Automated Reporting and Workflow Management of LS-DYNA Simulations

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Abstract:

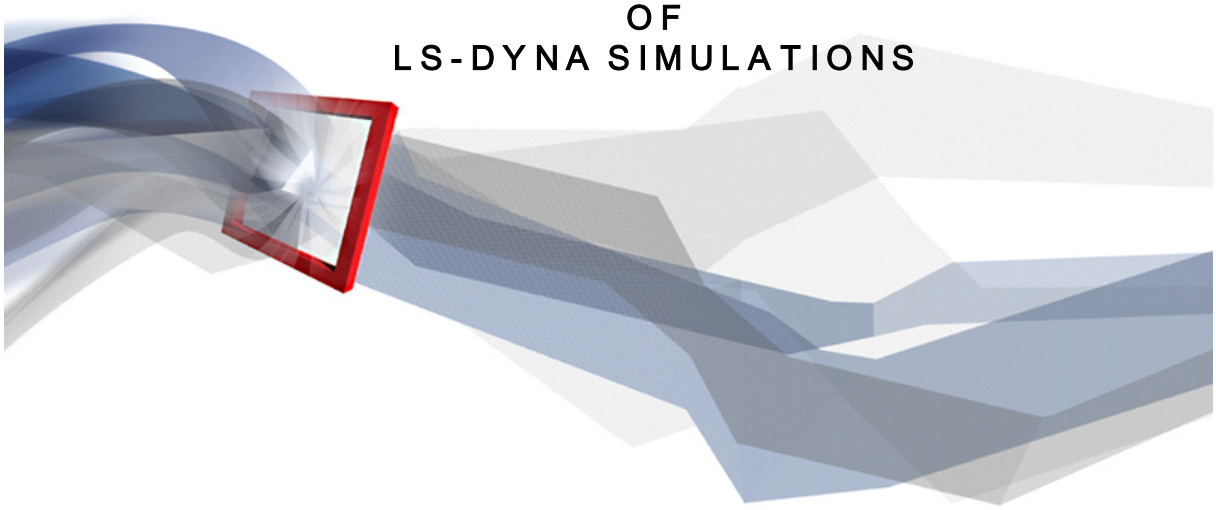
The steady need to decrease the product development time and to increase the quality requires a more and more automated workflow for the processes before and after the actual numerical simulation. This leads to developments in the direction of batch meshing of CAD geometry, auto reporting of simulation results, workload management of compute resources, or, more general, workflow management. Workflow management additionally provides a consistent way how engineers are performing their simulation task and finally leads to a higher quality and reproducibility of CAE work. In the talk we want to focus on the most obvious part of automation which is the generation of reports directly after the simulation has finished. It will be shown how the automated reporting according to Euro-NCAP standards helps engineers to use their time for product development rather than report generation. The talk should also demonstrate how this automated reporting can be implemented seamlessly into the whole CAE workflow and how Office Applications like PowerPoint or Excel can be integrated in this workflow.

Workflows can be improved with a management of CAE data management and relationships between the Engineering projects and this data.

Keywords:

finite element modeling, crash simulation, process automation, CAE data management, CAE workflow, batch reporting

AUTOMATED REPORTING AND WORKFLOW MANAGEMENT OF LS-DYNA SIMULATIONS



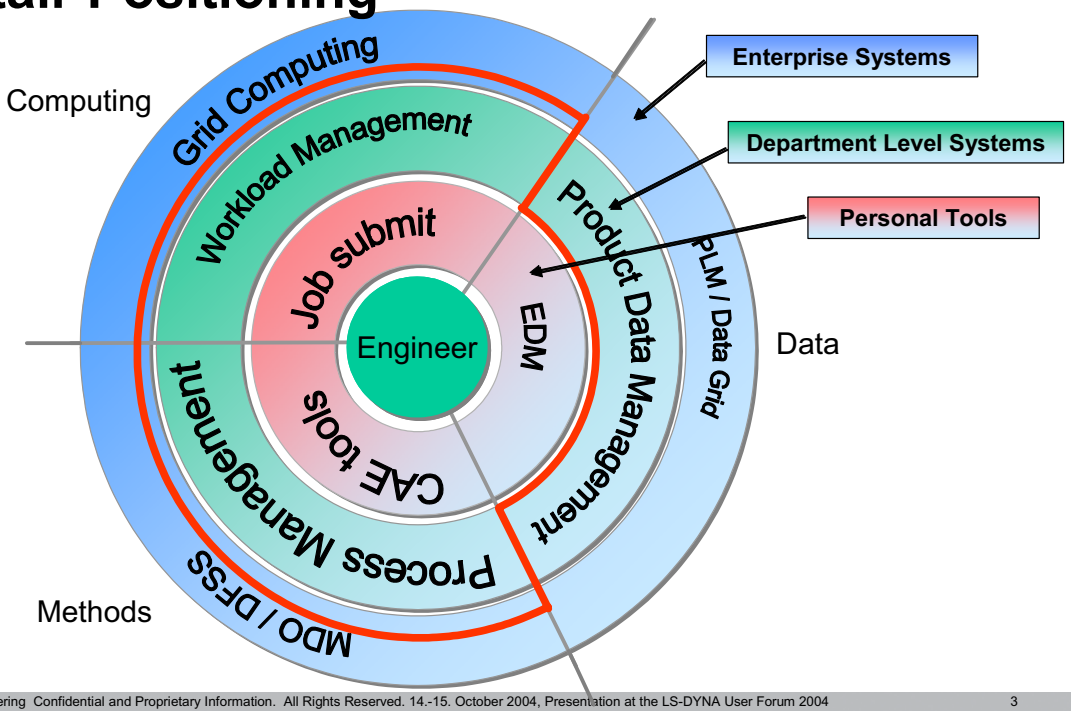
Dr. Jochen Seybold, Enterprise Process Management
Presentation at LS-DYNA User Forum 2004
14-15. October 2004, Bamberg

Altair Engineering
The Shortest Distance Between Concept and Reality®

Basic Elements of CAE Workflow Vision

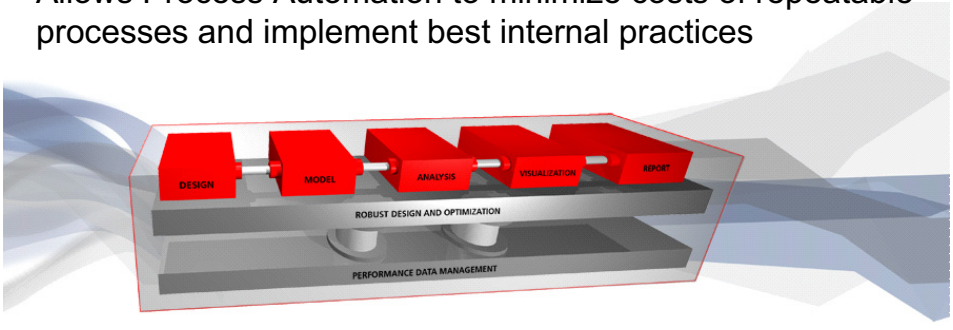
- Open, programmable architecture
- Automated CAE Processes
- Performance Data Management
- Concept Design Technology
- Six-Sigma CAE
- Manufacturing Simulation
- Automate creation of LS-DYNA models and reporting

Altair Positioning



Basic Elements of Altair Vision

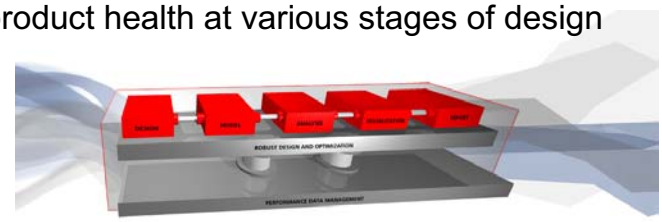
- Open, programmable architecture
  - Enables new methodologies to be integrated into a consistent framework
  - Extended CAD/CAE interfaces leverage customers existing CAD/CAE expenditures
  - Allows Process Automation to minimize costs of repeatable processes and implement best internal practices



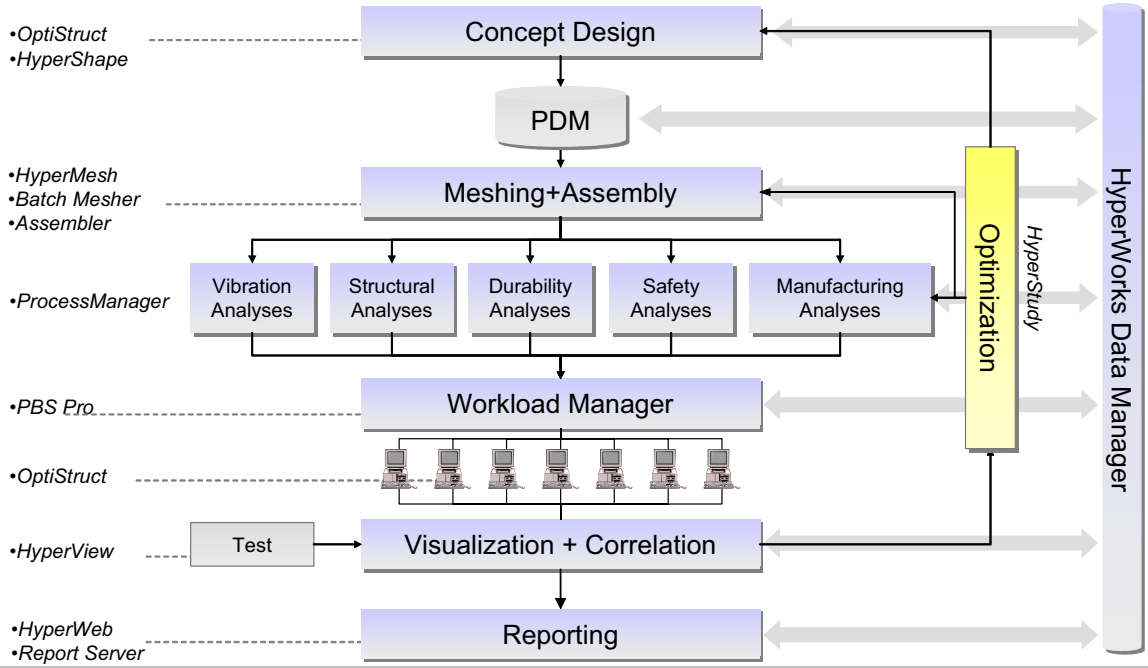
Basic Elements of Altair Vision

Automated CAE Processes

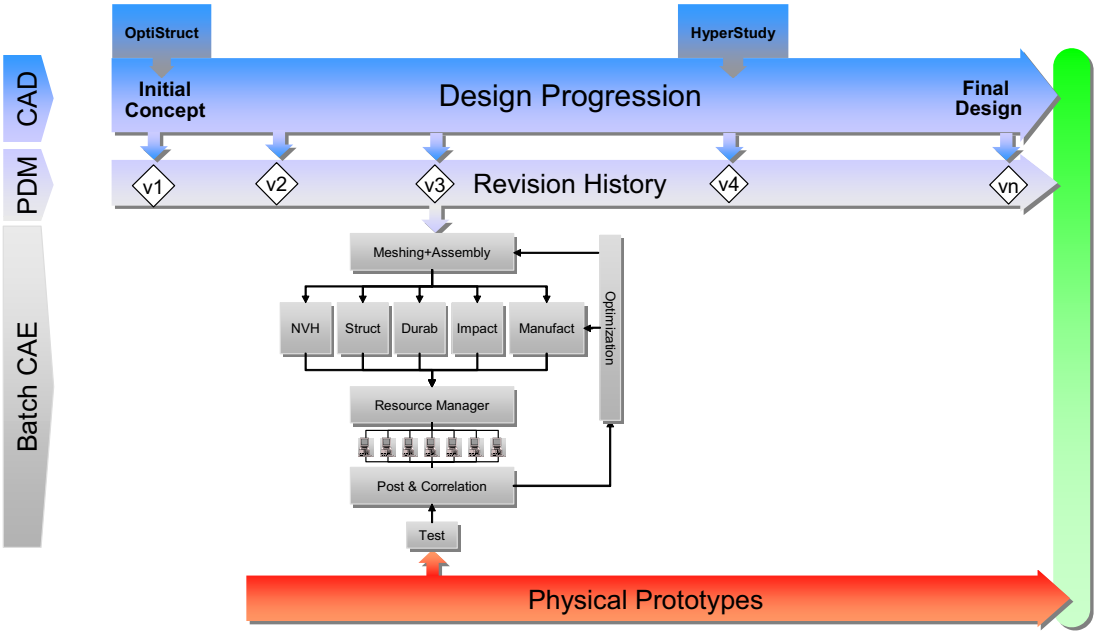
- Best-in-class technologies: topology clean-up, meshing (batch and interactive), connectors, optimization, visualization, reporting…
- Coupled with assembly management, automation routines, multi-solver interfacing, resource management, robust design practices…
- Forms an automated, repeatable CAE process for consistent measure of product health at various stages of design



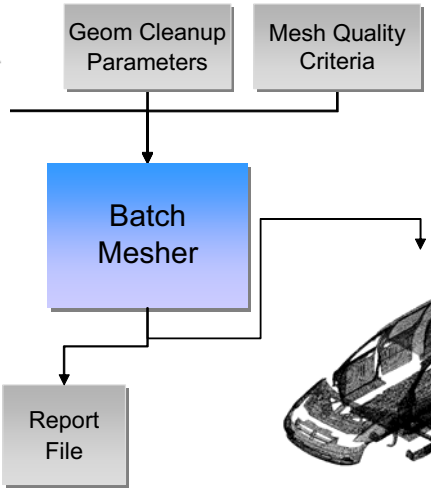
HyperWorks : The Engineering Framework



The Batch CAE Paradigm



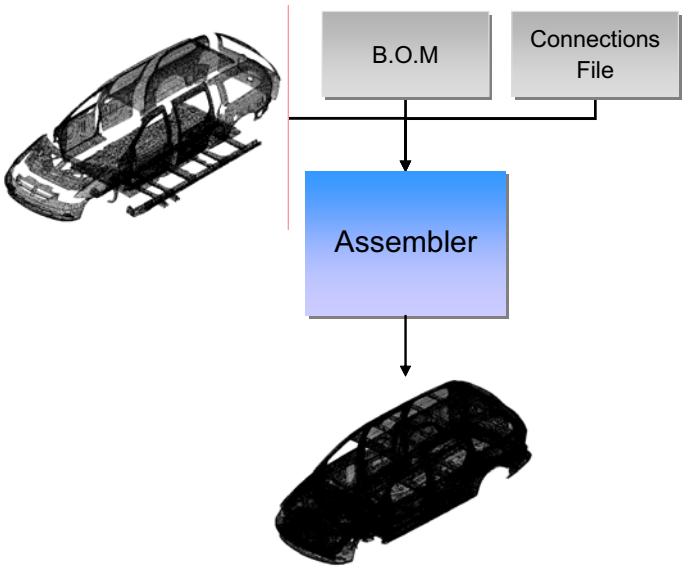
Batch Meshing



- End goal: eliminate all manual meshing
- Today: some hand-editing required after batch meshing
- Today: significant reductions in time and labor to complete meshes
- Distribute meshing jobs using PBS Pro
- Check meshes back into PDM and EDM

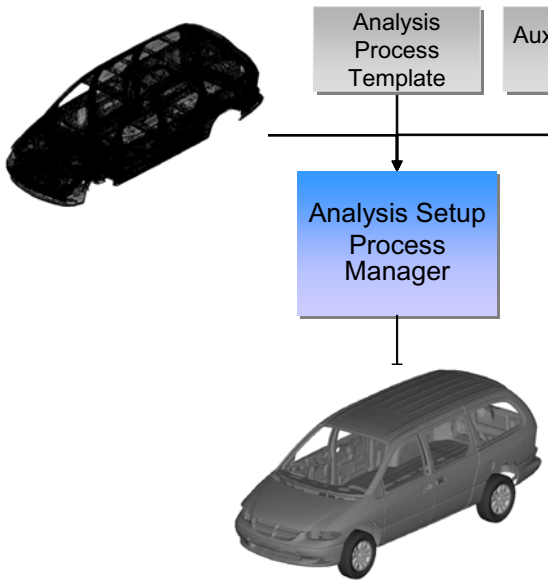
Project	before	after
Body in white	2 weeks	8 hours

Assembly Management



- Get B.O.M from PDM
- Filter B.O.M. for CAE purposes
- Import and position meshed parts and assemblies
- Import welds
- Export fully assembled models
- Back-end database for sharing meshes within departments

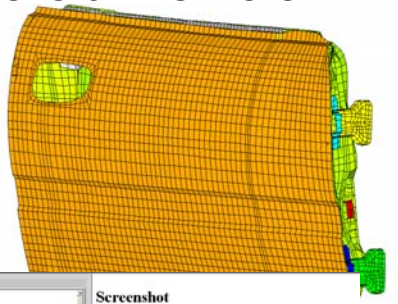
Analysis Setup with Process Manager

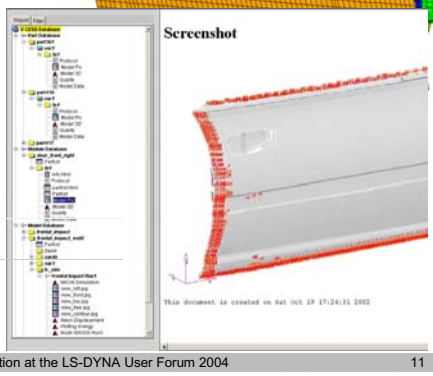


- Load assembled model
- Create loads and BC's
- Prepare model for solver
- Submit solver job
- Generate report templates for post processing

Virtual Process Automation Framework *(V-CESS)* for DaimlerChrysler Dept. Commercial Vehicle

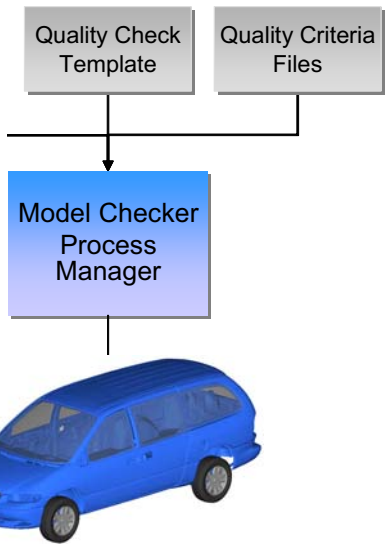
- Organization of CAE data though implementing a new CAE Processes.
  - **Quality assurance**
  - **Automated documentation**
  - **Interface to PDM Systems for CAD data**
  - **Store parts after meshing in the DB**
  - **Assembling of models based on PDM lists**
  - **Apply of load case**
  - **Complete reports and assessment**
  - **HyperWeb as Viewer for CAE-DB and Reports**





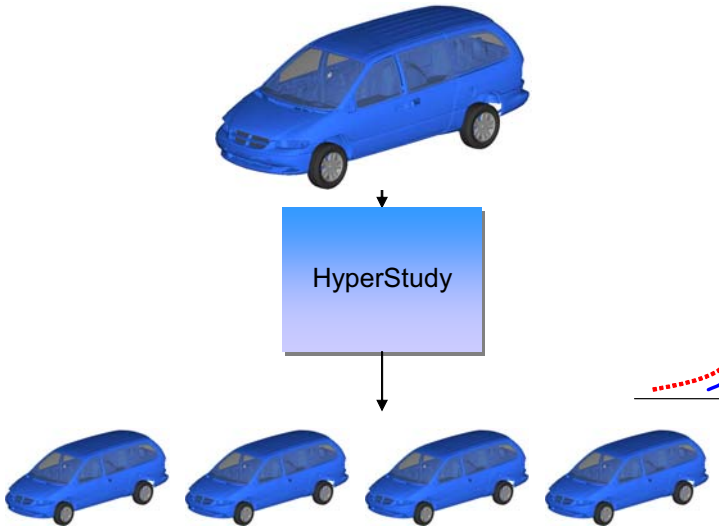
Project	Cost Reduct.
Meshing	-15 %
Engineering	-30 %
Investment / Project	15 %

Model Checking with Process Manager

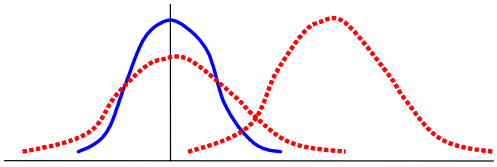


- Verify modeling practices
- Find modeling errors
- Check material properties
- Assign material data from library file
- Check section properties
- Display part thickness map
- Display part mass map
- Display point mass table
- Perform solver specific checks

Optimization Setup through HyperStudy

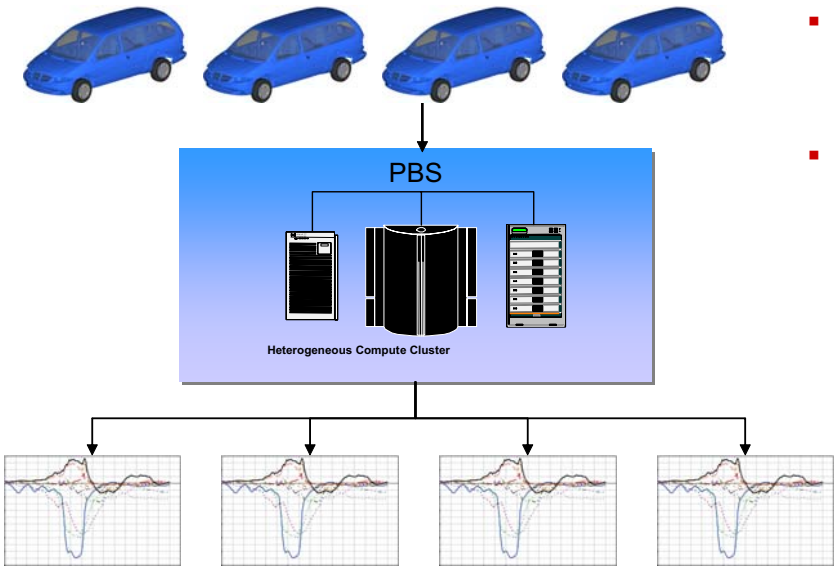


- DOE
- Optimization
- Stochastic Variation
- Robust Design



•Target mean (μ)
•Minimize variation

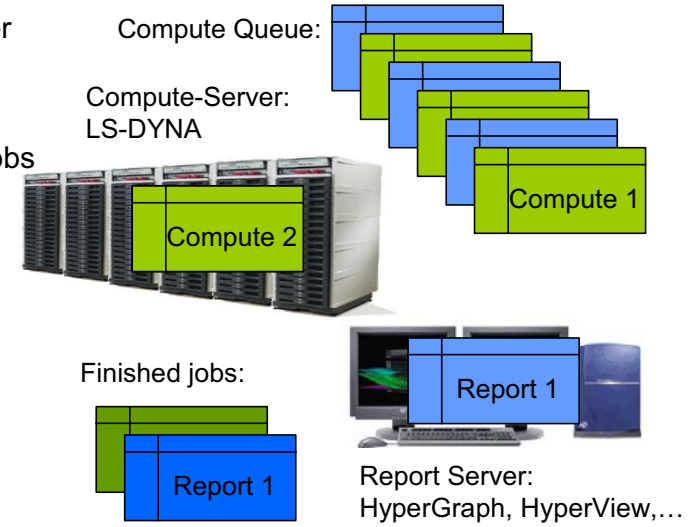
Job Distribution with PBS Pro



- Distribute jobs across clusters and heterogeneous networks
- Parallel computation is essential for robust design

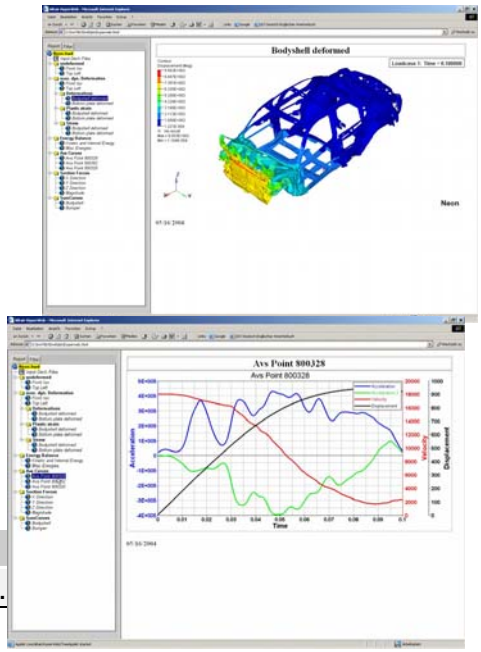
Job Distribution and Batch Reporting

- Compute- and Report Server
- Compute Queue
- Report Queue
- PBS Pro creates compute jobs
- Report job is depending on compute job
- Compute job starts when:
  - Hardware is free
  - Solver licenses available
- Report job starts when:
  - Report server free
  - License available
  - Compute job successfully finished



Batch Reporting with HyperView

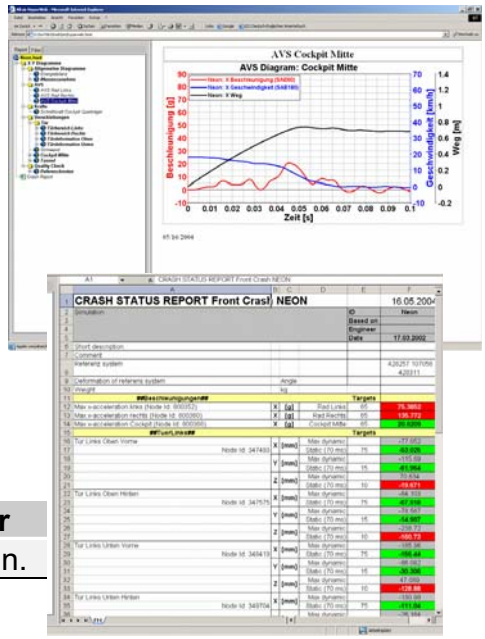
- After the simulation is finished the evaluation could be started interactively or by PBS Pro
- First batch assessment of results
  - Target Values
  - Animations, XY-Plots
  - Export to Bitmaps and HTML pages
  - Export to HyperWeb
  - Extracted reports are administered in the HyperWorks Data Manager
- From HyperWeb
  - Start an application (e.g. HyperGraph)
  - Comparison of results



Project	before	after
Every Report	4 hours	2 min.

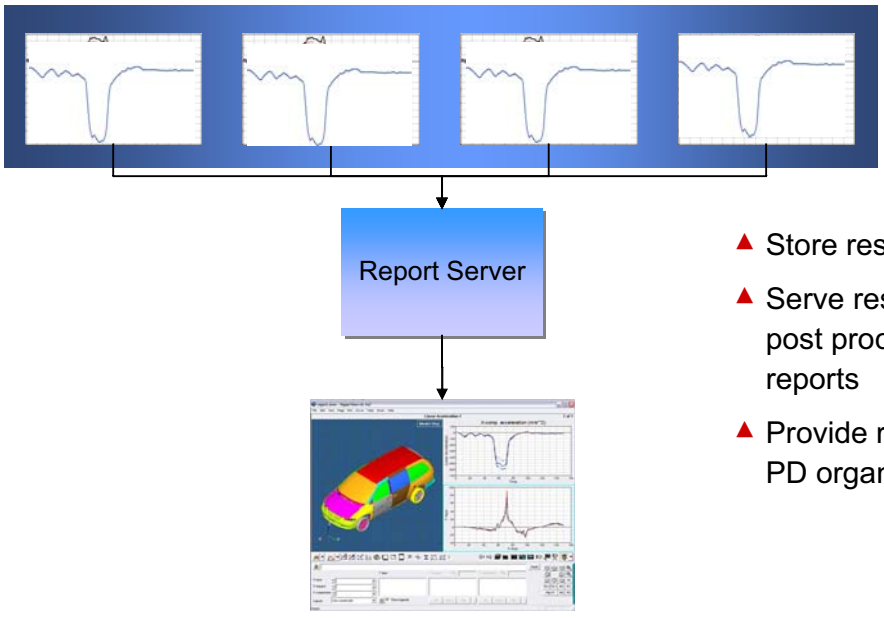
Auto Reporting with HyperView

- Apply e.g. the frontal crash report to the results
- Automatically filling out of the Excel tables with the load case specific target values
- Overlay and append of different simulations runs in HyperGraph
- HyperWeb documentation is created
- From HyperWeb
  - Start an application
  - Comparison of results



Project	before	after
Every Report	4 hours	2 min.

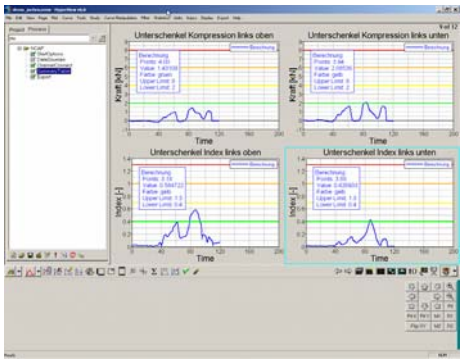
Serve Results and Reports



- Store results on server
- Serve results on demand to post processors and web reports
- Provide reporting throughout PD organization

ReportFramework – EuroNCAP, USNCAP and FMVSS208 Standard Report for BMW AG

- Standard Report
  - Test data
  - Simulation data
- Comparison of results
- Robust and automatic connection of needed input data
- Use Filter based on names and conventions
- Colored Table and Dummies
- Export – HyperWeb – Office

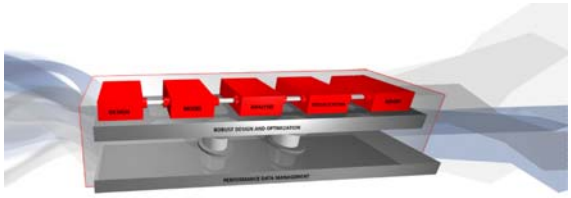


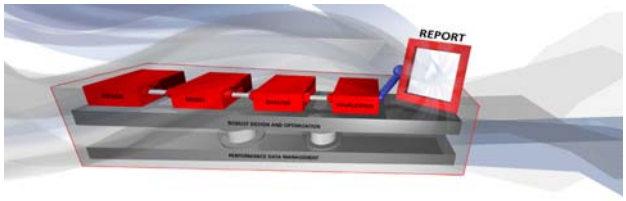
Project	Before	After
MADYMO Report	3 hours	3 min
Report from Tests	4 hours	3 min
Comparison of Test – Simul.	2 hours	3 min

Basic Elements of Altair Vision

- Performance Data Management
  - Manage CAE/CAT data from:

    PDM → CAE Model/Assembly → Analysis setup/submission → Results post-processing → Automated reporting
  - Individual, departmental, enterprise options available with various PDM adaptors
  - Allows intelligent query of historical results for design insight and automated management reports





Summary

- Altair is a global company focusing the virtual product development
- Programmable, open and modular CAE Desktop Environment allows implementation of Standard Workflows and the integration of all applications
- Case studies show the time savings, the cost reduction and the improvement of the quality of the CAE process

