

# **Support of Data Preparation in Model Build Process for Crash Analysis**

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Jens Philippeit, Siemens Industry Software GmbH & Co. KG

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## Industry Sector Organization

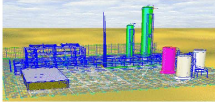
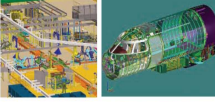
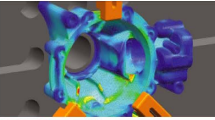


**Industry Automation**  
CEO  
Anton S. Huber  
CFO  
Miguel-Angel Lopez



**PLM Software**

**Industrial Software**



**Industry Software Solutions**

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### Siemens PLM Software Profile

**Organization**

- Siemens PLM Software
- Business Unit within Industry Automation
- HQ – Plano, Texas
- Workforce of 7,600

**Products**

- Product Lifecycle Management Software & Services

**Market presence**

- 63,000 customers
- 6.7 million licensed seats of software

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### Siemens PLM CAE Heritage

The diagram illustrates the lineage of Siemens PLM CAE software. A horizontal timeline from 1967 to 2007 shows the following components and their evolution:

- 1967:** UG (UGRAPHICS) and SDRC (SolidWorks) are established.
- 1985:** MADA and Metaphase are introduced.
- 1999:** I-deas and MAN INFORMATION MANAGER are added.
- 2003:** Enterprise Software Products, Inc. and Femap are included.
- 2004:** UGS and NX Nastran (evolving from NASTRAN) are shown.
- 2007:** All these entities converge into the **SIEMENS** logo.

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### Siemens PLM CAE Heritage

1967 1985 1999 2003 2004 2007

UMGRAPHICS Metaphase Enterprise Software Products, Inc. TEAMCENTER NX Nastran NX Nastran Femap

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### Motivation Supporting the Model Build Process

**Challenges from an industrial point of view**

derivate developments in shorter cycles to compete in global market

e.g. Audi Q7

in less than 30 months from idea to product

**What does it mean for ... ? (Social) Networking:**

Collaborative Product Development

**Systems/Processes:**

- Integrated Platforms
- Data Synchronization
- Manage change and complexity
- Reuse knowledge
- Automation

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## Enable Program Visibility for Simulation Challenges

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- Bring simulation data in context with product configurations, variants and requirements
- Manage CAE tasks in context of overall program
- Initiate workflows with re-usable templates
- Compare simulation model with latest design
- Reuse model instances to build FE assemblies
- Easily locate simulation data, results, and reports in context with design
- Share results easily across disciplines

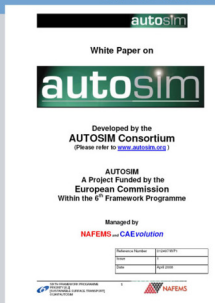
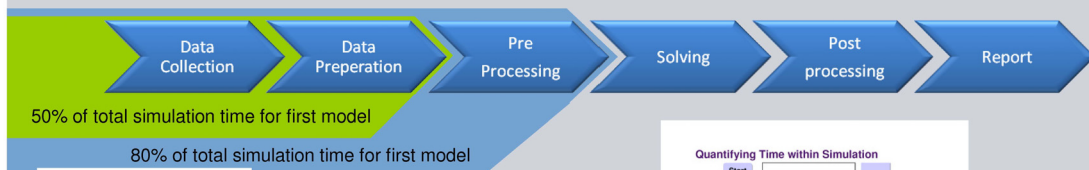


Are you confident simulation results will be ready when you need them?

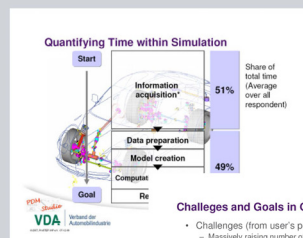
**Integrate assembly and change management with simulation data and simulation workflows.**

## Engineering Simulation Cycle Status Quo - Automotive Industry

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- „We are maintaining 14 digital prototypes for different analysis. The challenge is to organize the data allocation.“
- „40% of CAD data for simulation cannot be used for automated CAE data preparation. Rework is necessary to prepare the data“.



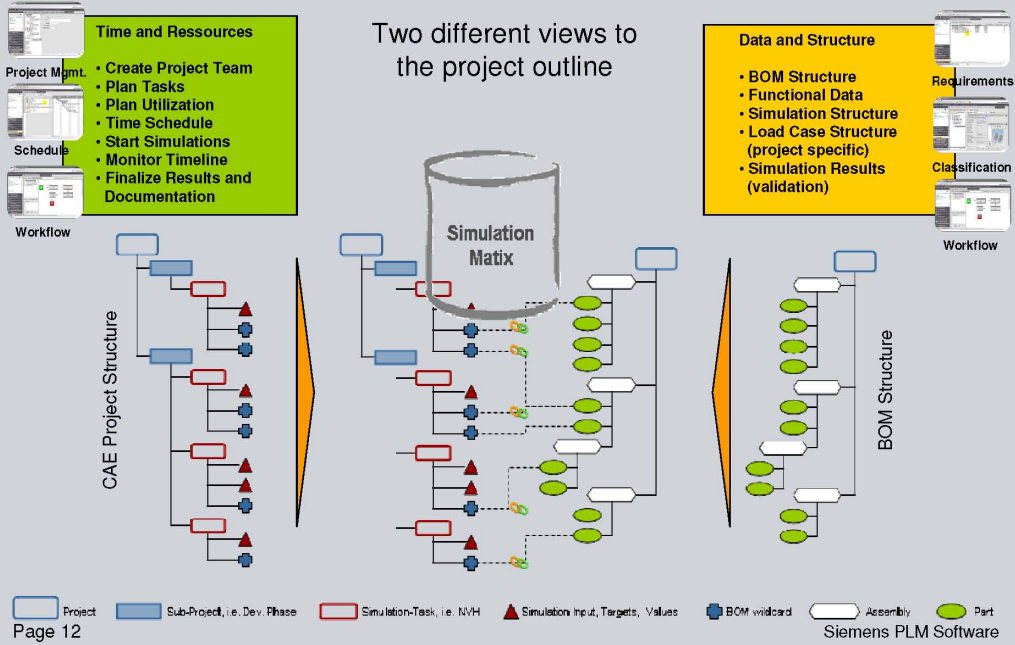
- Challenges and Goals in General**
- Challenges (from user's point of view)
    - Massively raising number of simulation for virtual product verification requires increasingly the introduction of Simulation Data Management
    - Simulation and computation data usually are not managed within the PDM system
    - Time for gathering data and information for the model creation takes approx. 50 % of the time. This is rather long.
  - Project goals (from user's point of view)
    - Reduction of wrong data sets / versions within computation
    - Reduction of the portion of time for gathering data and information for the model creation
    - Reduction of the time amount needed for simulation model changes when design changes occur

**Simulations should be managed as an integral part of the overall product development process. Ad-hoc or isolated solutions are not sufficient.**



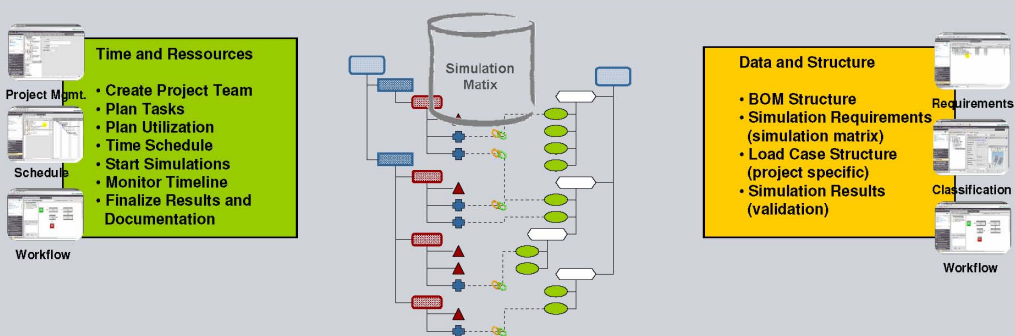
### Simulation Process Support: Organization in Simulation Projects

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### Simulation Process Support: Organization in Simulation Projects

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- **Simulation Matrix** is the interface between PDM and SDM as well as Engineers and Physical Prototyping
- **Simulation Matrix** predefines the simulation needs/disciplines, schedule and resources
- **Simulation Matrix** holds Status and Dependencies (cross-domain relations) of Simulations tracked down to Part Level

## Simulation Process Support: Data Collection

- BOM information from PDM and other systems
- Variant Rules + Revision Rules create the configured Structure
- CAD BOM mapping to CAE Project Structure (Templates, Rules)
- Data and Completeness Check → Get the „Missing List“

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## Simulation Process Support: Data Preparation

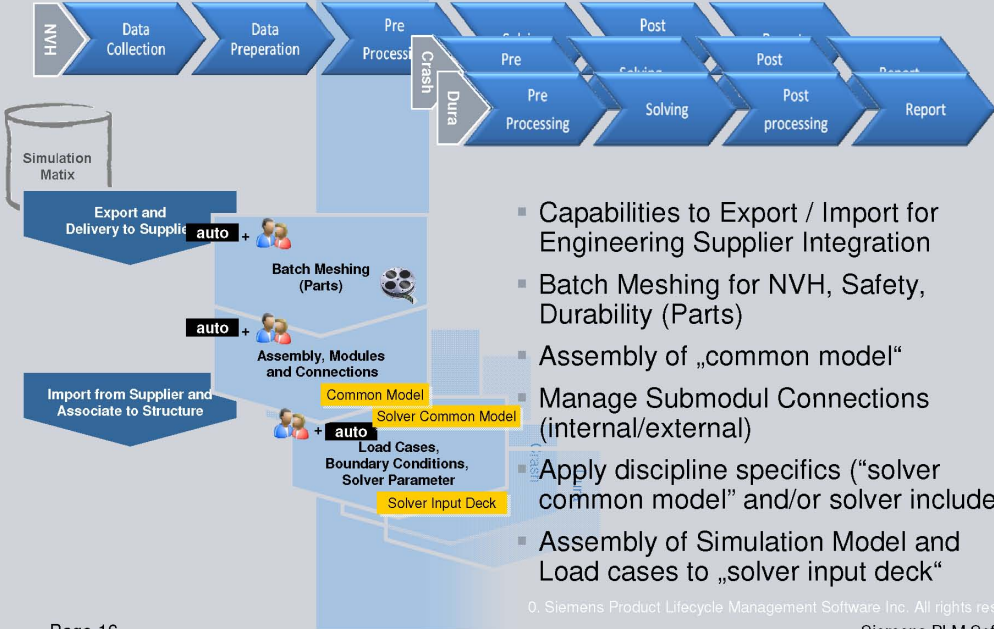
- Geo-Translations, Batch CAD cleaning and mid-surface extraction for all panels
- (Visual) Check of Completeness and Quality
- Linking to Simulation Matrix (Simulation View)
  - CAD models
  - Connection data, e.g. weld spots, weld lines
  - Non-geometric data, e.g. materials and properties
- Automatically flag parts rule-based for multiple mesh variants
- Apply individual Parameters (i.e. parts to be reused from NVH to Safety, Predfine Properties, Material Mapping ...)

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## Simulation Process Support: Supplier Integration and Pre Processing






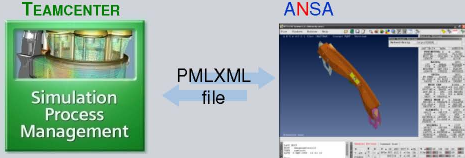
- Capabilities to Export / Import for Engineering Supplier Integration
- Batch Meshing for NVH, Safety, Durability (Parts)
- Assembly of „common model“
- Manage Submodul Connections (internal/external)
- Apply discipline specifics (“solver common model” and/or solver includes)
- Assembly of Simulation Model and Load cases to „solver input deck“

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## External Application Integration PreProcessor ANSA





### Summary of ANSA Integration:

- Input for each step is a configured CAE structure
- Each step can save monolithic file (containing complete assembly) or individual component levels
- No process modifications necessary to handle component updates as well as re-use of existing data
- All cases are handled inherently either by Teamcenter or by the intelligence of ANSA PMLXML interface.

Interaction Points:

**Point 1 – Component meshing**

- Translation of CAD components
- Batch meshing of components

**Point 2 – Create CAE sub-assemblies**

- Translation of CAD components
- Application of sub-assembly connections

**Point 3 – Create complete CAE assembly**

- Build-up from sub assemblies and components
- Application of model connections

**Capabilities within each interaction point**

- Process new data
- Handle component updates
- Re-use existing data
- Re-use common content

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## Application Integration SIEMENS

**Philosophy:** Provide a generic and flexible environment where customers can integrate codeless their CAE applications into managed processes.

**Framework:**

- CAE spezific Data Modell
- Environment to configure external Applications
- PLM XML for Data Exchange

**Dataset Mode**

Pre/Post:  
Ansa  
FEMAP  
(AMESim)

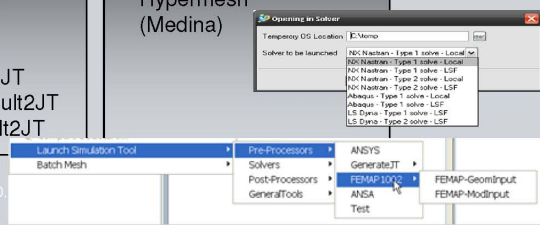
**Item Revision Mode**

Pre/Post:  
ANSA  
FEMAP  
(ANSYS)  
(Hypermesh)  
(Medina)  
(StarCD)

Solver / Konverter:  
Batchmesher  
NX Nastran  
Abaqus  
LSDyna  
NasResult2JT  
AbaqusResult2JT  
AnsysResult2JT

**Item Revision Structure Mode**

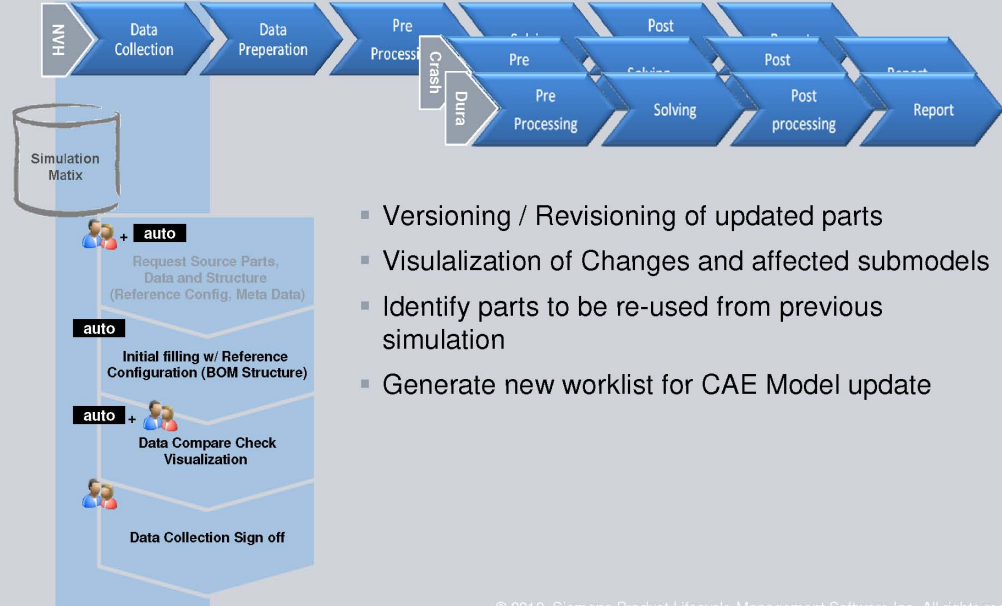
Pre/Post:  
Ansa  
Hypermesh  
(Medina)



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## Simulation Process Support: Model Update from CAD SIEMENS



The simulation process flow is as follows:

- Data Collection
- Data Preperation
- Pre Processing
- Solving
- Post processing
- Report

The 'Data Collection' step is detailed with the following sub-processes:


- Request Source Parts, Data and Structure (Reference Config, Meta Data)
- Initial filling w/ Reference Configuration (BOM Structure)
- Data Compare Check Visualization
- Data Collection Sign off

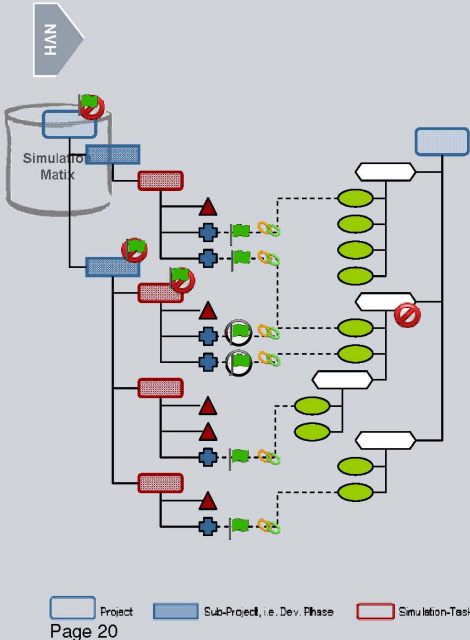
- Versioning / Revisioning of updated parts
- Visualzation of Changes and affected submodels
- Identify parts to be re-used from previous simulation
- Generate new worklist for CAE Model update

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### Simulation Progress Monitoring with Simulation Matrix






- CAD BOM mapping to CAE Project Structure and identify leaks
- Sign off first Completeness Check or Sign off Simulation Results
- Request Design Data / Change
- Track CAD Model Updates
- Model Assembly / Quality Report
- Run/Rerun Simulations and PostProcessing
- Sign off Simulation Results

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### Model Build Process Simulation Matrix Solution Elements



1. User Access, Roles, Permissions  
→ discipline and role specific

2. CAD/CAE Structure Mapping  
→ Data Model, Mapping Templates

3. Workflow Definition  
→ Templates

4. Application Integration

- Pre/Post
- Solver
- Scripts

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## Simulation Process Support: Summary of Process Gains at Automotive OEMs

15-20%	15-20%	10-15%	Estimate on Time Savings with model build process support (European Premium OEM)
From 200 work hours down to 100 work hours			Realized time reduction for a BIW model setup (European OEM)

- manual steps have been reduced to a well defined sequence of actions
- overall improvement of the process well recognized
- Executives noted this step towards a rolling model build on a daily basis compared to gated model builds after CAD freeze once a quarter per program
- Standard Solution “Teamcenter for Simulation” Out-of-the-Box with some customization

Optimize Collaboration between Simulation Disciplines and Suppliers through IT technology.

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## Solution Elements To manage the CAE data in a common PLM environment

### Teamcenter Simulation Process Management

**CAE Data Model**  
OOTB CAE data model: CAE Model, CAE Geometry, CAE Analysis, CAE Results, ...

**Structure Mapping**  
Create automatically CAE structure from a product structure using filter and reuse rules.

**External Processes**  
Exchange CAE data with external applications: pre-processor, solver and post-processor. CAE data model fully supported by PLMXML.

Additional Solution Elements:

Schedule Manager

Product Configuration

Workflow

Multisite Collaboration

Envelop & Notification

Reference & Queries

Requirements Management

Security

Classification

CAE Structure Editor

Document Management

Change Management

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## Simulation Process Management

### TEAMCENTER

- Systems Engineering & Requirements Management
- Portfolio, Program & Project Management
- Engineer Process Management
- Simulation Specific PLM Functionality**
- Compliance Management
- Content & Document Management
- Formula, Package & Brand Management
- Supplier Relationship Management
- Mechatronics Process Management
- Manufacturing Process Management
- Simulation Process Management
- Maintenance, Repair & Overhaul
- Reporting & Analytics
- Community Collaboration

Lifecycle Visualization

Platform Extensibility Services

Enterprise Knowledge Foundation

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## Thank you!

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Questions?

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