

BatchMeshing and CAE Data Management as Key Technologies for Six Sigma Compliant CAE Processes for LS-DYNA Simulations

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Summary:

The effort to achieve a six sigma process is one of the important ongoing quality assurance activities at many companies. This means that from one million produced products only 3.4 error possibilities occur in manufacturing.

Six sigma requirements to a CAE process is the consistency of design decisions, the repeatability of the process, and the robustness of the product.

To achieve this for LS-DYNA simulations and for the complete CAE process, major uncertainties need to be identified and the overall CAE process and they need to be improved.

BatchMeshing is a technology to reduce the cost and time for meshing and to improve the robustness of the created simulation models. If meshes are created manually by hand, the sensitivity and scatter of the results is higher than for meshes created with the BatchMesher. This means, that BatchMeshing is a contribution to a six sigma design, because it leads to a robust design, but only if the BatchMeshing process itself is controlled, to make the process reproducible.

This can be achieved with an automated BatchMeshing process which has a connection to the CAD product structure and builds models automatically based on this information. It must be known from which CAD parts we have created the meshes, which quality and status the meshes have, which modules have been used, which load cases have been simulated, and what results, reports and documents belong to this simulation.

All data from all simulation disciplines belonging to the simulated product need to be managed and consistency for design decisions is mandatory required. CAE data and process management is an enabler for this and available.

Keywords:

BatchMeshing, CAE Data Management, Robust Design, Six Sigma CAE



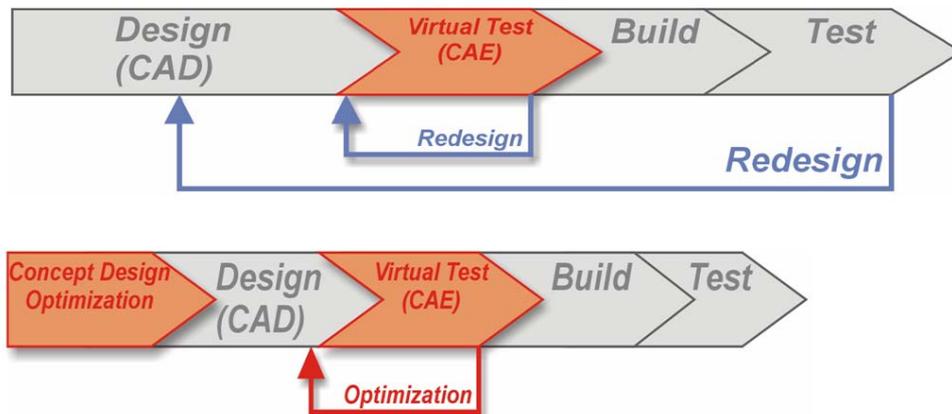
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5. LS-DYNA FORUM
Modeling Process Integration
12th – 13th October 2006, Ulm

Vision



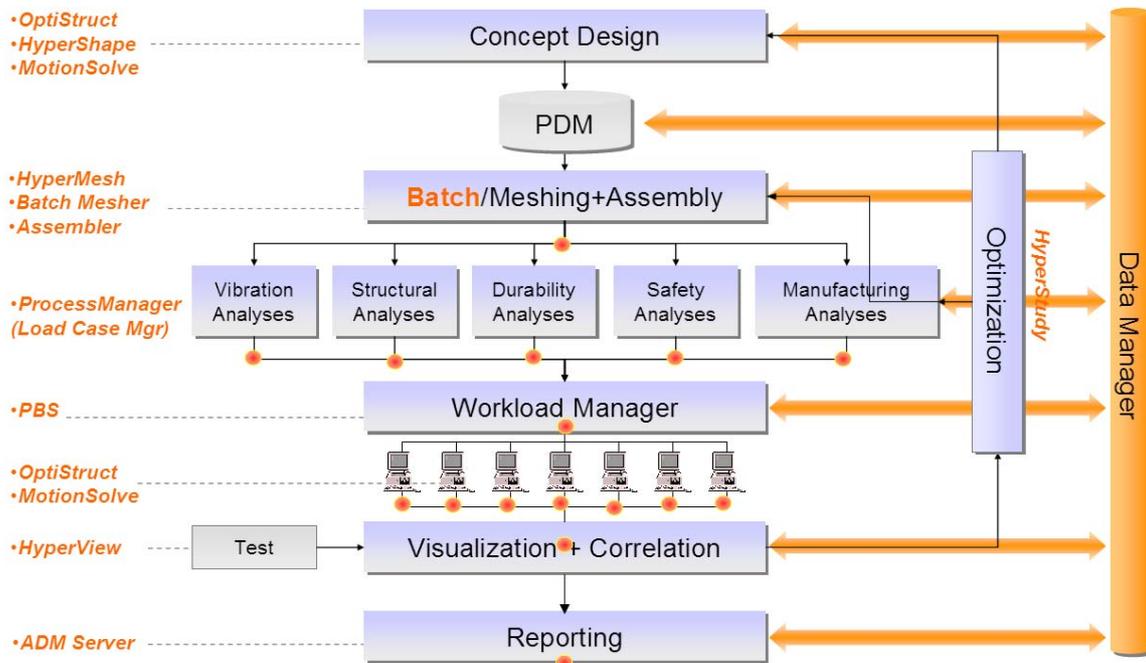
Challenges



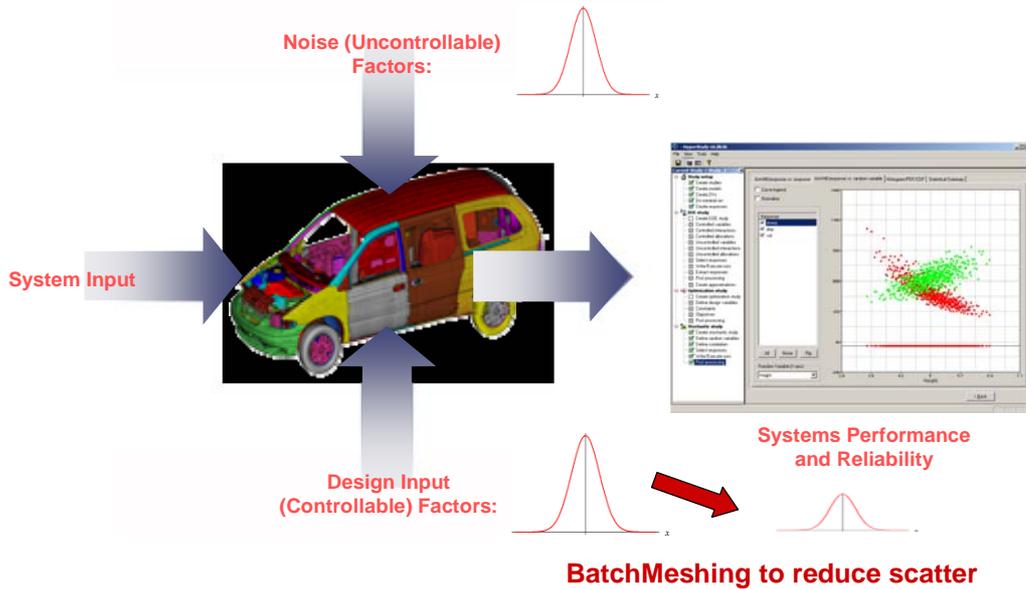
- Need for innovation, shorter time-to-market, product performance
- High cost of design iterations
- Even higher cost of changes to the design concept
- Six sigma requirements
 - Robustness of the product
 - Consistency of design decisions
 - Repeatability of the design process
- Amount of data produced
 - Data management
 - Best design practices
 - Knowledge management
- Need for up-to-date performance and manufacturing validation
- Amount of uncreative engineering time involved in modeling
- Fragmented CAE environment



HyperWorks : The Engineering Framework



Six-Sigma CAE: Influence of BatchMeshing



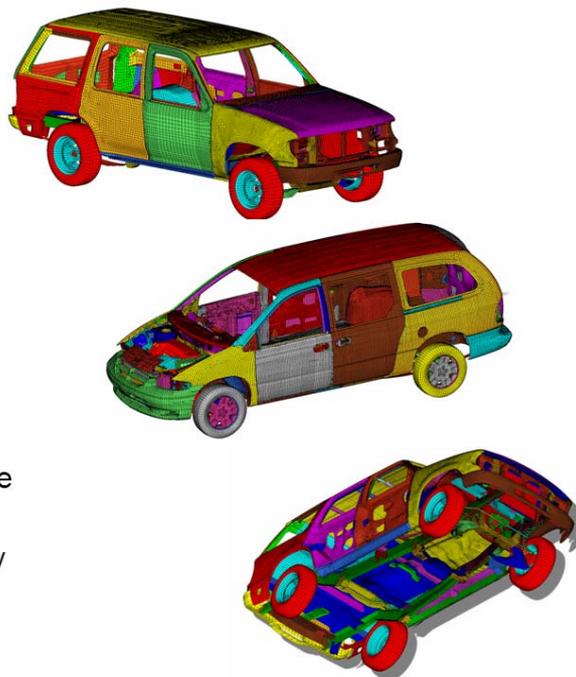
“Operating points of a design variable are set at an optimum value so that product performance is less sensitive to random factors”



BatchMeshing



- **FULLY Automatic Geometry Cleanup and Meshing**
 - Imports all geometry formats supported by HyperMesh
 - Detects special geometric features such as beads, fillets and flanges
 - Removes unwanted holes or adds washers around bolted locations
 - Meshes models with special optimization routines to create the best quality elements
 - Runs in a GUI mode or a fully automatic batch mode, both requiring minimal inputs for automatic meshing



BatchMeshing Different Mesh Strategies



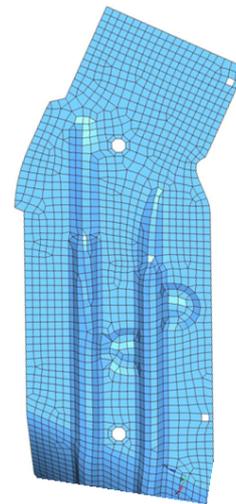
hand-meshed



batch-meshed, orthogonal



batch-meshed, non orthogonal



5. LS-DYNA FORUM, Modeling Process Integration, 12th – 13th October 2006, Ulm

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BatchMeshing Simulation Data



- Body in white in a front-crash with LS-Dyna (3 LS-Dyna versions)
- 102 parts, 13.6 m/s initial velocity
- Models: Hand-meshed / batch-meshed (orthogonal) / batch-meshed (non orthogonal)

Element size 8 and 10 → 6 models

Name	Element size in the chassis beam	Number of elements	% - Trias
hm_10	10	229000	6.7
bm_10 (orth.)	10	227200	6.7
bm_10 (non orth.)	10	234700	7.3
hm_8	8	234800	6.6
bm_8 (orth.)	8	232100	6.6
bm_8 (non orth.)	8	238700	7.1

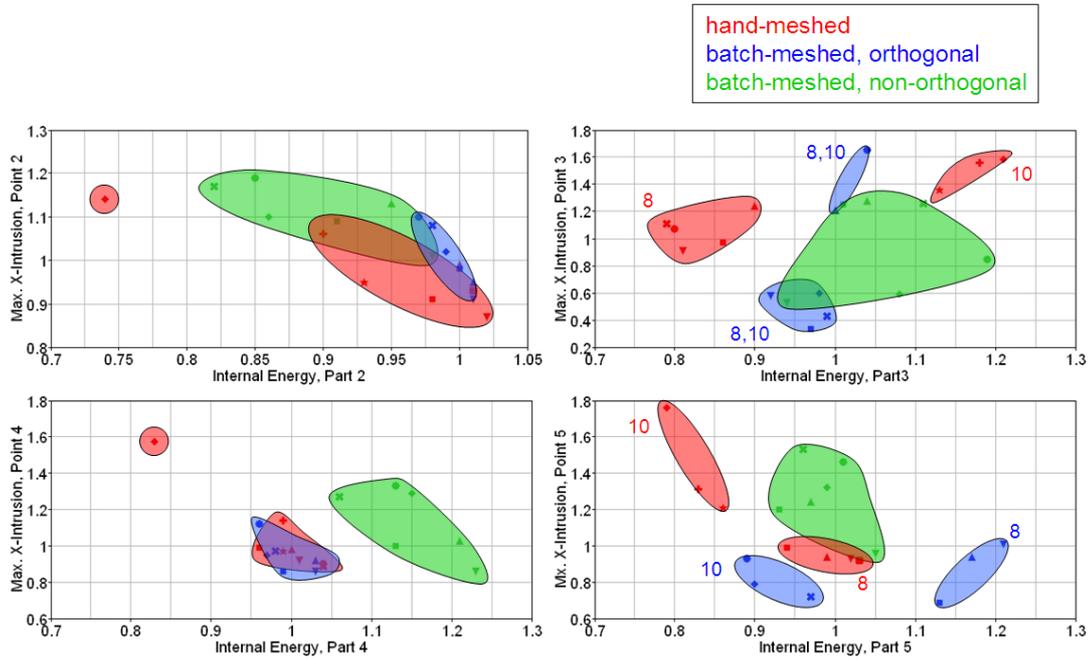


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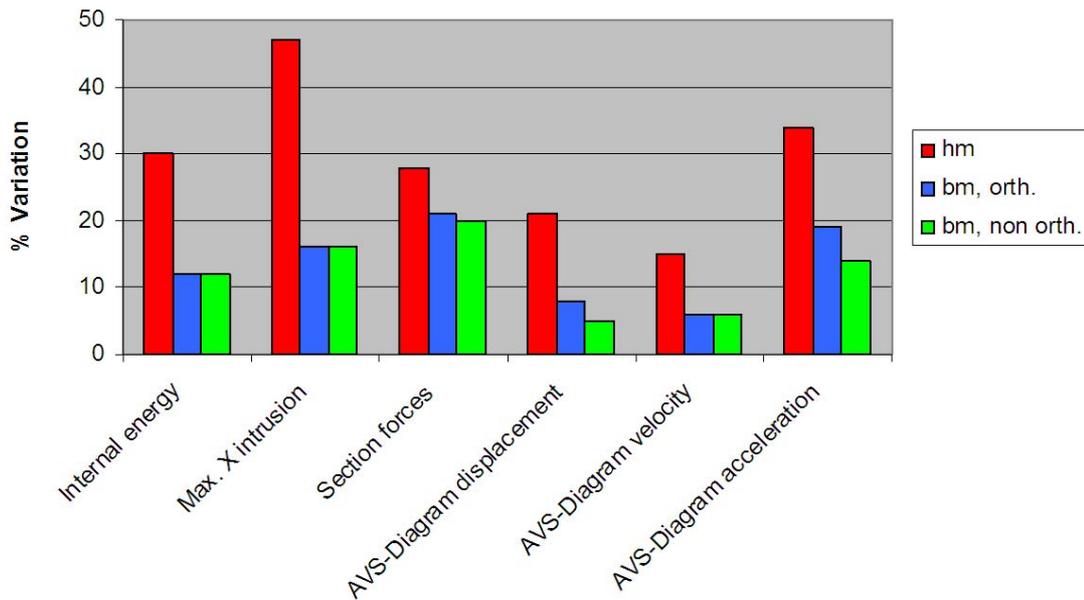
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BatchMeshing Scattering (Max. X-Intrusion / Internal Energy)



BatchMeshing Influence of element size (size 8,10)

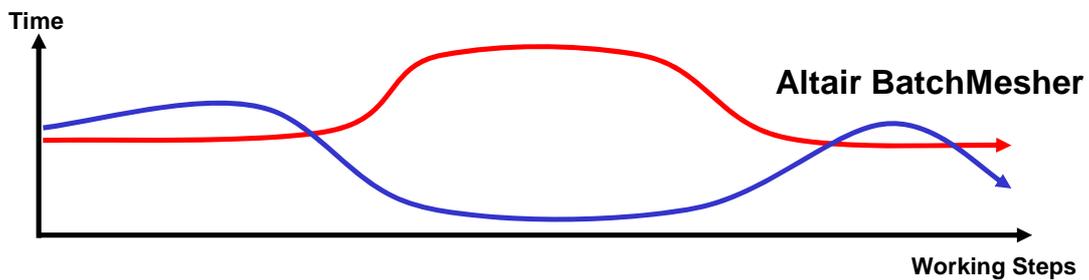


BatchMeshing Conclusion

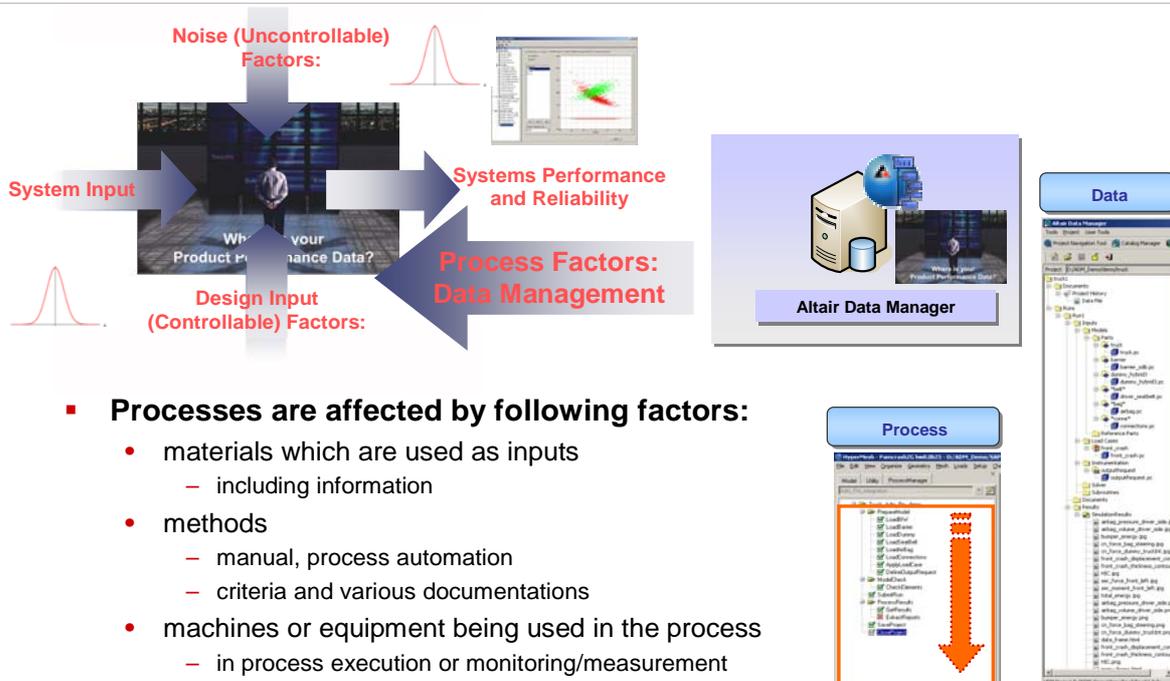


- Less scattering in the batch-meshed results
- Reduction of the factor ‚human being‘ in the meshing process
- Data Management can further improve this process

- Time for meshing:
 - Hand meshed: approx. 150 hours
 - Batch meshed:
 - 30 hours (w/ initial version of software)
 - potential to decrease to 8 hours automated pre and post routines



Six-Sigma CAE: Influence of Data Management



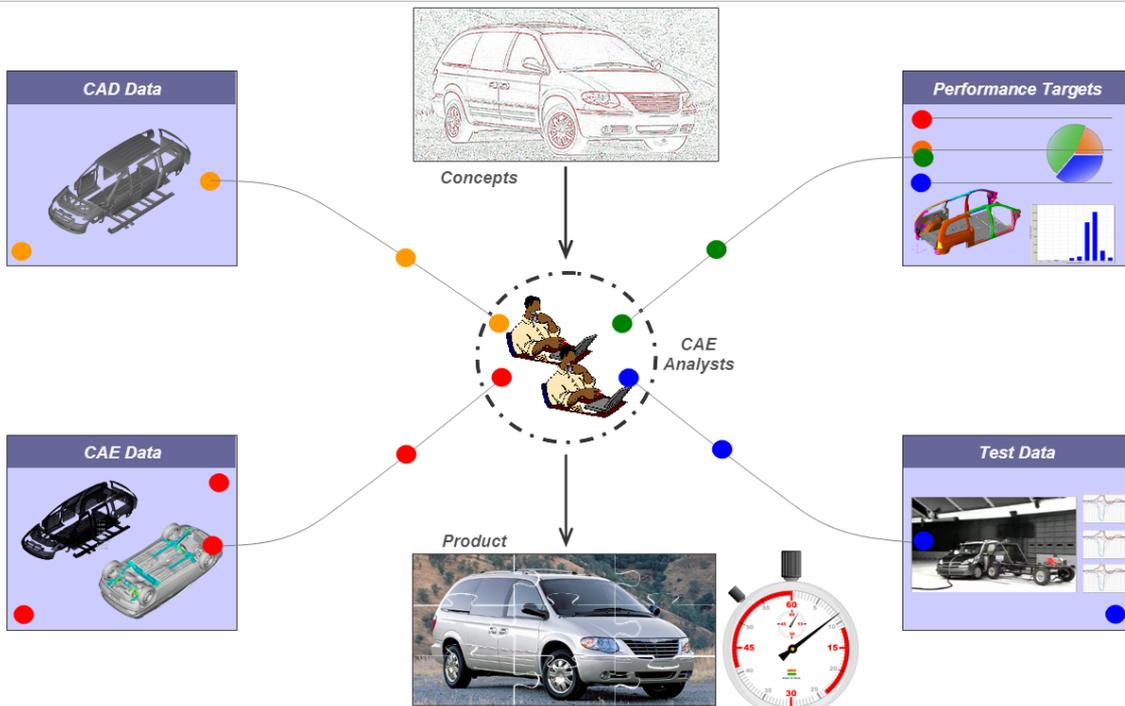
- **Processes are affected by following factors:**
 - materials which are used as inputs
 - including information
 - methods
 - manual, process automation
 - criteria and various documentations
 - machines or equipment being used in the process
 - in process execution or monitoring/measurement
 - personnel who operate the processes



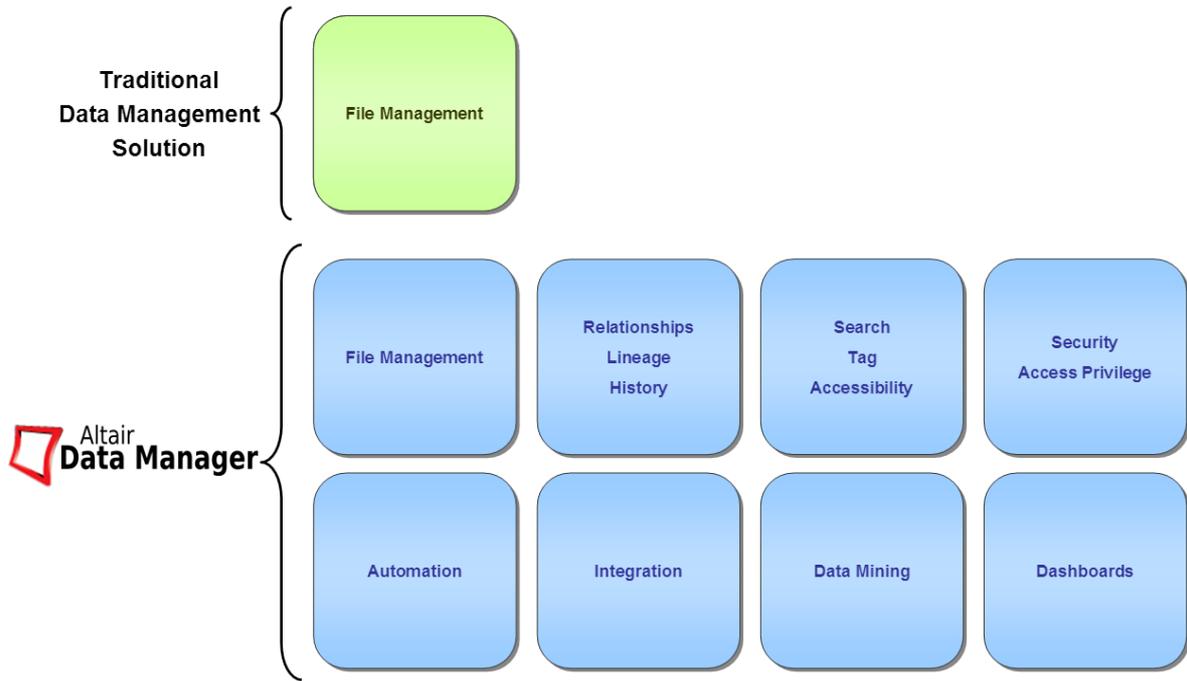
Altair Data Manager for CAE & Test Data



Data Management Challenges



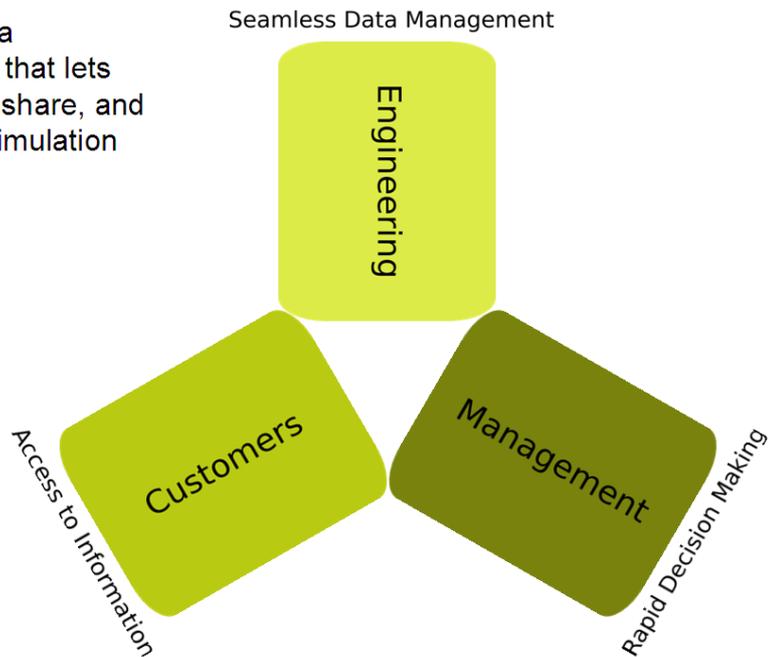
Data Management Components



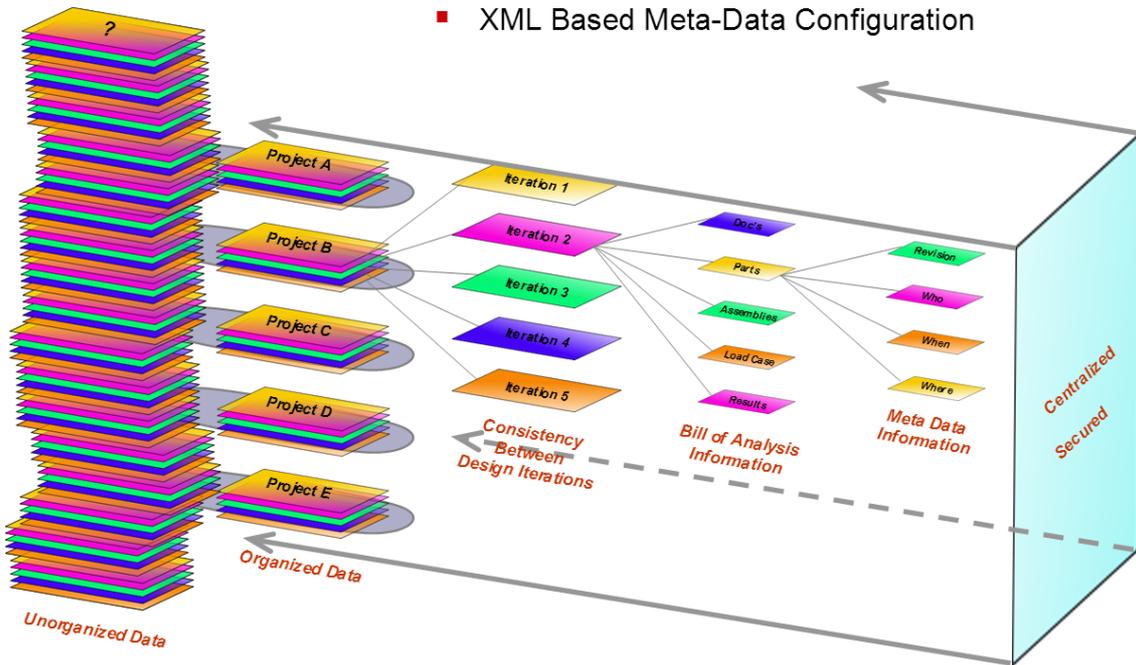
Introducing Altair Data Manager



- A comprehensive Data Management solution that lets users easily manage, share, and control Engineering Simulation and Test Data.



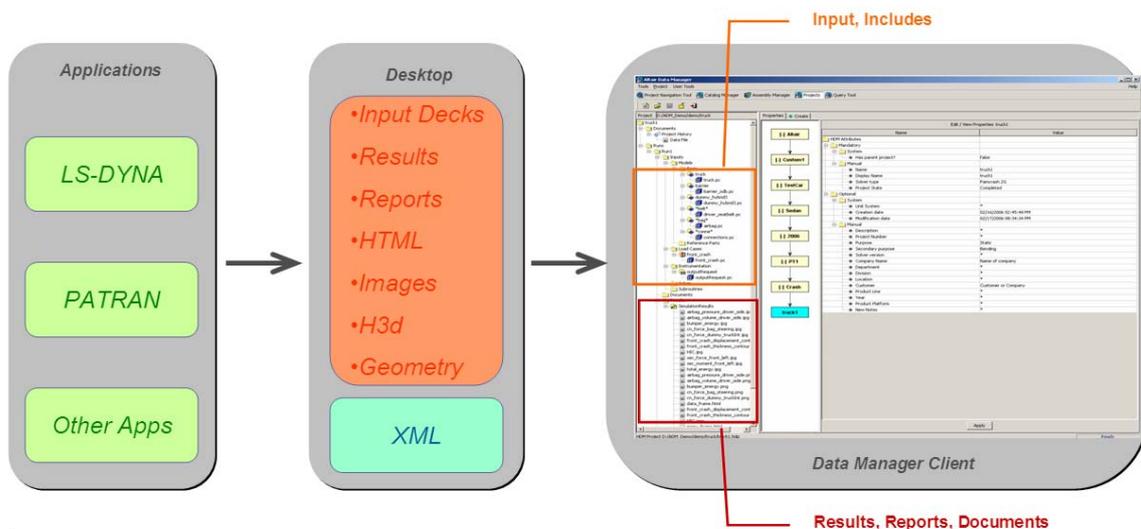
Data Structure



Desktop Data Manager Client



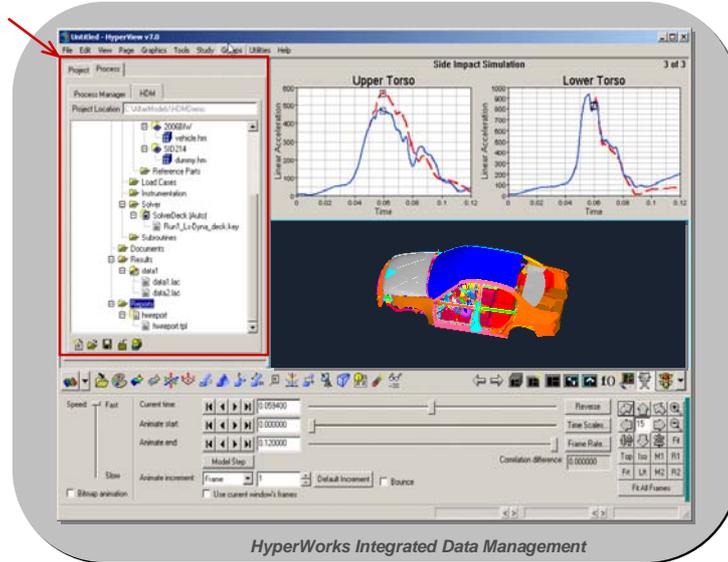
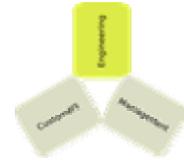
- Pre & Post Application Neutral Client
- For every Application and Solver



HyperWorks Integration



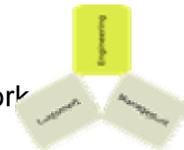
- Integration with HyperWorks (HyperMesh, HyperView)
- Open Architecture allows Integration with Applications (ANSYS, PATRAN, Etc.)



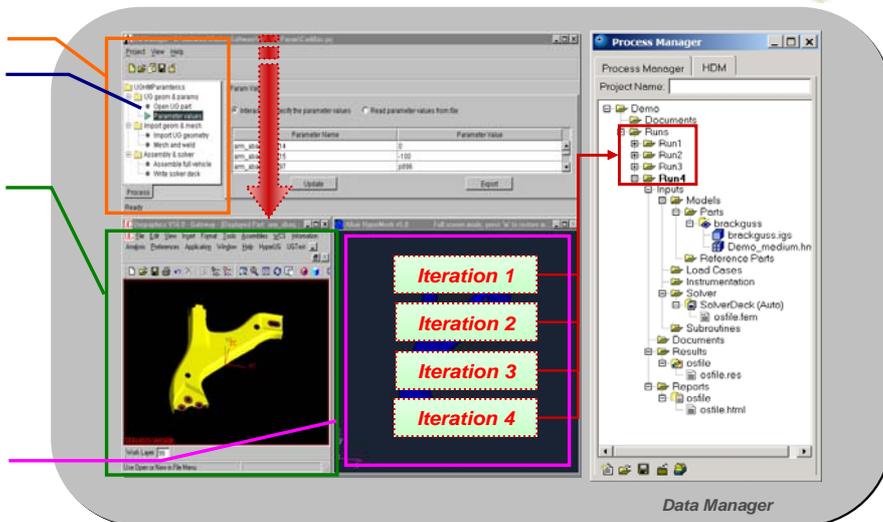
Automated Data Management



- User/Application Level Process Automation
- Application/Domain Independent Automation/Load Case Framework



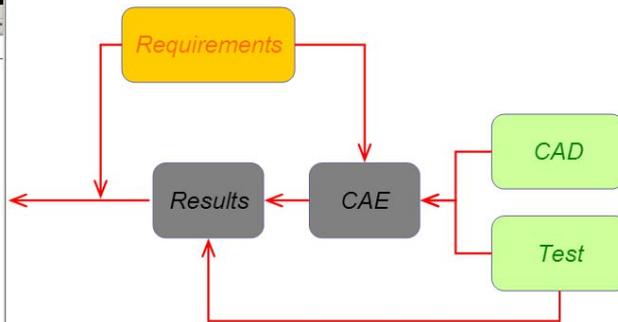
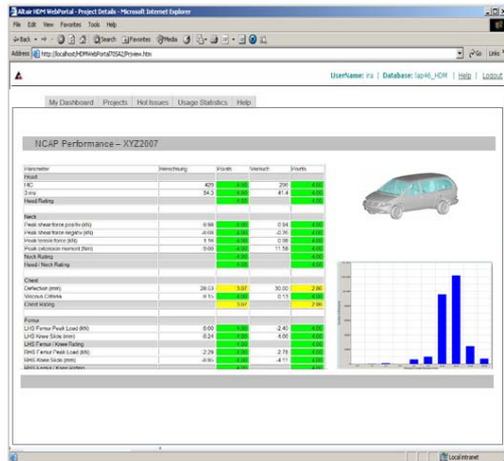
- Process Tasks
- Interact with PDM systems
- Interact with CAD systems
- Interact with CAE systems



Rapid Decision Making



- Custom Web based Dashboards
 - Performance Metrics Vs Targets
 - Project Status
- Synergy between
 - Design - Analysis – Testing Departments



Common Misperception



- Data management
 - Multi-year project
 - Large investment in software AND services

Not with Altair's Data Manager!



ADM Deployment/Configuration Timing



Summary



BatchMeshing Process with Data Management

- BatchMeshing is a Standard Technology
- BatchMeshing creates a huge amount of data, which need to be modified, checked, mirrored, and revised.
- Altair Data Management is available as an “Out of the Box” product.
- The integration between BatchMeshing and Assembling with the ADM allows to check data and to work in a distributed environment to do the meshing of geometries and in parallel.
- Altair Data Manager
 - has Assembling Module included.
 - provides high data security.
- **Results:**
 - Robust Process
 - Multi-user Solution and Data Security
 - Saving of time through automation of 30%
 - Standardized, reliable, and reproducible Process and Method for Six-Sigma CAE.

