Enabling MBSE with Configuration Management

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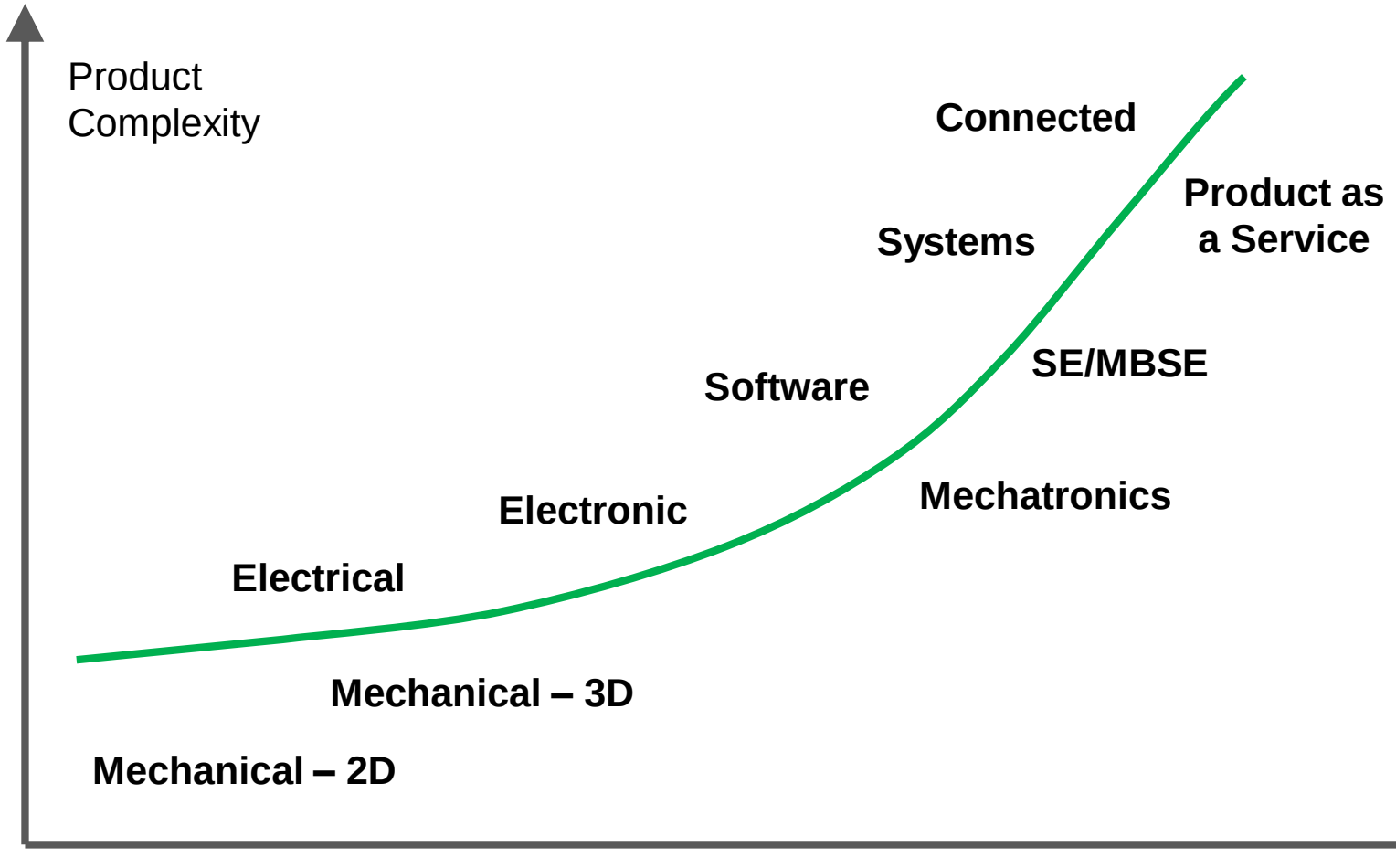
Increasing product complexity



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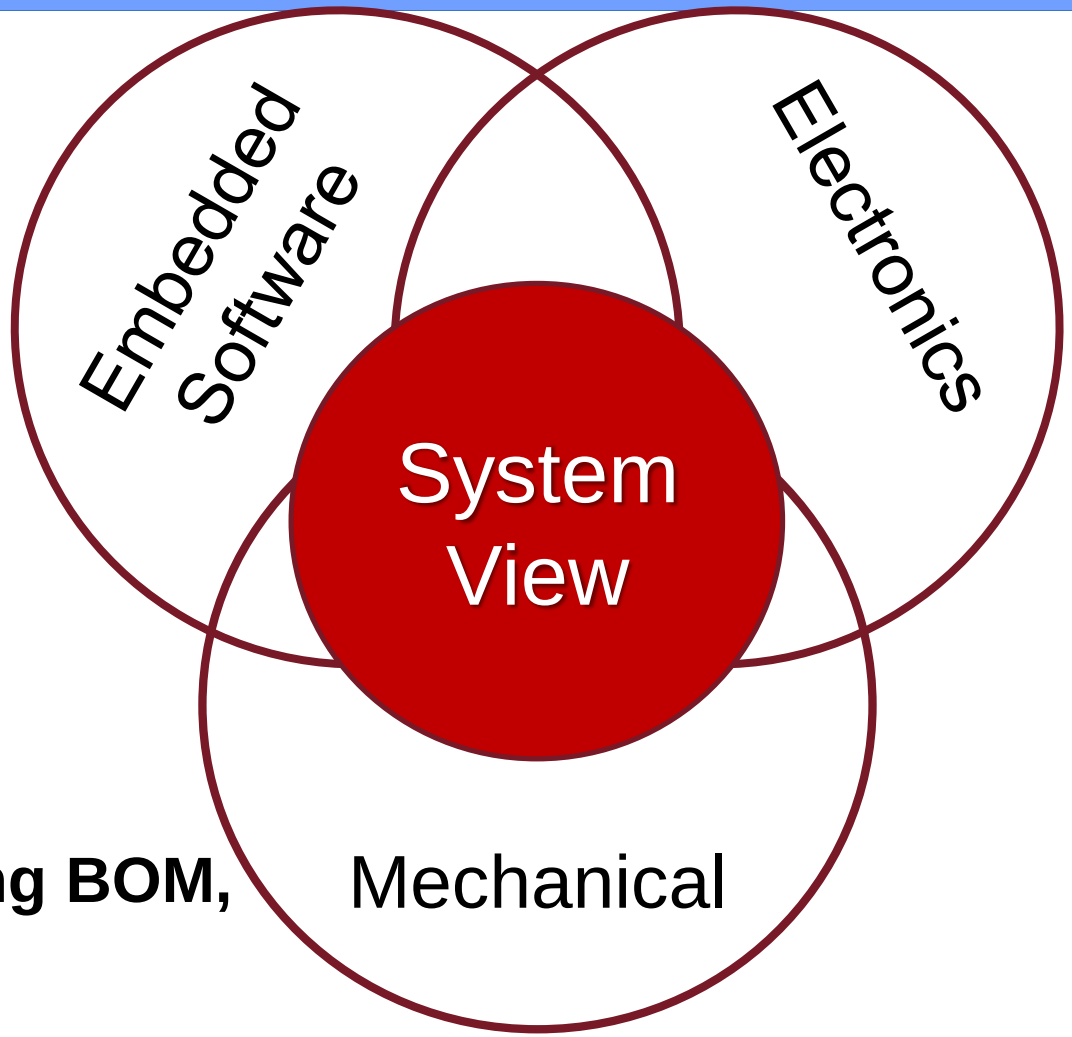
Cross-discipline collaboration

- **System/Product View**
  - **Functional Block diagram**
  - **Linked to Requirements**
- **Engineering Domains**
  - **Software (Embedded)**
  - **Electronics (ECAD)**
  - **Mechanical (MCAD)**
- **Product structure**
  - **Parts & BOM oriented**
  - **Drives Engineering BOM to Manufacturing BOM, etc.**



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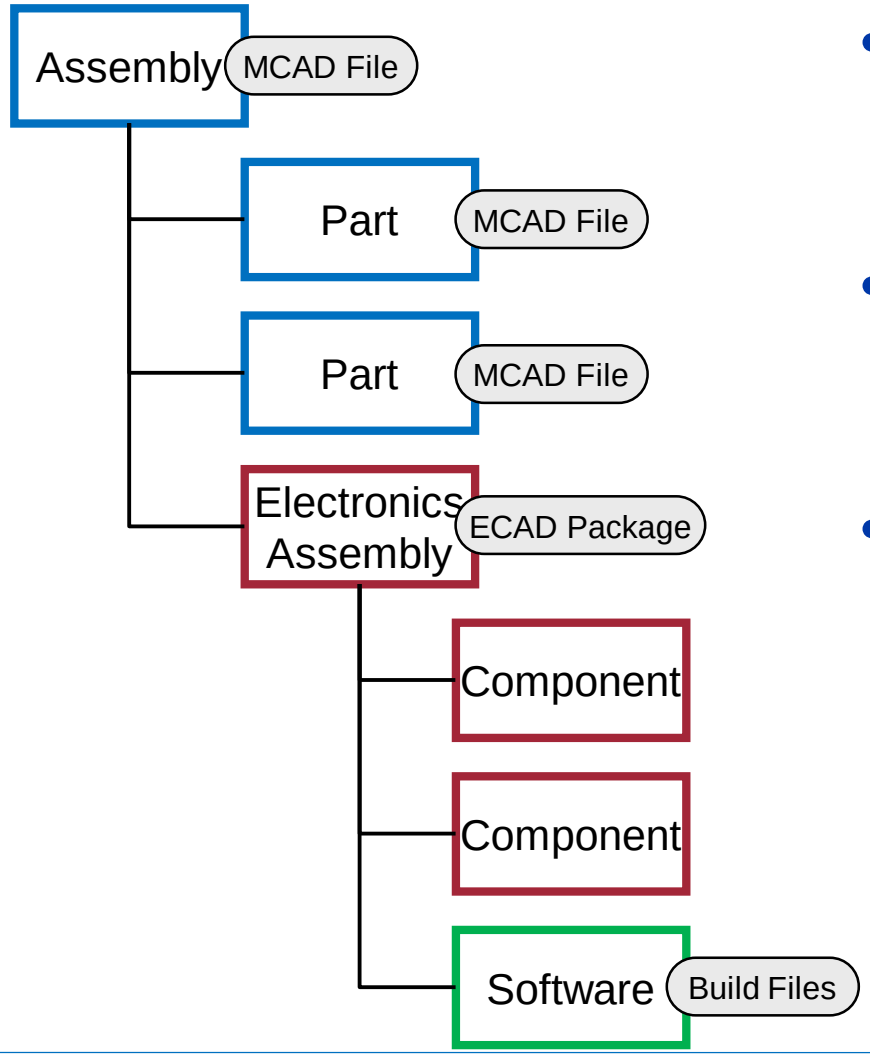
Cross-discipline product structure



- **MCAD – explicit**
  - **MCAD file ≈ PLM Part/Assembly (BOM)**
  - **MCAD files mapped to PLM Parts**
- **ECAD – extractable**
  - **ECAD file ≠ PLM Part/Assembly (BOM)**
  - **Components mapped to PLM Parts**
- **Embedded Software – indirect**
  - **IDE files ≠ PLM Part/Assembly (BOM)**
  - **Released binaries (builds) mapped to PLM Parts to drive manufacturing processes**
  - **Mapping via System/Product View**

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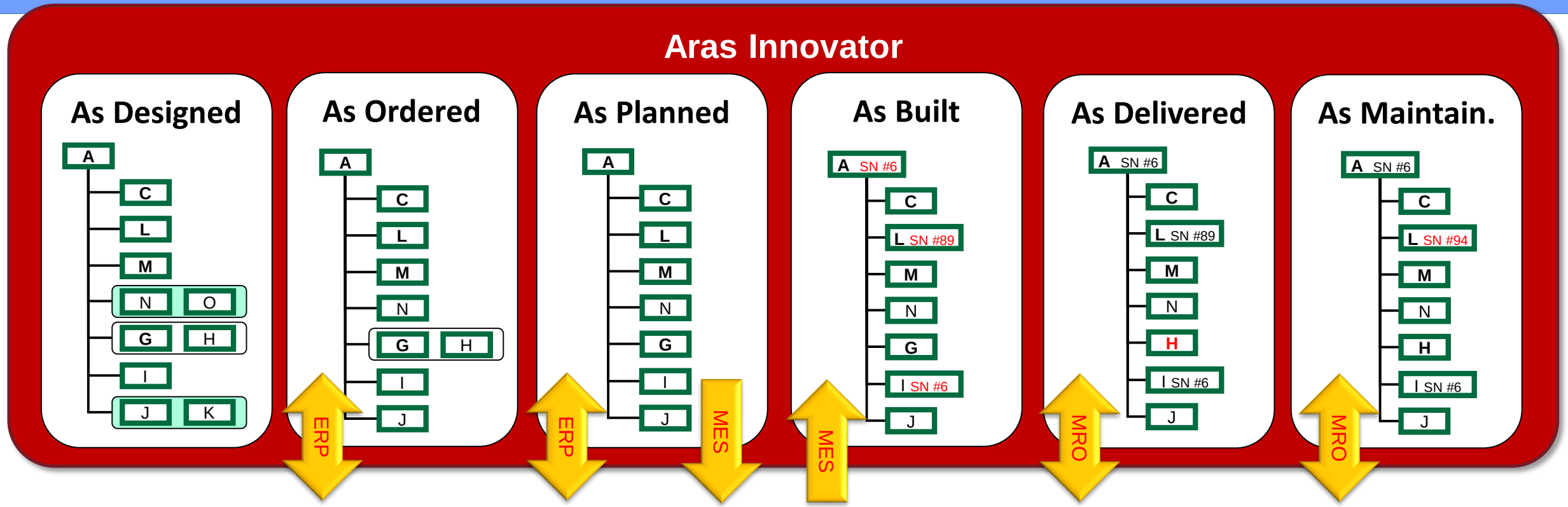
Complex configuration management reality



- **Multiple configurations & effectivities throughout the product lifecycle**
- **Forward and backward traceability**
- **<u>All leveraging CM - Baselines, Enterprise Change Management, etc.</u>**

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What is Model-Based Systems Engineering?

"Model-based systems engineering (MBSE) is the formalized application of modeling to support system requirements, design, analysis, verification and validation activities beginning in the conceptual design phase and continuing throughout development and later life cycle phases."

Source: INCOSE

Systems Engineering is an **interdisciplinary** approach and means to enable the realization of successful systems. It focuses on defining **customer needs and required functionality early** in the development cycle, documenting requirements, then proceeding with **design synthesis and system validation** while considering the **complete problem.**

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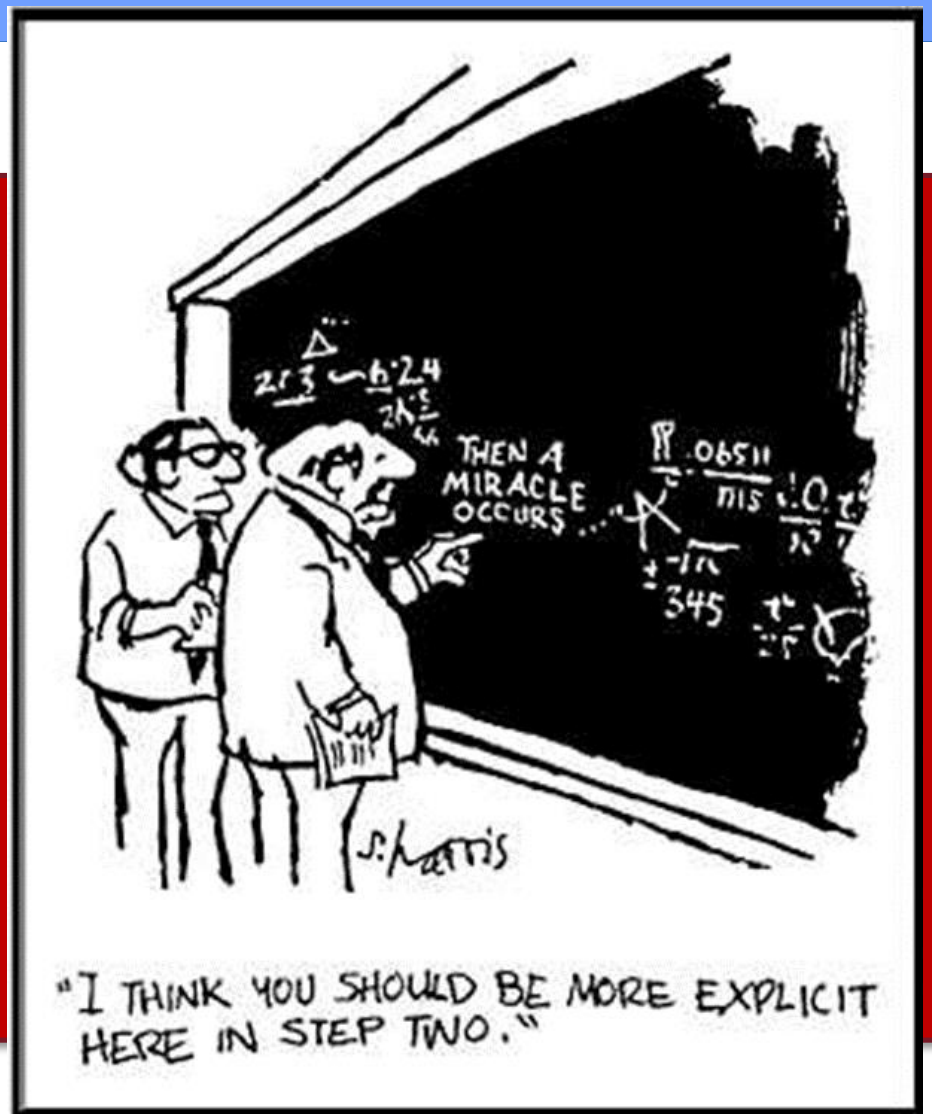
What is Model-Based Systems Engineering?

"I want..."

Requirements

- FAA/FDA
  - Rqt
- Project1
  - Rqt
- Project2
  - Rqt



Product Definition

- System
  - Sub Sys
  - Sub Sys
- System
  - Sub Sys
  - Sub Sys

To mfg

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What is Model-Based Systems Engineering?

"I want..."

Product Design Organization

Requirements

- FAA/FDA
  - Rqt
- Project1
  - Rqt
- Project2
  - Rqt

Every product development organization does "Systems Engineering", whether they call it that or not.

It is the process of synthesizing the design to meet the requirements

Product Definition

- System
  - Sub Sys
  - Sub Sys
- System
  - Sub Sys
  - Sub Sys

To mfg

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Real-world MBSE example

Look familiar?

Aras Innovator

Requirements
- Speed
- Size
- Material
- Cost
- Etc.

Functional
- Read/Write
  - Network
  - SD Card
- Print
- Cooling
- Etc.

Logical
- Movement
  - Head
  - Platter
- Heating/ melting
- Feeding
- Etc.

Physical
- Frame
- Platter
- Print head
- Etc.

Traceability

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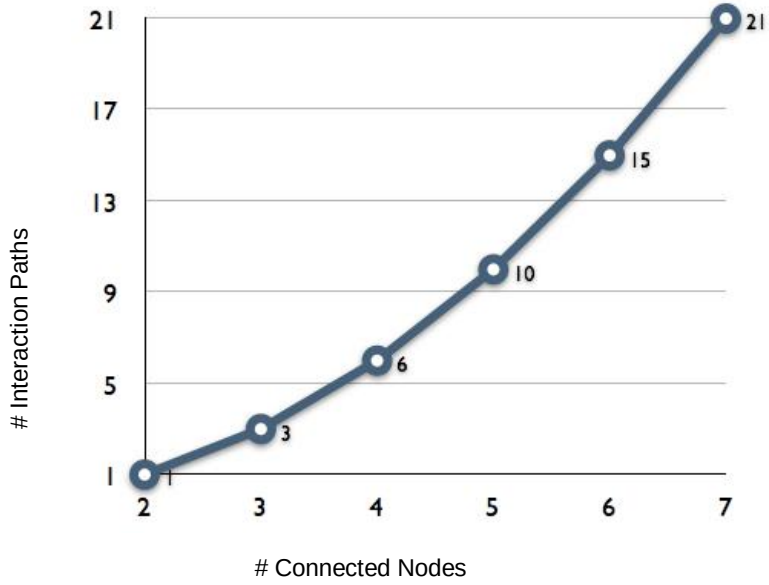
So why isn't MBSE used more widely?

The Complexity Crisis

- As complexity grows, the number of potential interactions grows disproportionately

- Each layer removes us further from core analytical capabilities
- Confidence diminishes in explaining how things work *a priori*
- Even "correct" designs surprise us routinely



$$\#\ \text{Paths} = \frac{n\,(n-1)}{2}$$

Reference: Robert Rasmussen, NASA JPL

MBE & MBSE - Golden Age of Simulation? Prof. Dipl.-Ing. Heinz Stoewer, M.Sc., SECESA Conf., Lisboa, 17. October 2012

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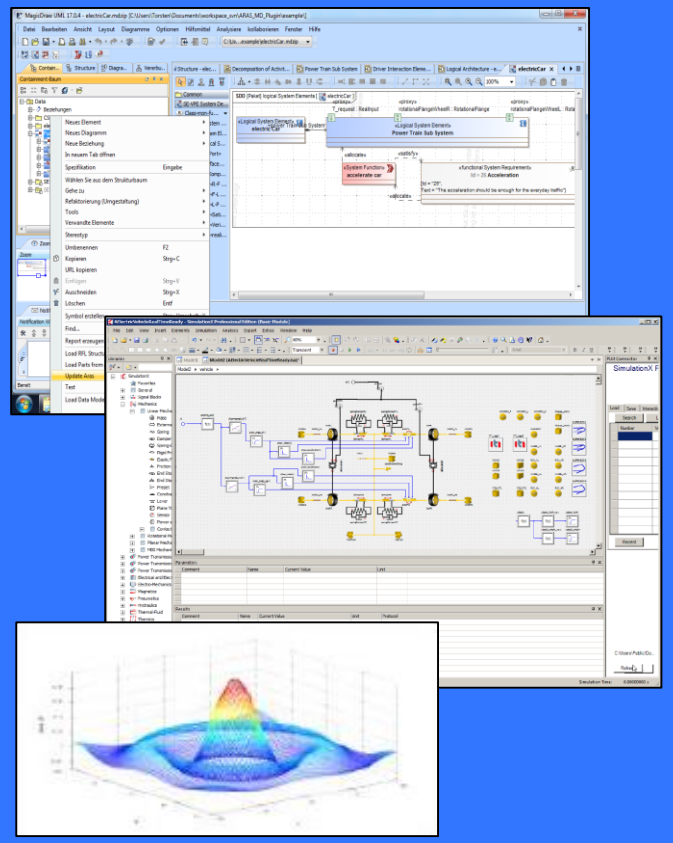
MBSE Integrations in Aras

Supporting efficient, informed decision making on product development across the Enterprise

MBSE System(s)



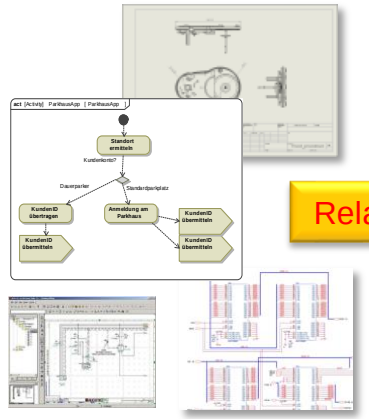
OSLC, PLCS,
AP242XML,…..

MBSE Connector

Bidirectional

Aras Innovator

MBSE Items



Relationships

Functional/Logical

- Funct
  - Sub Funct
  - Sub Funct
- Logic
  - Sub Logic
  - Sub Logic

EBOM

Test BOM

MBOM

SBOM

Security

Items & Relationships

Lifecycle

Configuration Management

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Integration example

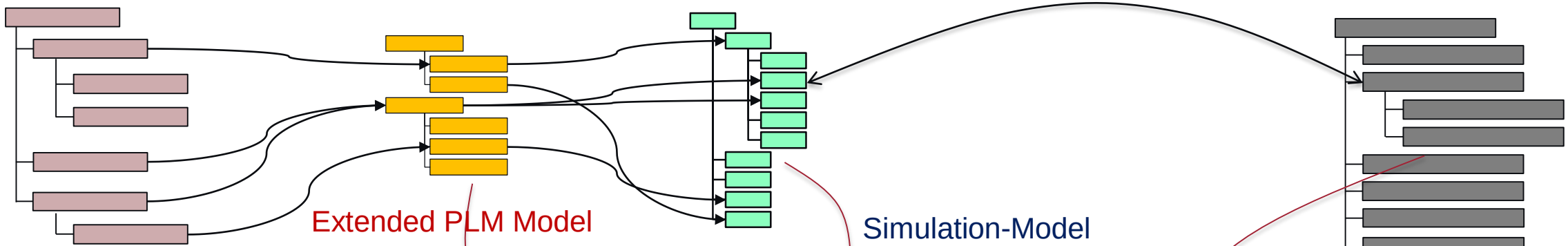
The MBSE Data Model for ALM and PLM

Requirements Breakdown

Functional Breakdown

Logical System Breakdown

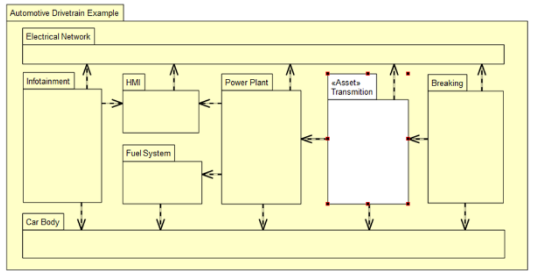
(Physical System Elements)
E-BOM structure

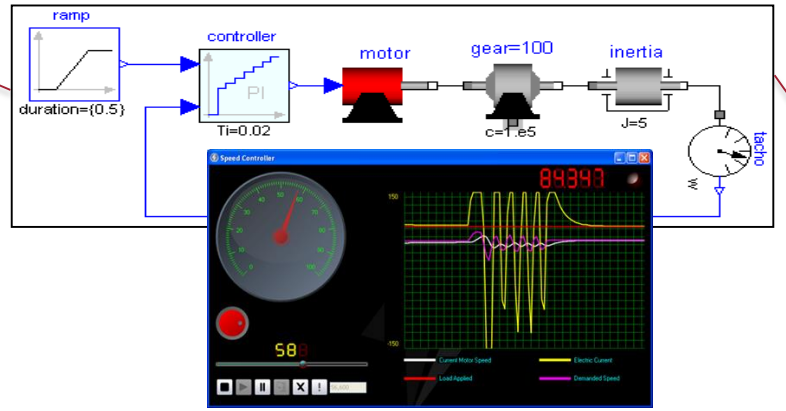


Extended PLM Model

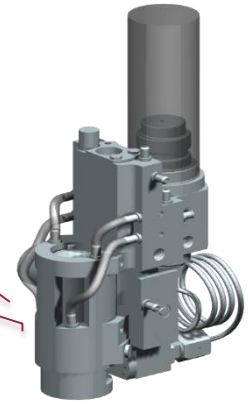
Simulation-Model

System Model





CAD-Model



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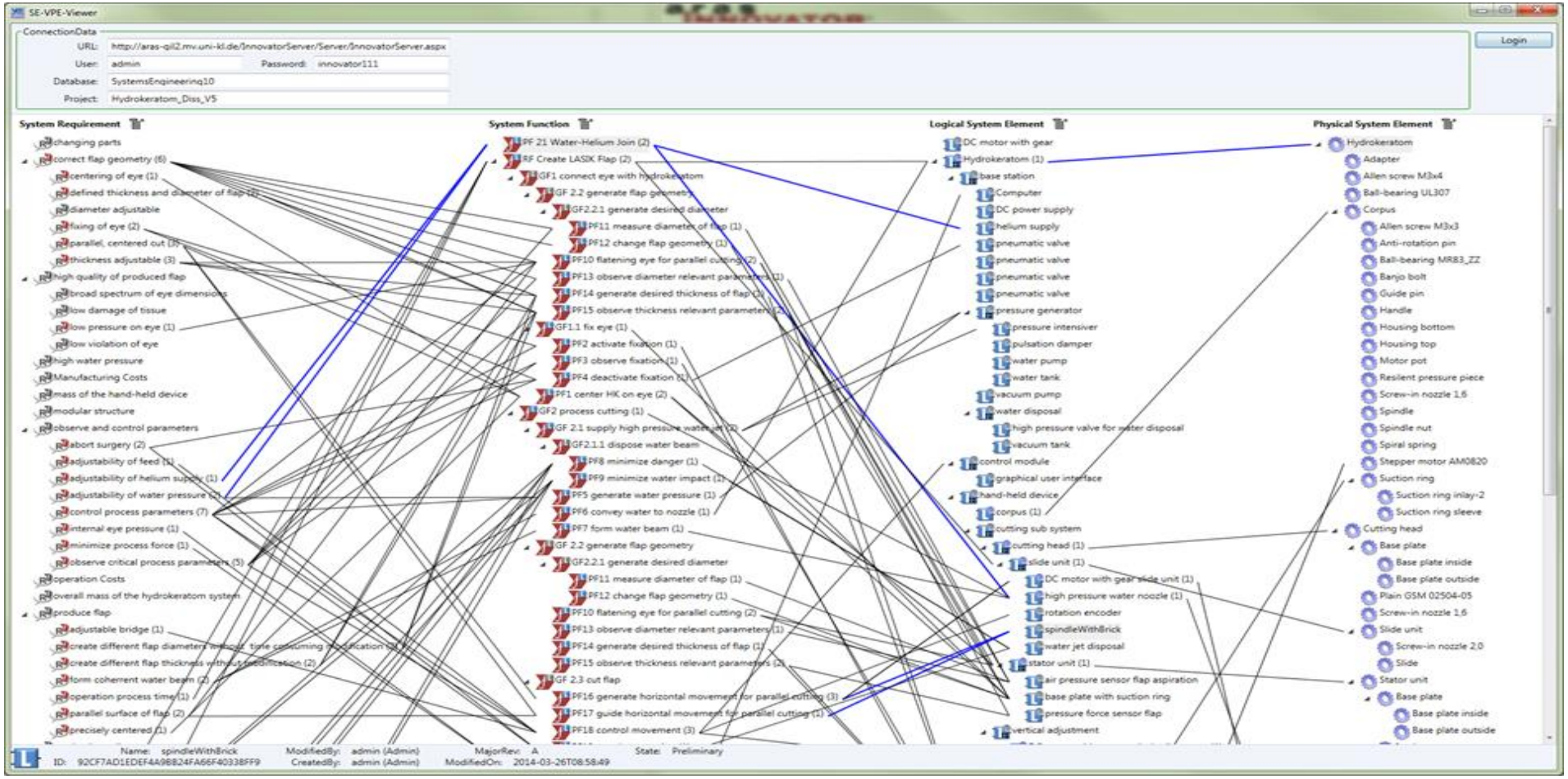
Example change impact visualization



Requirements **Functions** **Logic** **E-BOM**

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Conclusions

- **Product complexity continues to rise**
- **MBSE is a powerful tool to manage the design of complex products**
- **MBSE needs to be part of an overall configuration management philosophy**
- **<u>Strong, foundational CM is a REQUIREMENT to realize MBSE benefits</u>**

Aras PLM is positioned to provide Future Proof Enterprise PLM with industry leading CM capability

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