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# Ford Motor Company
# CAE PLM Solution and integration with CAE Pre-Processor Software

2011 European HyperWorks Technology Conference
Bonn, November 8–9, 2011

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# Introduction

# Drivers for CAE PLM @ Ford

- Efficiency
  - CAE Model Build effort
  - CAE Model Quality and Reliability
  - Process Automation
- ONE FORD
  - Global CAE Process
  - Global Sharing of Data and Work




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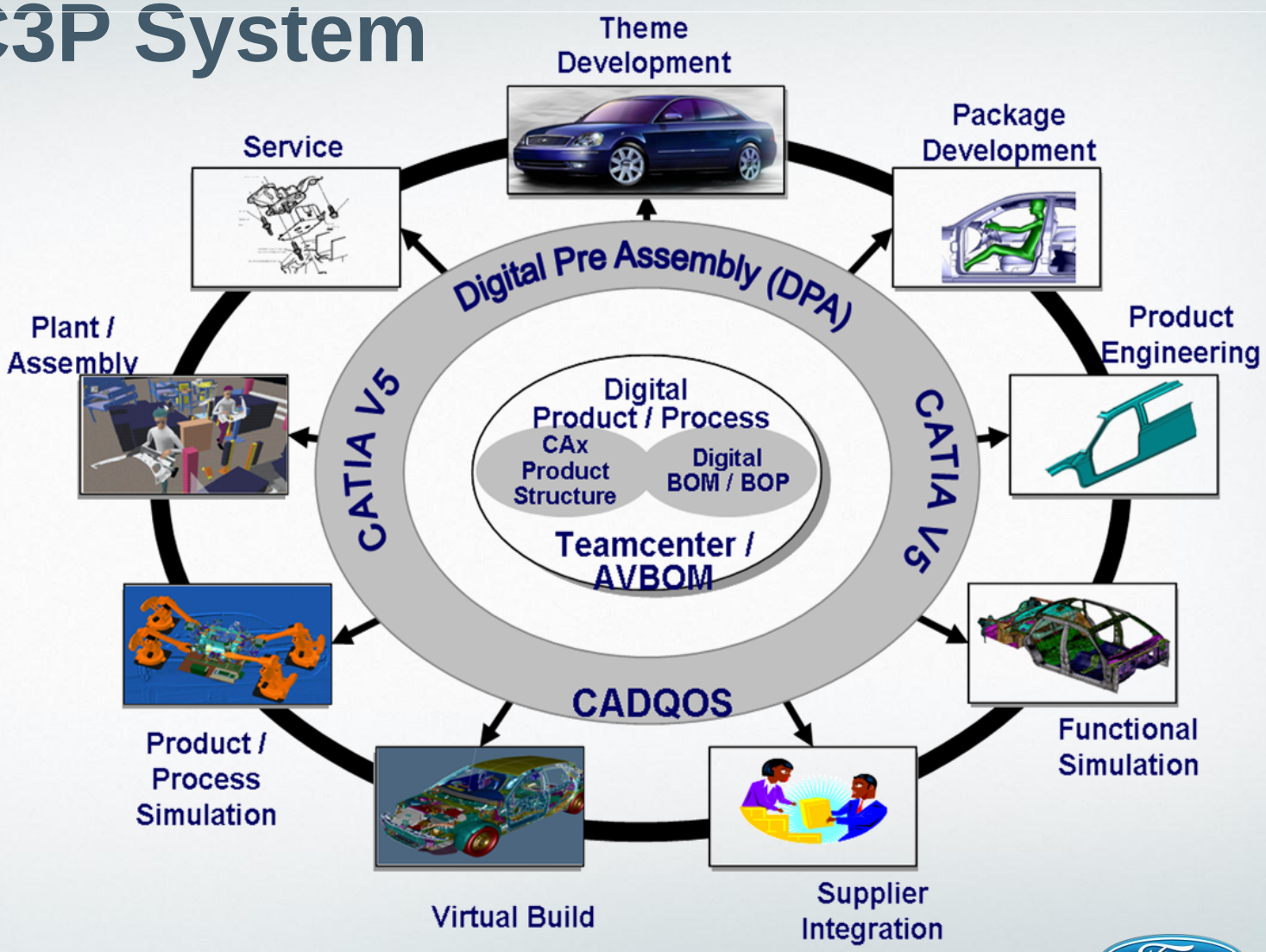
# Ford C3P System



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# Ford C3P Sites




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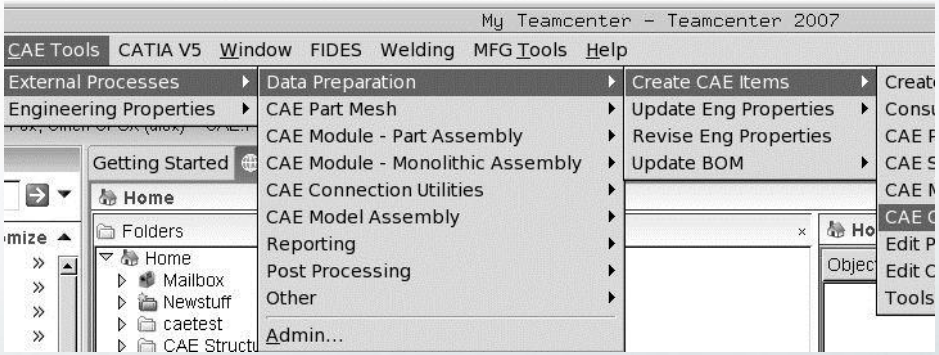
# CAE PLM History

1997: Deployed Metaphase for „CAE PIM“
- CAE Model storage assigned to Product data

2000: CAE Model Build and Management with I-DEAS/TDM
- CAE Model creation based on CAD authoring tool

2004: Teamcenter Deployment for CAE PIM
- CAE Data management as first Teamcenter Deployment worldwide

2006: Teamcenter CAE Customization
- CAE Process Automation
- Pre-Processor Integration



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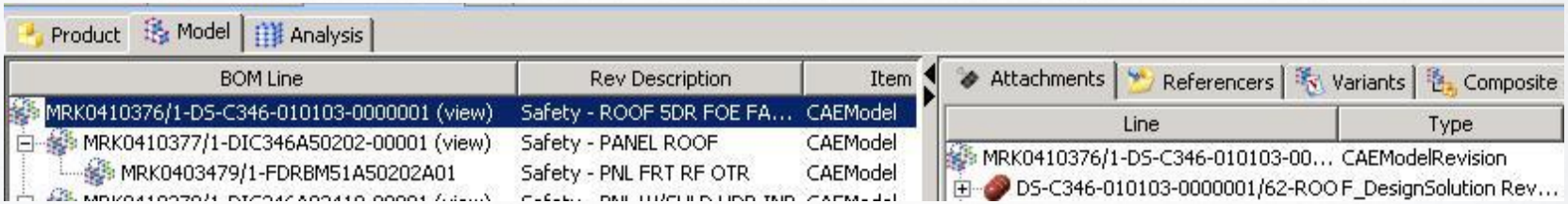
# CAE PLM History cont.

2008: TCSim Project

- Teamcenter for Simulation (TCSim) Selected as Strategic CAE Data Management Tool
- Developed Solution for CAE Model Build Management

April 2010: Deployed TCSim for CAE PIM

- OOTB CAE Data Management Solution



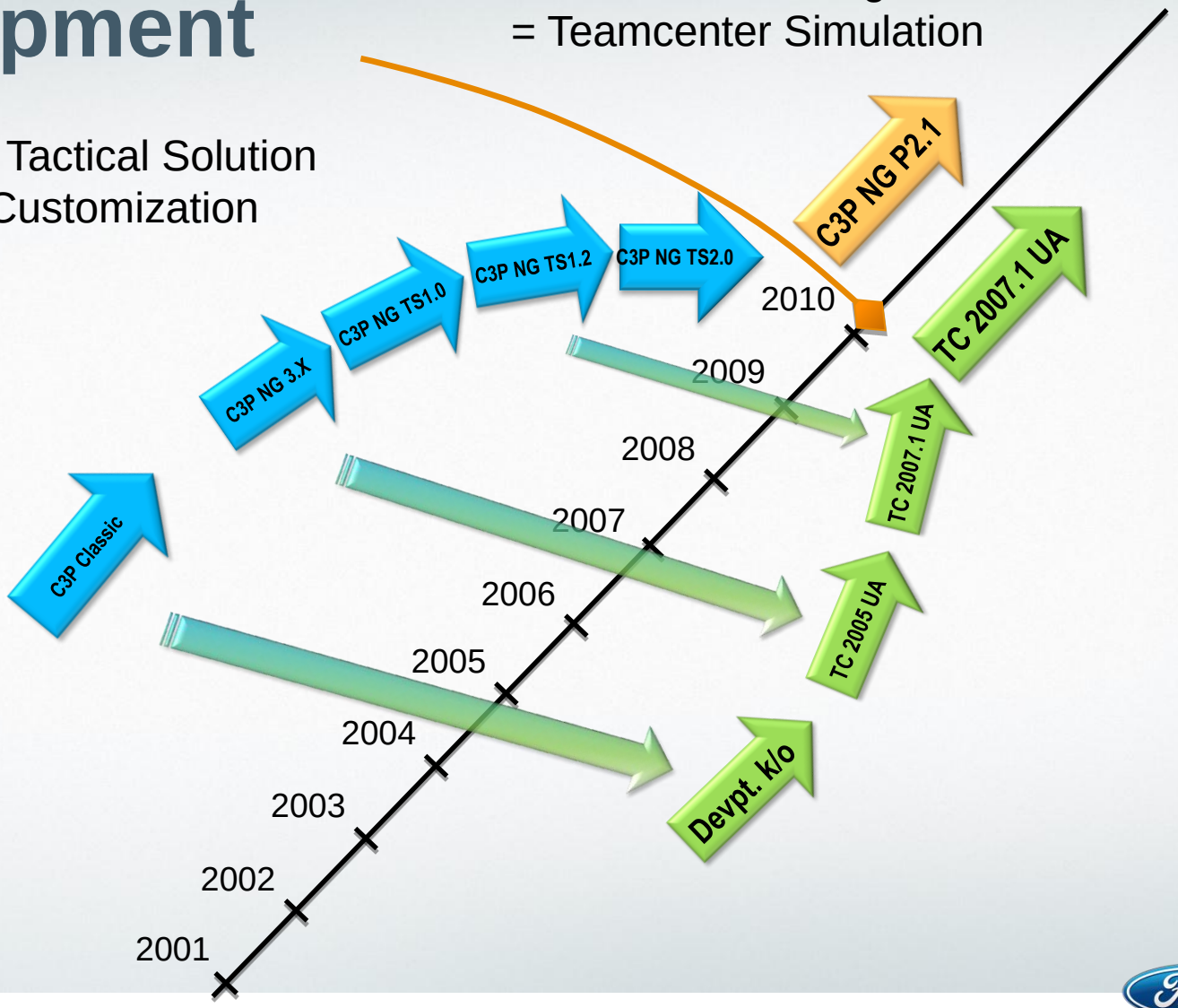

Jan 2011: CAE PLM Strategy workshop

- Defined set of global CAE PLM Principles (e.g. on sync. & mapping w/ product structure, knowledge capture, etc)

# Development

Ford Global Strategic Solution
= Teamcenter Simulation

Ford EU Tactical Solution
= Local Customization



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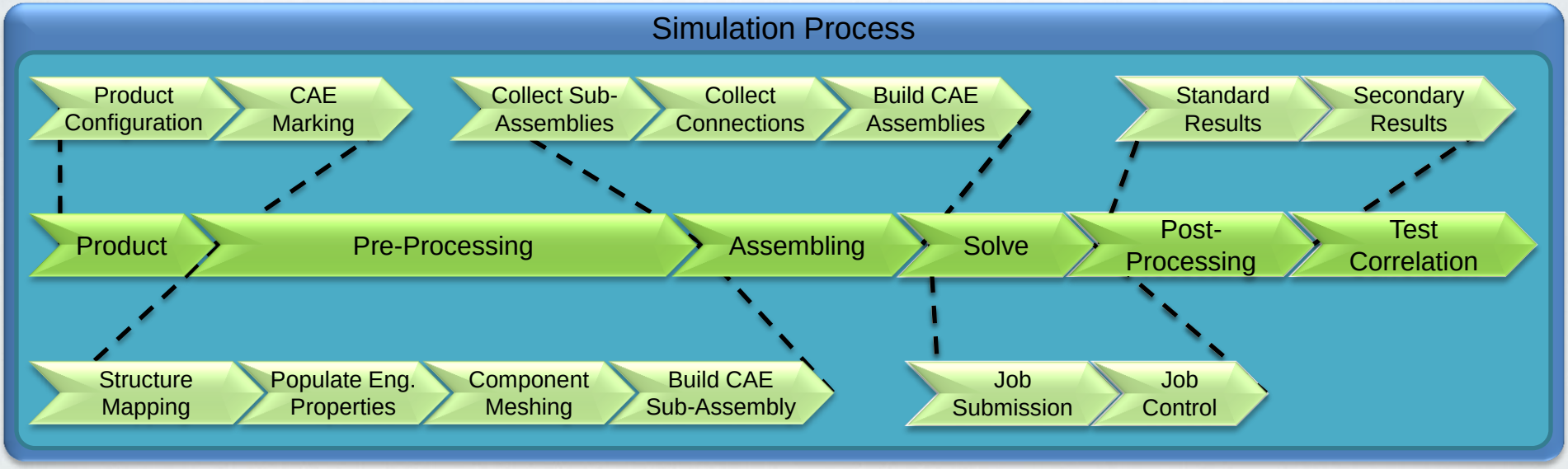
# Scope

# TCSim Project Scope (2008-2010)




**Phase 1** **Phases 2+**



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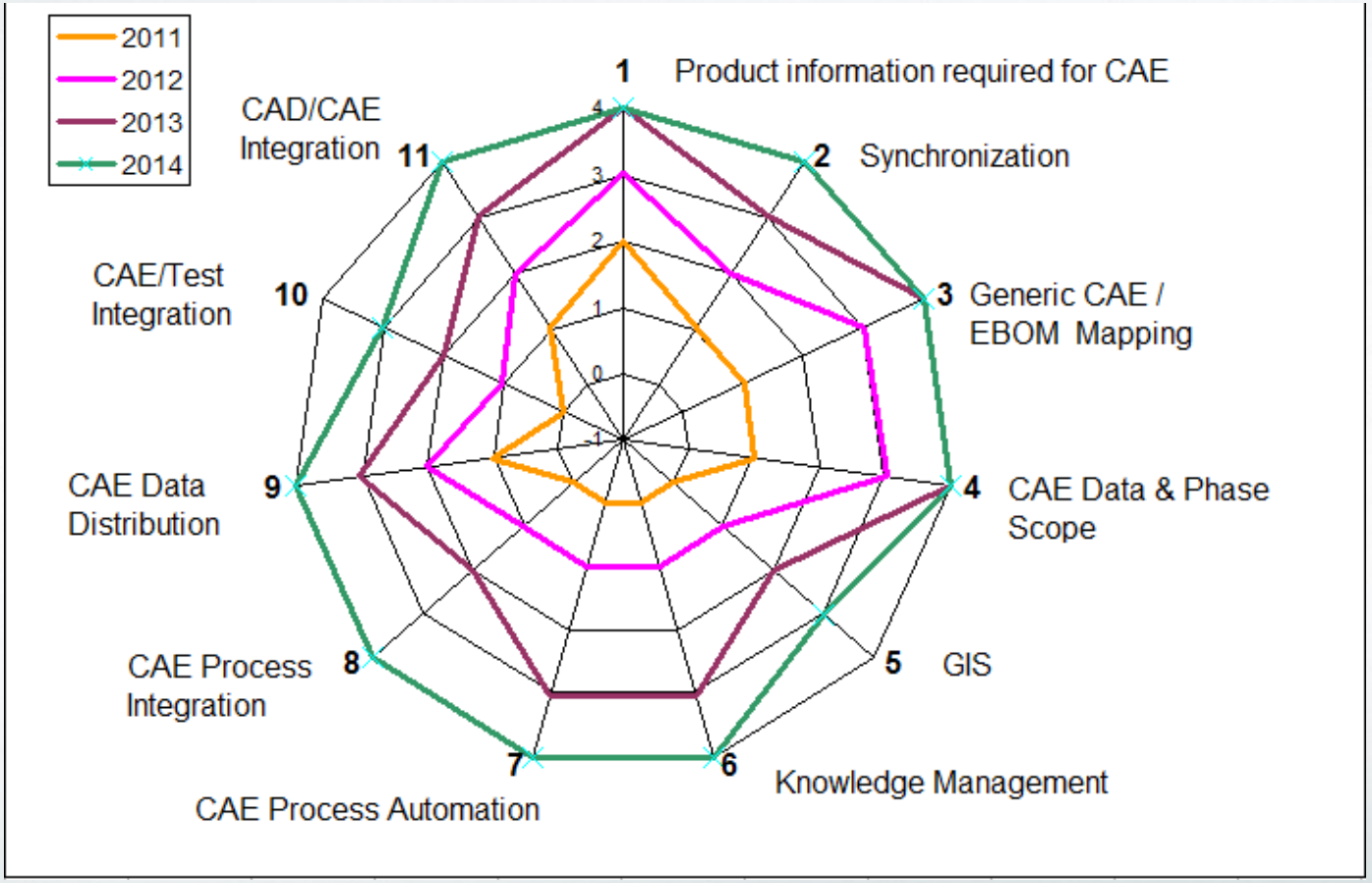
# CAE PLM Development Scope (2011-2014)



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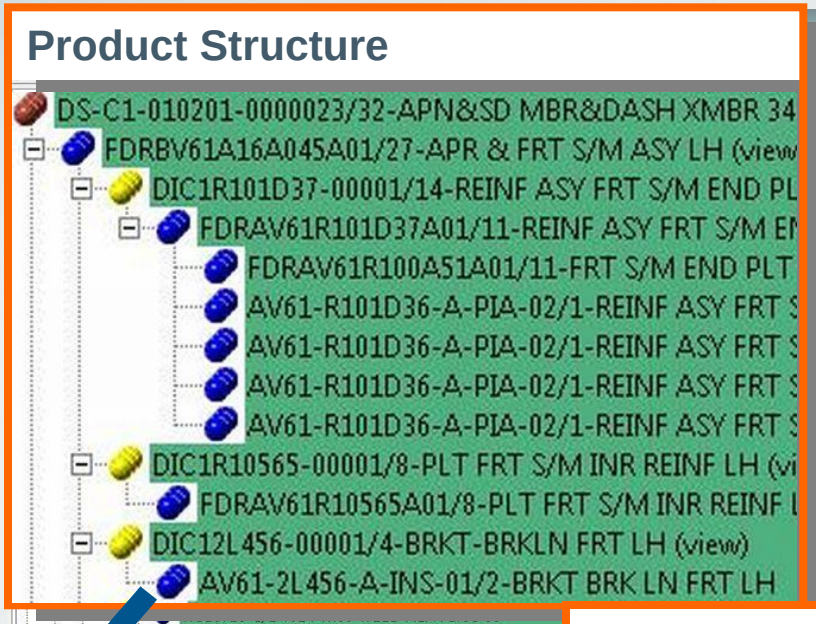
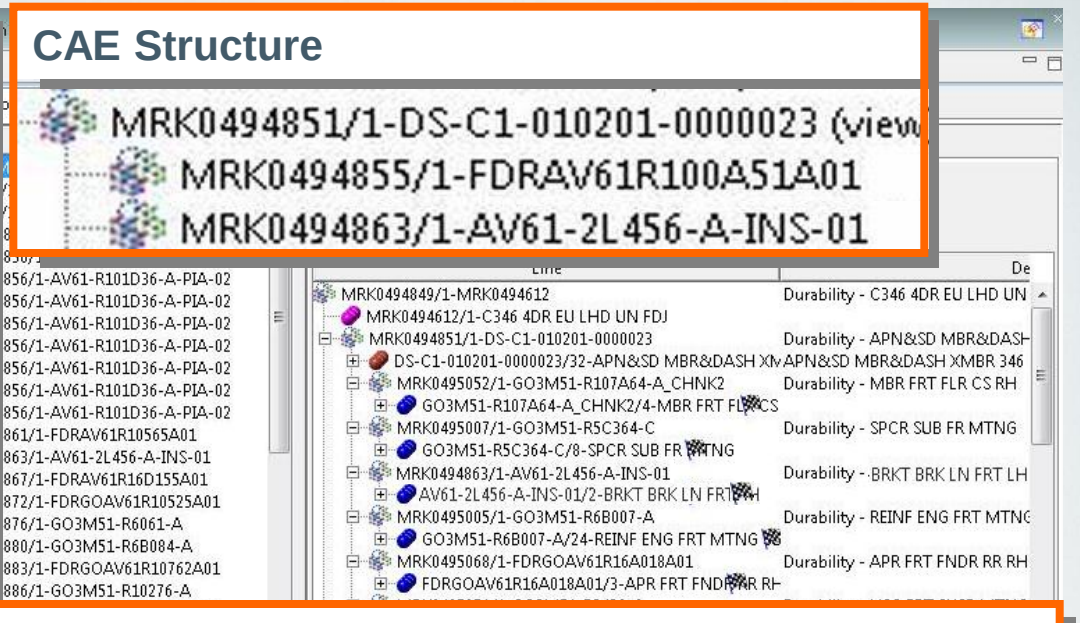
# Architecture

# Data Model – “EBOM embedded in CAE str/”

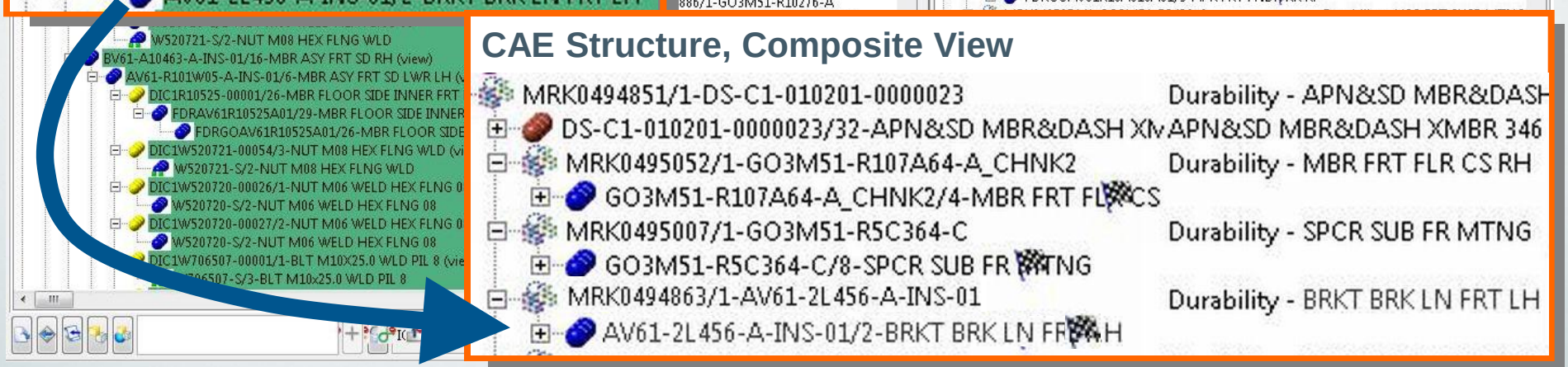
## Product Structure




## CAE Structure




## CAE Structure, Composite View



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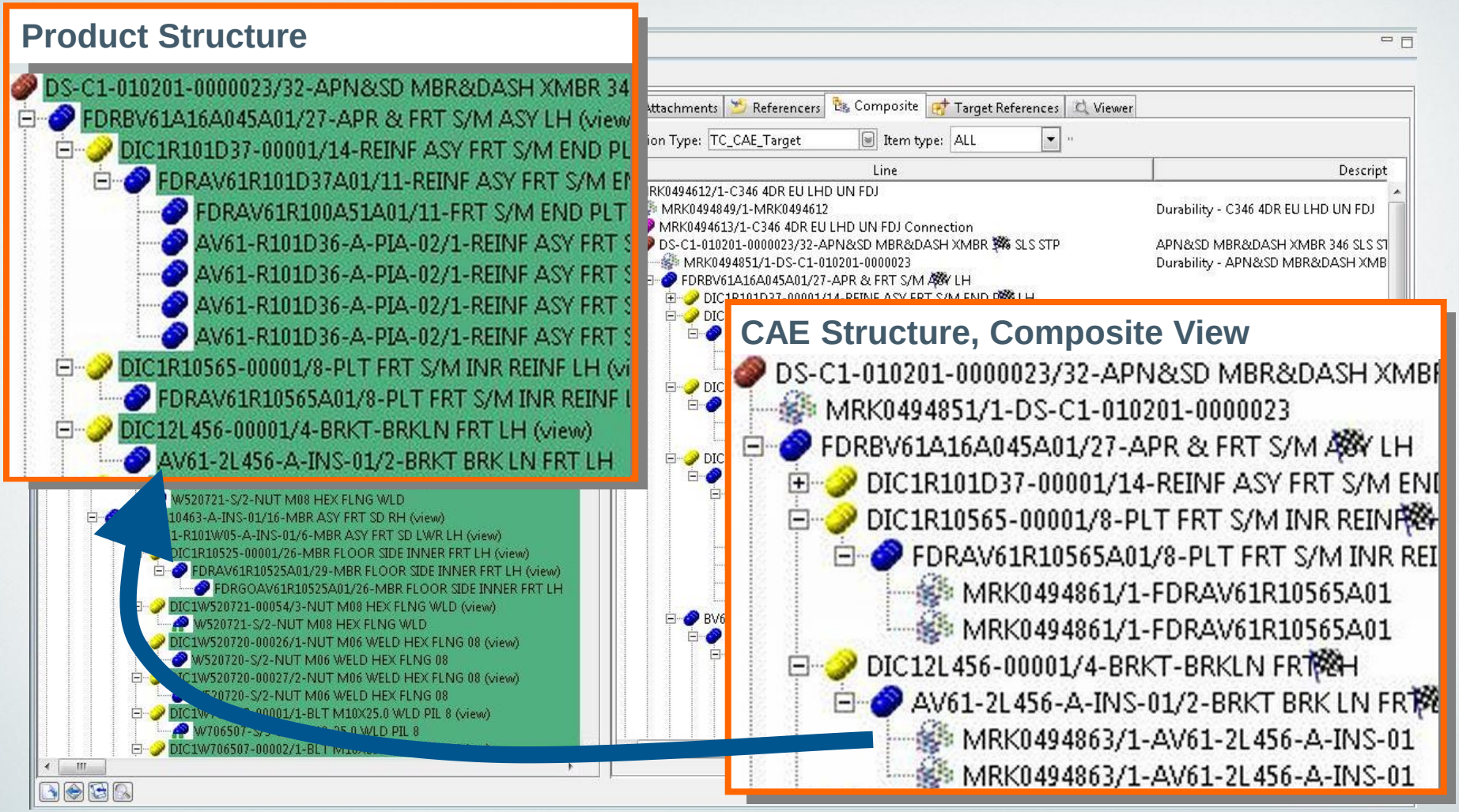
# Data Model – “CAE embedded in EBOM”



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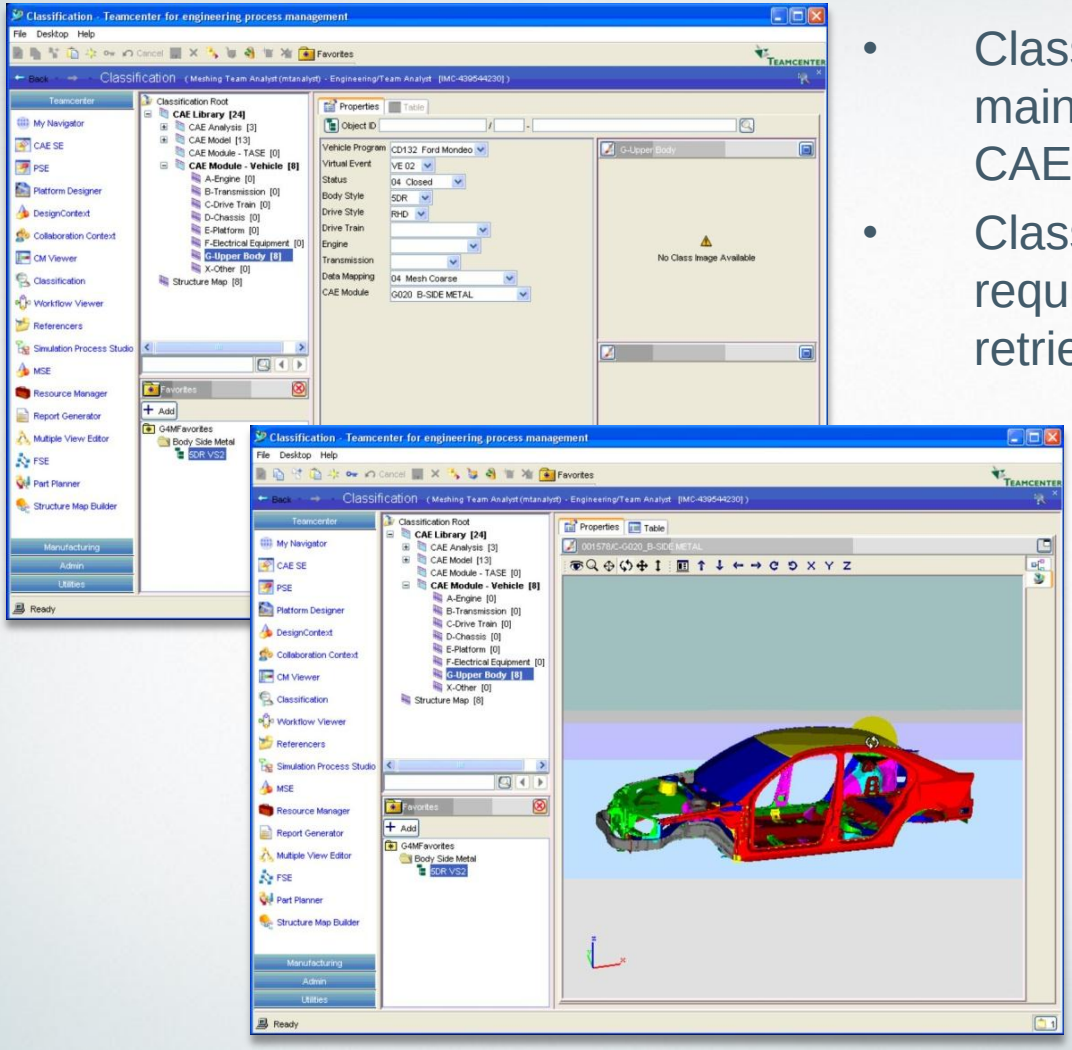
# Data Model – Classification




- Classification is used to create and maintain a structured library based on CAE specific classification attributes
- Classification of CAE Data makes required data easier to find and retrieve

- Search the classification hierarchy based on different criteria to find the CAE data you need
- View data associated with your CAE item in the viewers. (jt, text, etc)
- Control complexity of growing CAE Library



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# Tool Architecture

**Server/Client**

**Teamcenter for Simulation**

- Create/Maintain Structure
- Change mgmt.
- Notification
- Manage EPs
- Maintain/Document Data Sets
- Work Packaging
- Share Data
- …

D/B Common w/ PDM

PLM XML

**Client „TCSim tool set“**


**tc_inspector**

- Customer specific utilities
- Advanced functionality
- Fix Minor Bugs

**tc_xyz / Preproc.**

- CAE Pre-Processor
- Read Structure
- Read Data sets
- Start Processes
- Modify Data Sets
- Modify EPs



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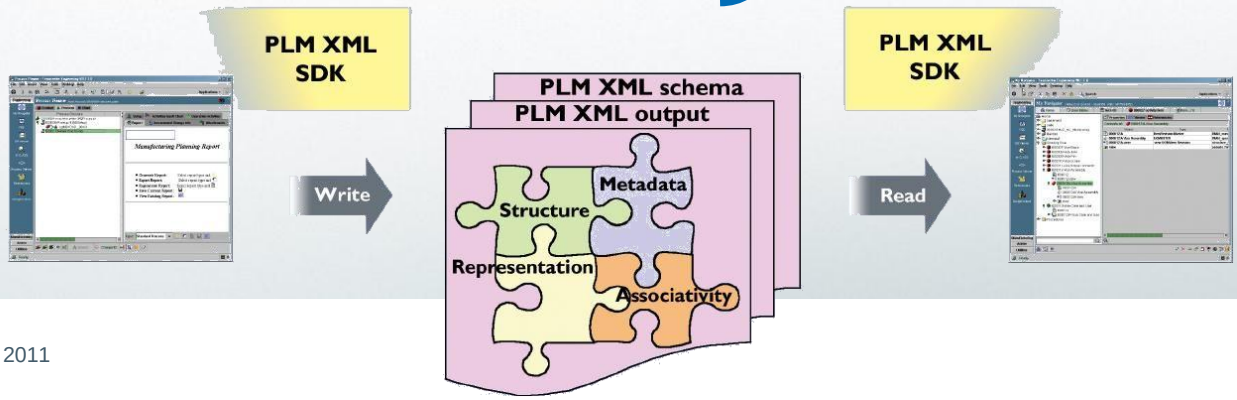
# Interface Format

- Siemens PLM XML Format Selected
  - Versatile Format
  - Configurable via „Transfer Modes“
  - Provides Image of the Selected Structure
    - Structure & Metadata
    - Paths of Included Data Sets
    - Copies of the Files Attached to Data Sets in Native Format

} Package



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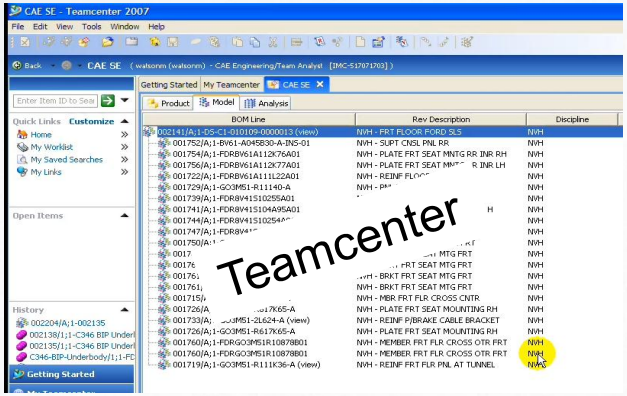
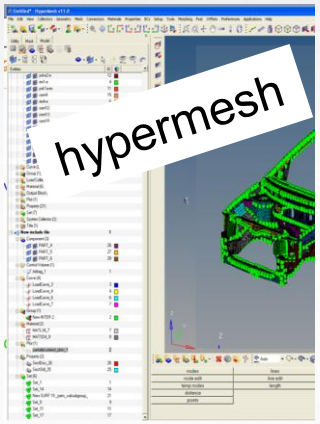
# CAE Pre-Processor Integration

# Pre-Processor Integration – Crash Vehicle Assy

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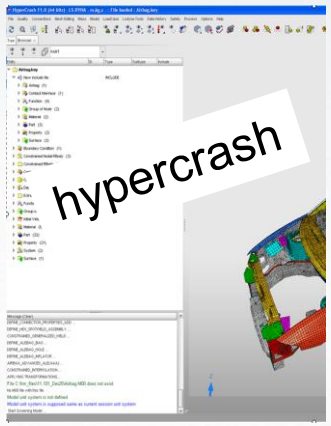


- Modular library
- Generic Models
- Manage mcf‘s
- Module selection
- Model content
- Instances
- Module Positions
- …

PLM XML

- Modify mcf‘s
- Realize connections
- Modify Meshes
- Position Modules
- Quality Checks
- Numbering
- Mass Trimming / Balancing
- Loadcase Setup
- Output Request
- Final Deck



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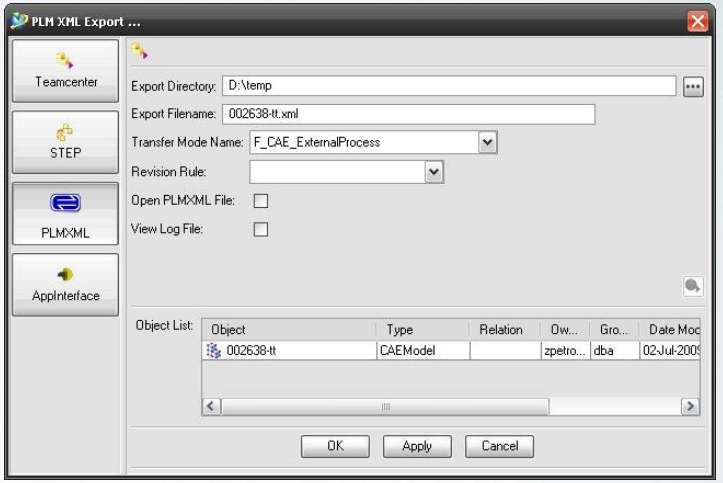
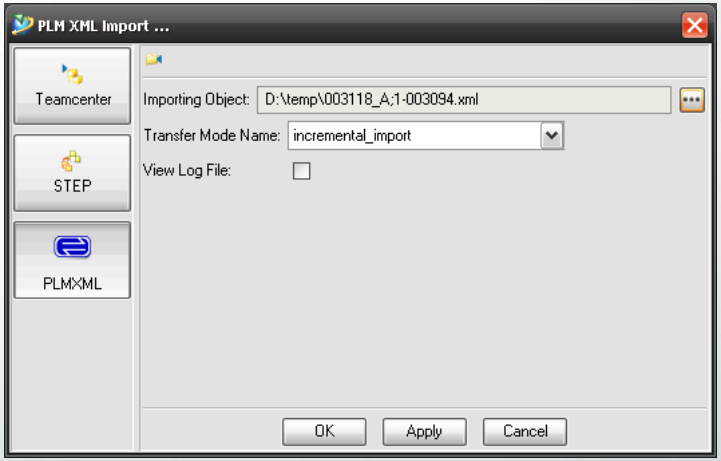
# Pre-Processor Integration Modes

- Full Data (Metadata+Bulk)
  - Geometry / No FE Model
  - FE Model / No Geometry
  - Geometry & FE Model
- Separate Bulk / Metadata
  - Metadata / No Bulk data
  - …
- „Parallel“ Build
  - Incremental Packages
  - …

→ Develop more sophisticated integration (based on API’s)



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# Summary & Outlook

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- Efficient, global CAE PLM implementation in place
  Key success factors :
  - Business driven development approach
  - Full integration with PDM solution, small extra IT effort
  - Use Out of the box, uncustomized solutions where possible
  - CAE s/w integration provides user efficiency gain of initial solution
  - Ground up scoping, implementing CAE model build solution first and growing to wider process steps gradually
- 2011-2014 Extension Proposals
  - Analysis management, process automation
  - CAE / Test integration
  - Generic mapping of CAE and product data
  - Business process integration

# Thank You

# Backup Material

# Data Model

C3PNG | GET IT Home Page | View My Learning Path | Core Methods | Use my Utilities | Engineering Communities | Logout

Welcome Ulrich Fox

Expand the Categories/Software to see the Methods

Show ID when rolling over methods, units

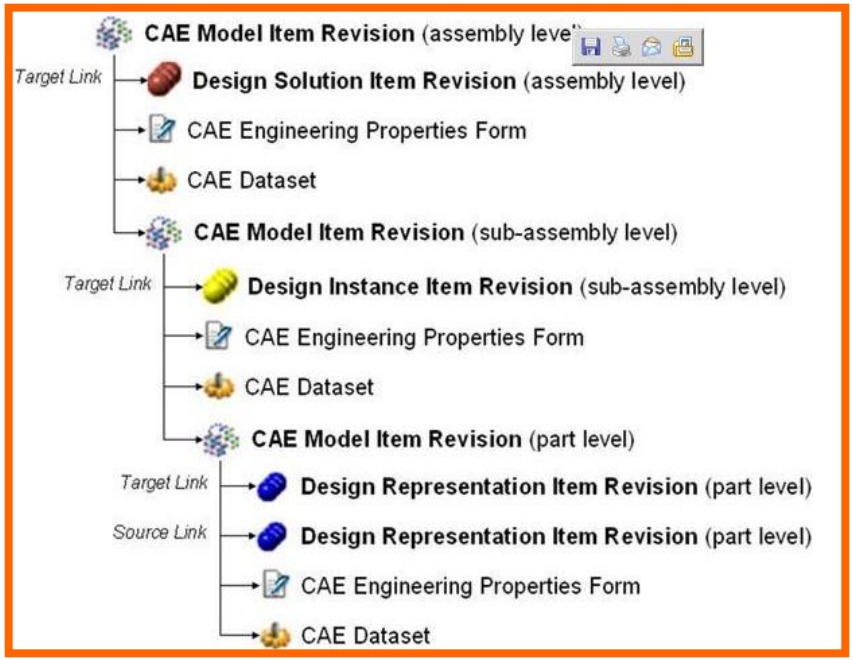
- Global CAE PLM Methods
  - CAE PLM 01 - Foundations for CAE PLM V1
    - 0101 - Ford CAE PLM Solution Overview
    - 0102 - Teamcenter Settings for CAE PLM
    - 0103 - Teamcenter CAE PLM Data Model and Apps
      - TC CAE PLM Data Model Overview
        - TC CAE PLM Data Model Overview
      - CAE SE App Overview
      - Classification App Overview
      - Structure Map Builder App Overview
  - CAE PLM 02 - CAE Module Build V1

**0103 - Teamcenter CAE PLM Data Model and Apps**

Method | Unit | Document

CAD data for consumption by CAE, for CAE model build and analysis.

A theoretical example of the CAE PLM data model for a CAE model item assembly that has been generated from a Design Solution based CAD item assembly is shown below.



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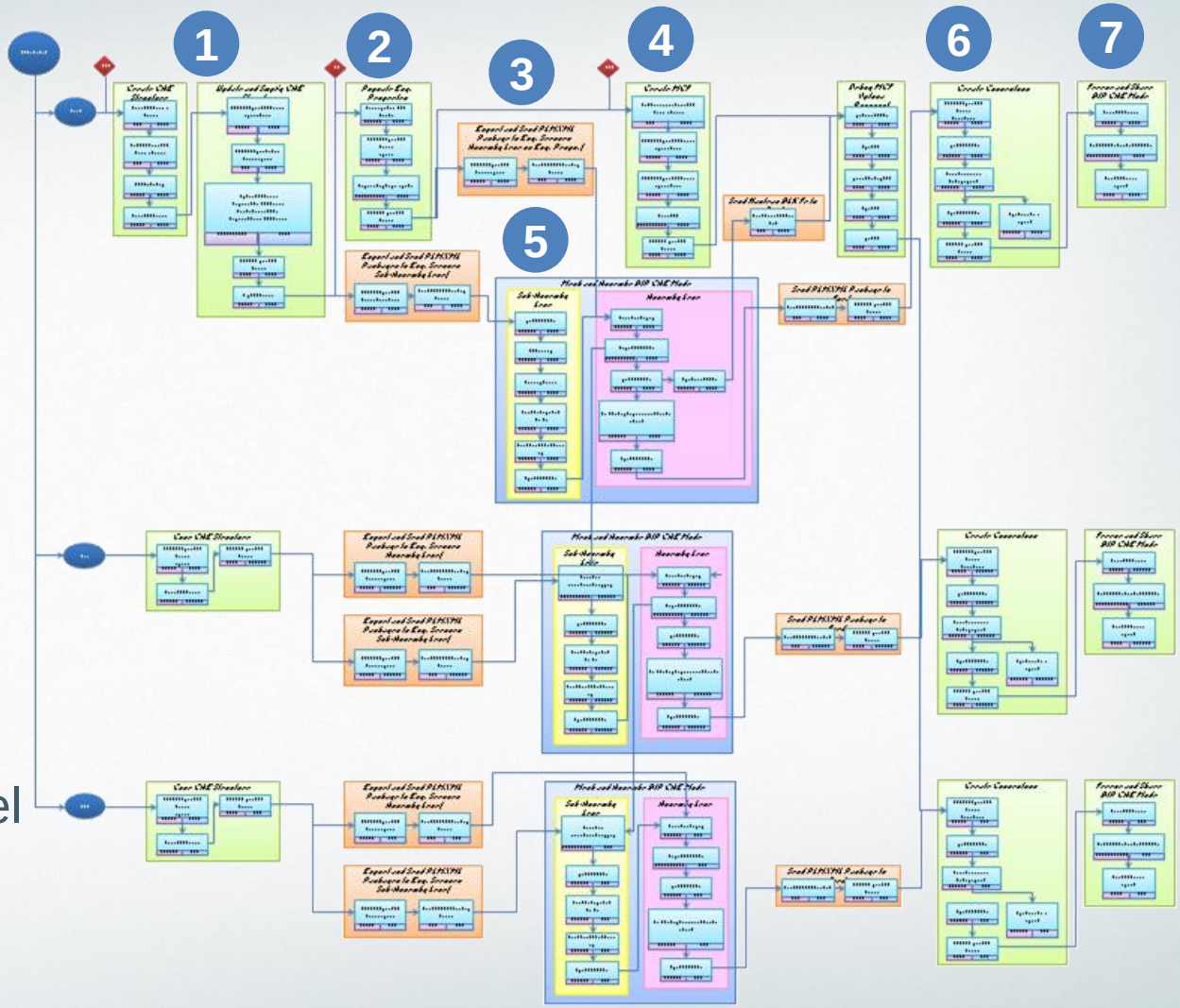
# Use Cases

# Use Cases

1. Body-in-Prime CAE model build
   - Batch meshing CAD data (including Catia V5/JT CAD conversion, automated mid-surfacing)
   - Automated assigning of CAE engineering properties to CAE parts (PID, part thickness, part material, MID etc)
   - Automated creation of CAE connections via Master Connection File
2. CAE Module Management
   - Store, maintain and share CAE System Modules
3. Vehicle CAE Model Build
   - Automated assembly of CAE Modules, incl. connections

# Use Case #1 (details)

1. Create/Clone/Update CAE Structure
2. Populate EP's
3. Export & Send PLMXML Pkg
4. Create & Debug mcf
5. Mesh & Assemble
6. Create Connections
7. Freeze & Share Model



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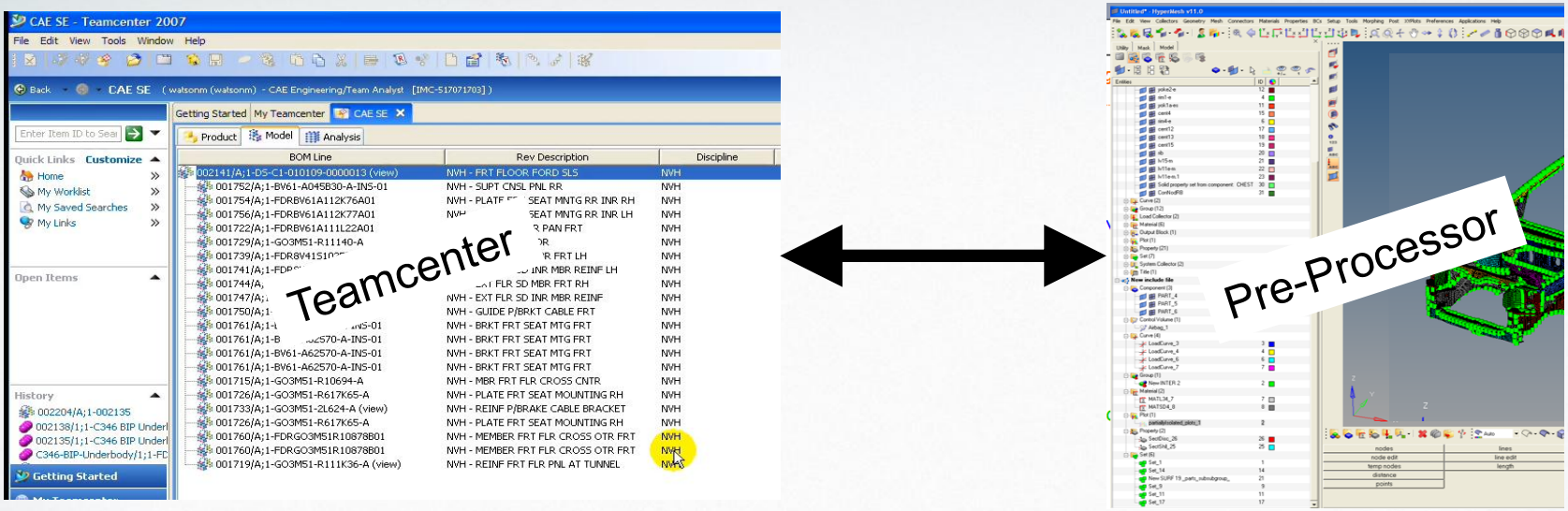
# Pre-Processor Integration – Model Build




- Export CAE structure from Teamcenter via PLM XML Export
- Launch Pre-Processor integration and import CAE structure PLM XML Package
- Perform automated Data Preparation Steps
  (e.g. Translation, positioning, instancing, mid-surfacing, structuring, ...)
- Export CAE PLM XML package from Pre-Processor, containing CAE model data
- Import CAE PLM XML package into associative CAE structure in Teamcenter

# Experiences

# Experiences

- Rollout successful w/o show stopper issues
  - Memory limitations unveiled
  - Remote data transfer issues
  - Dependency from PDM tree integrity
- 8 x Performance increase of key steps compared to previous Teamcenter CAE PIM solution
  - Initial „Overhead“ for CAE Data Management of BIW CAE model is close to 0
  - Overhead is more than offset by downstream benefits
- Technology still evolving
  - Configuration (Data Model, Key PLM Behaviors) is stable
  - TCSim “Tool Set” improving, 2 releases / month since April
  - Improvements realized in Teamcenter 8.3 and planned for Teamcenter 9 and beyond