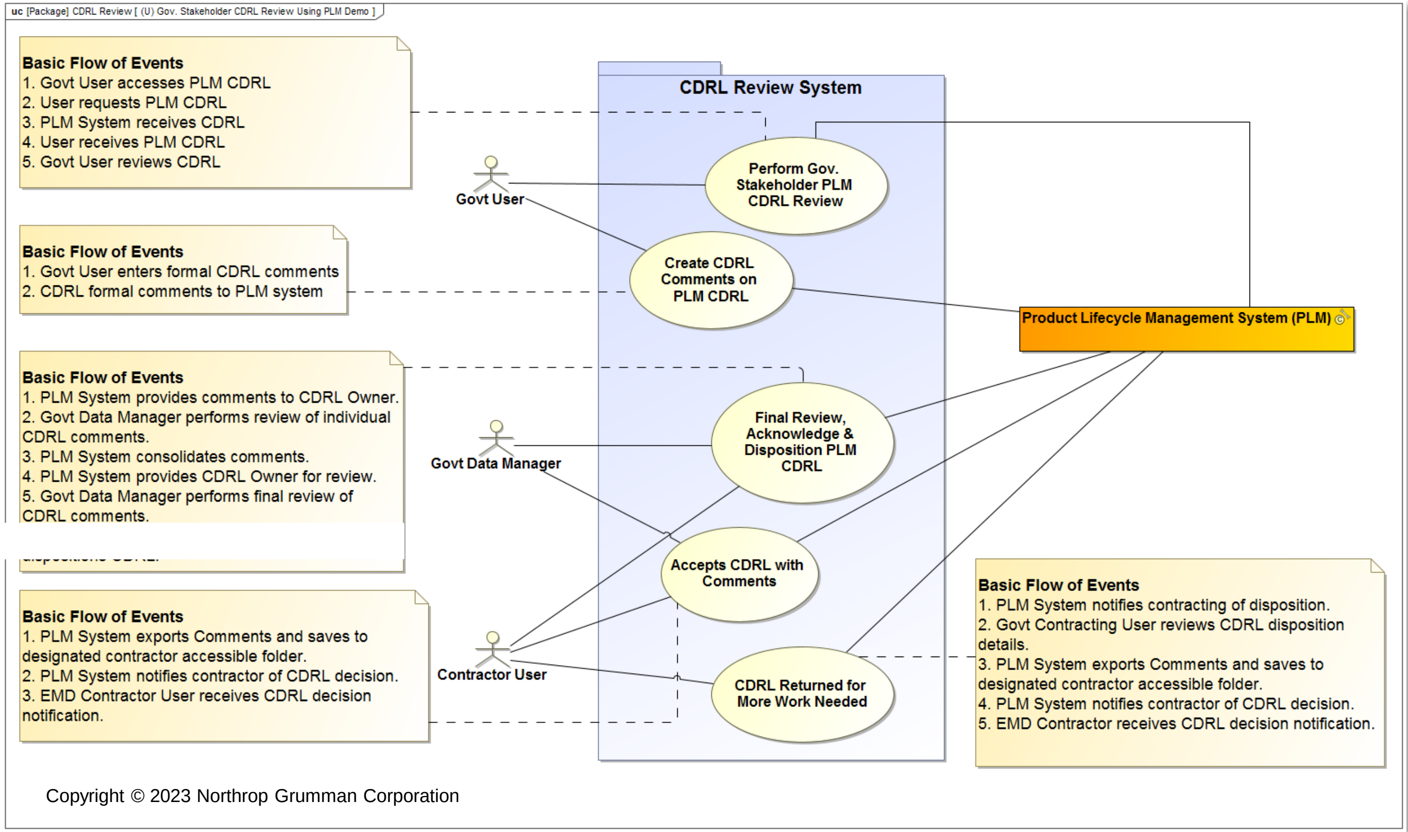


Digital Threads trace critical product data needs

Concept of Operations – How do I create a digital thread between Model(Element) and PLM(CDRL) ?

- **Use Cases –** critical to understanding the creation, update, and maintenance of product baseline
- **User Roles –** model user interaction with ASoT Systems
- **Use Cases –** are critical to analyzing, documenting, and agreeing on how users will interact with the ASoT Systems

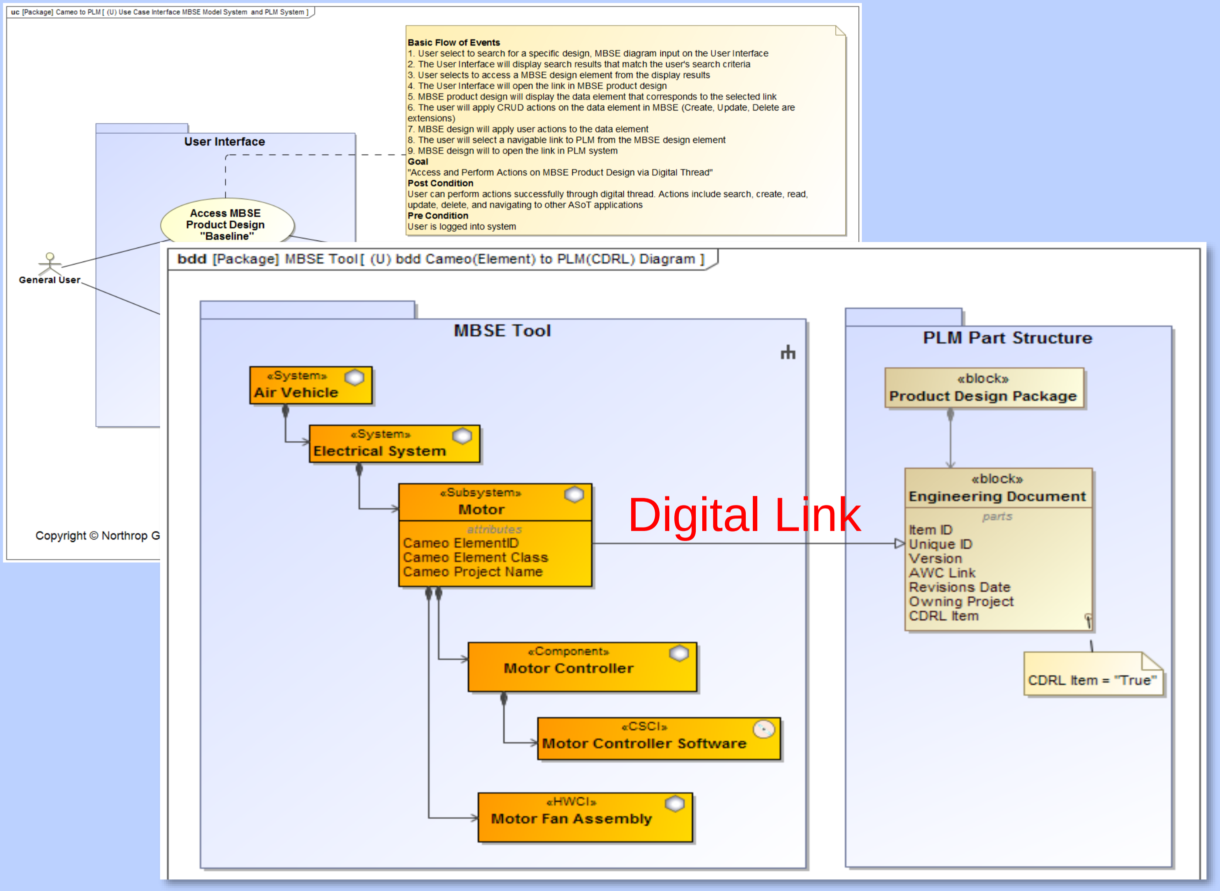
Use Case - CDRL Review Process



Explore user interaction with ASoT Systems to perform critical processes

- **Example (CDRL):** Modeling digital thread between MBSE product model and PLM CDRLs
- **Use Case –** The customer needs to review MBSE product model and related CDRLs
- **Structure** – Modeling structure of a digital thread between MBSE(element) and PLM(CDRL)
- **Data Model –** physical data model depicts MBSE product structure and PLM metadata fields of CDRL data items

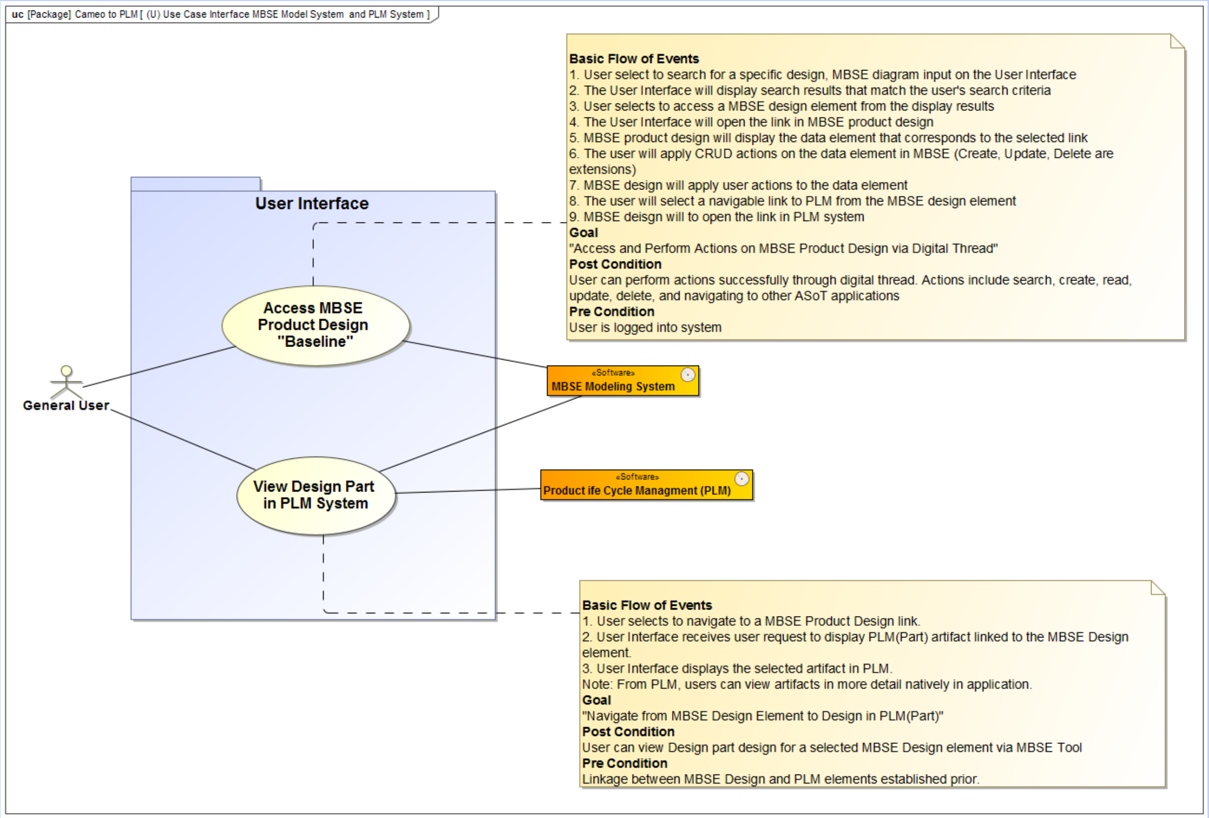
bdd – Digital Thread – Connect MBSE Design to PLM(CDRL)



Concept of Operations —— How do I create a digital thread between Model(Element) and PLM(Part) ?

- **Example (Part):** Modeling digital thread between MBSE product model(Element) and PLM(Part)
- **Use Case –** The customer needs to review MBSE product model and related PLM(Part) Information
- **Structure** – Modeling structure of a digital thread between (MBSE(Element) and PLM(Part)
- **Data Model –** Physical attributes to be linked between MBSE product(Element) and PLM(Part) metadata fields

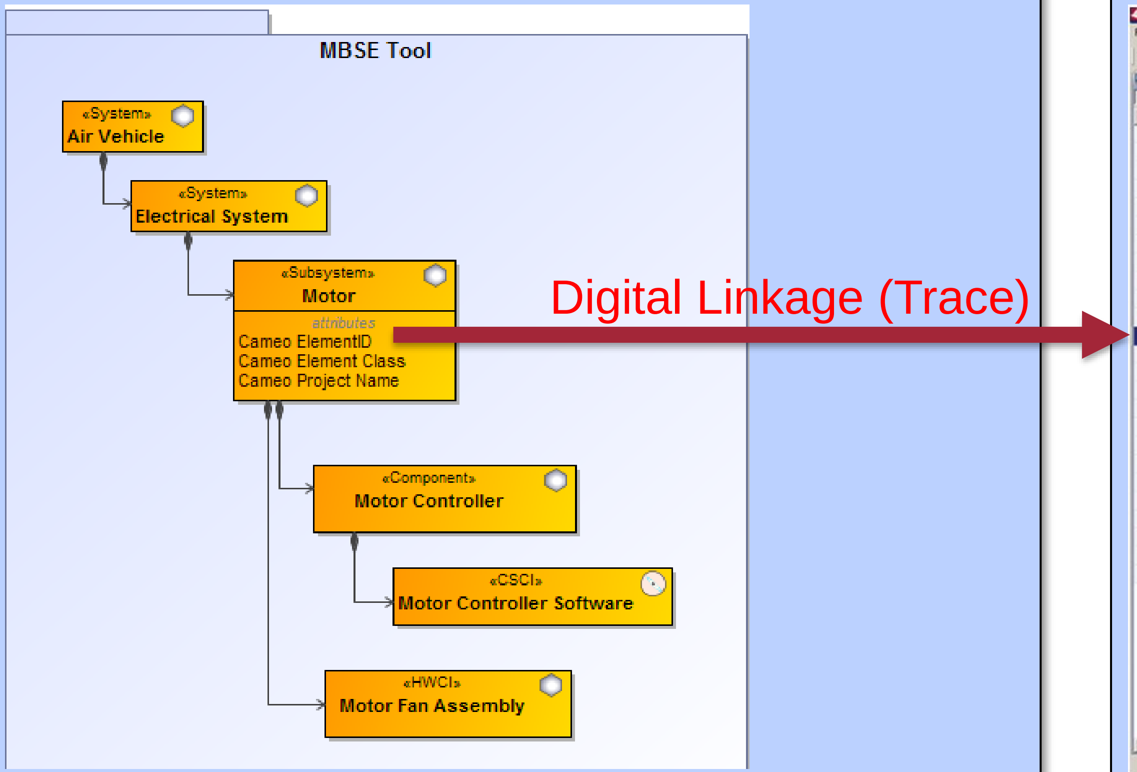
User Case – Customer review of Cameo Model and PLM Part



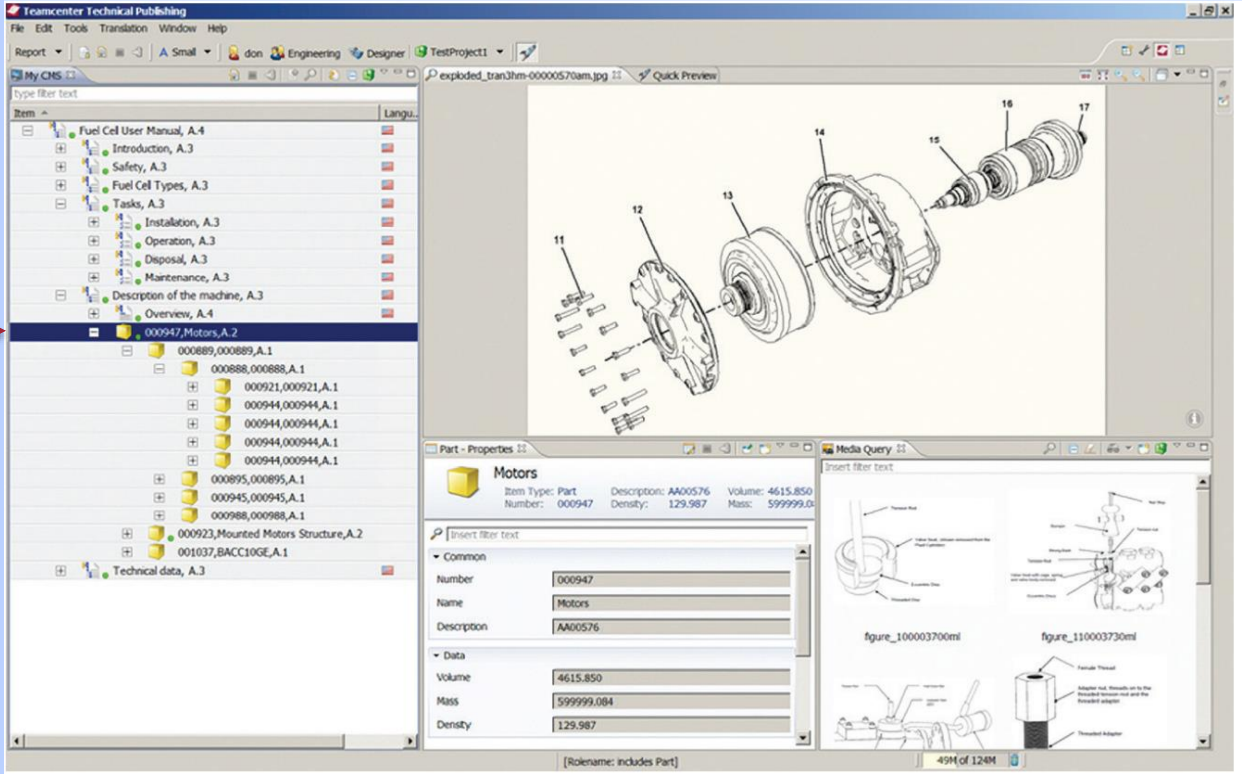
Use Cases - help analyze, document, and agree on customer needs

Digital Thread Models – How do I create a digital thread between Model(Element) and PLM(Part) ? *(continued)*

MBSE Product Design Model



PLM Technical Publishing Solutions Example



Reference – Teamcenter Technical Publishing Solutions © 2017 Siemens Product Lifecycle Management Software Inc.

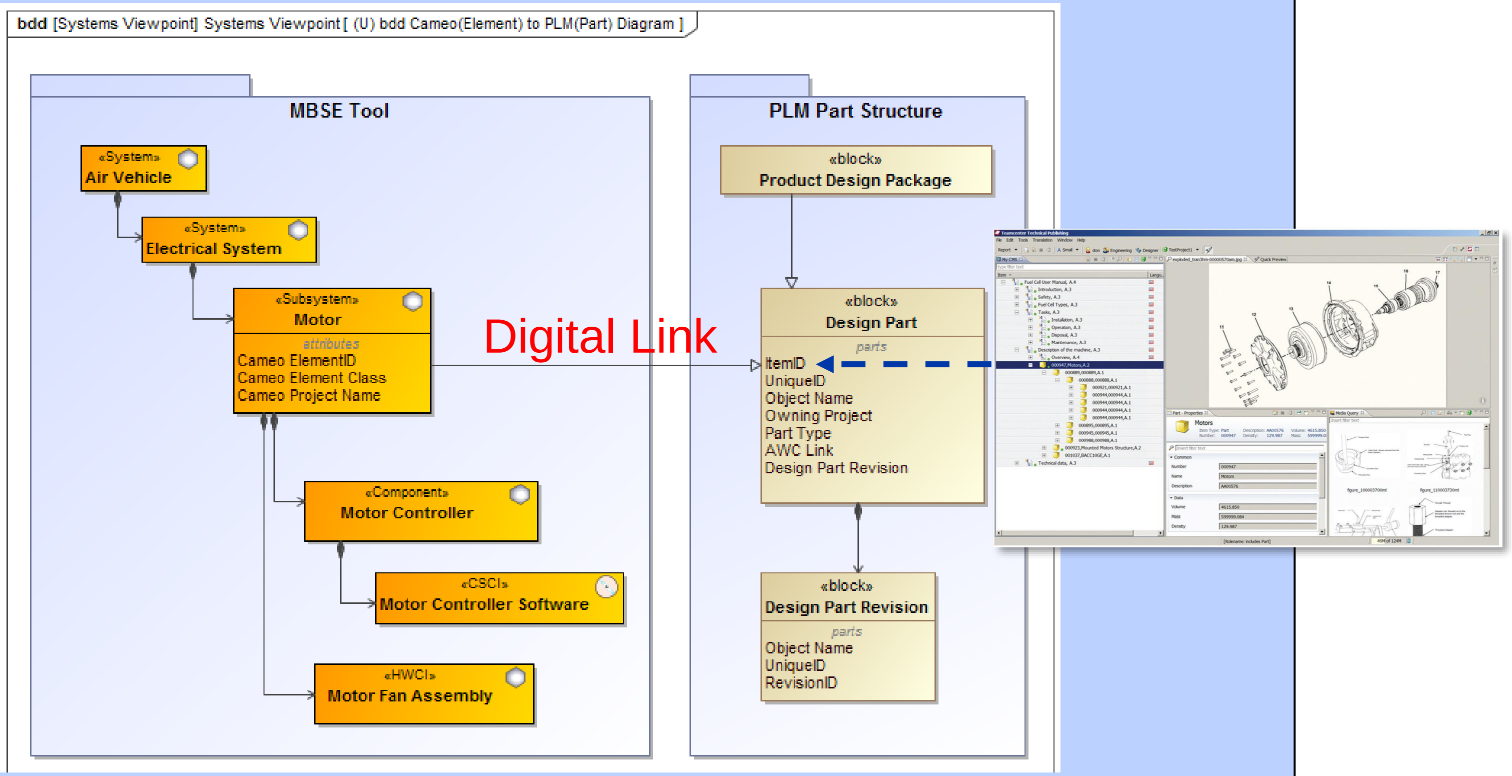
Digital Thread requires detailed knowledge of ASoT system metadata

Digital Thread Models – How do I create a digital thread between Model(Element) and PLM(Part) ? *(continued)*

Modeling Digital Thread:

- **Product Linkage** – determine if the linkage is critical to the product baseline.
- **ASoT Linkage –** Identify the physical data attributes which will be linked.
- **Define type of linkage** – SysML level associations *(Association, Generalization, Satisfy, Derive, Trace, Verify, Refine)*
- **Automation –** Determine ability to automate digital linkage

bdd – Digital Thread – Connect ASoT elements together to create product baseline



ASoT Systems data models are complex to navigate with multiple trees and branches

Summary

- **Scope – (Operational Data vs Analytic Data)**
  - **Operational data -** digital threads provide current state of the business.
  - **Analytic data -** can be generated from product data to analyze the business.

- **Use Cases**
  - **Use Cases –** Critical to analyzing, document, and agreeing on how users will interact with the DEE.

- **ASoTs**
  - **ASoT Systems –** Manage and control the product baseline for the program.

- **Digital Thread - Modeling Digital Threads**
  - Define user needs
  - Clarify ASoT data linkage
  - Define type of link
  - Determine ability to automate digital linkage

Questions?

Thank you for attending the presentation!

I hope you found some useful tips and examples for your MBSE projects