

**Improved development approach
using
fast concept modeling and optimization methods**

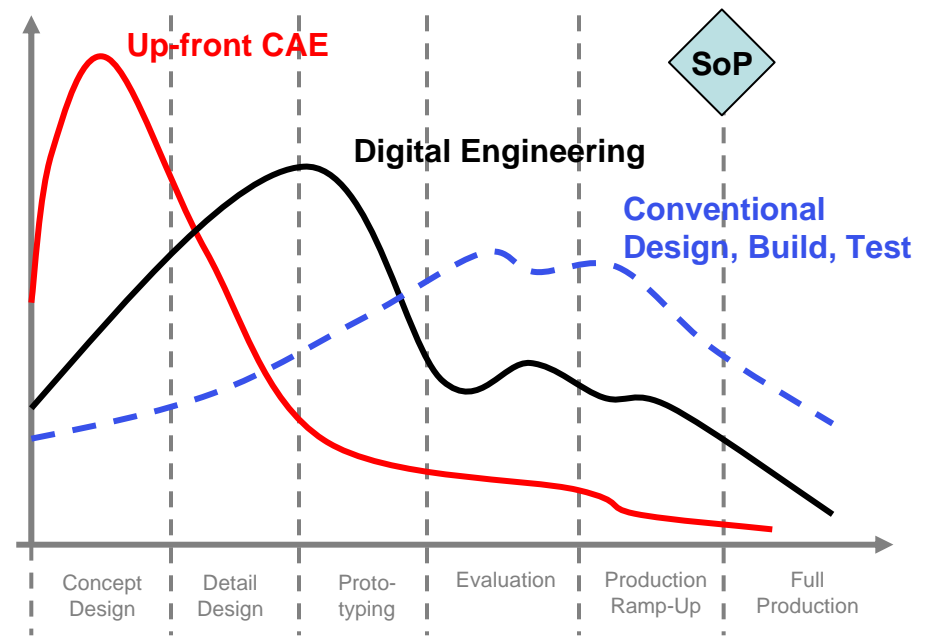
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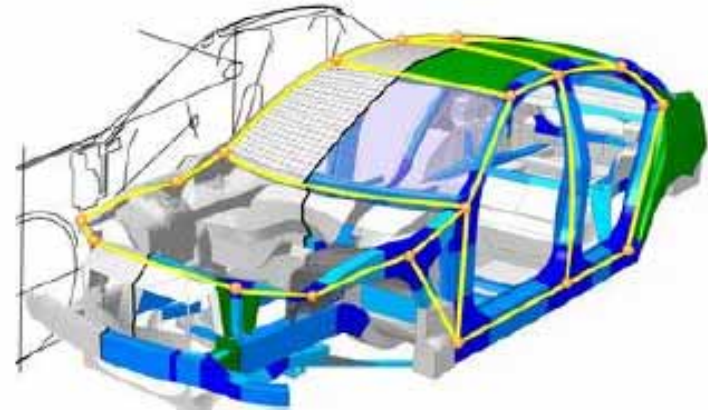
Ludwigsburg, 2nd – 4th November 2009

- Strong demands on new products
 - Improved Quality
 - Enhanced Features
 - Reduced Costs
 - Reduced Time-to-Market
- Conventional development strategies (Design – Build – Test) are not suitable to meet today's requirements.
- Current CAx methods give more product insight but often late in the development process, when no conceptual changes can be brought to the design.
- Up-Front CAE allows early in-depth investigations of alternative concepts reducing the number of issues to be resolved in follow up processes.

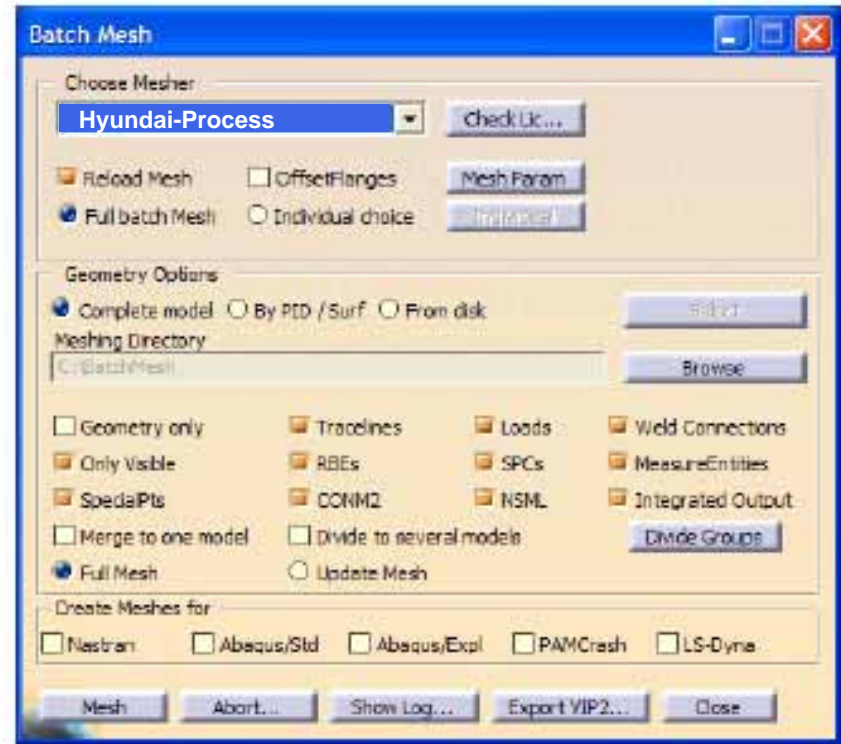


Amount of resolved issues during the development process for different development strategies [2]

- Fast-Concept-Modeler is an Add-On to CATIA-V5.
- Parts need to be modeled completely using FCM-entities in order to take advantage of the full parametric approach.
- Basic FCM-Entities are:
 - Point
 - Spline
 - Surface
- Advanced Entities are:
 - Sections
 - Beams (extrusion of sections)
 - Junctions of beams
 - Maps of geometry to surfaces
 - Flanges
 - Swages and cut-outs



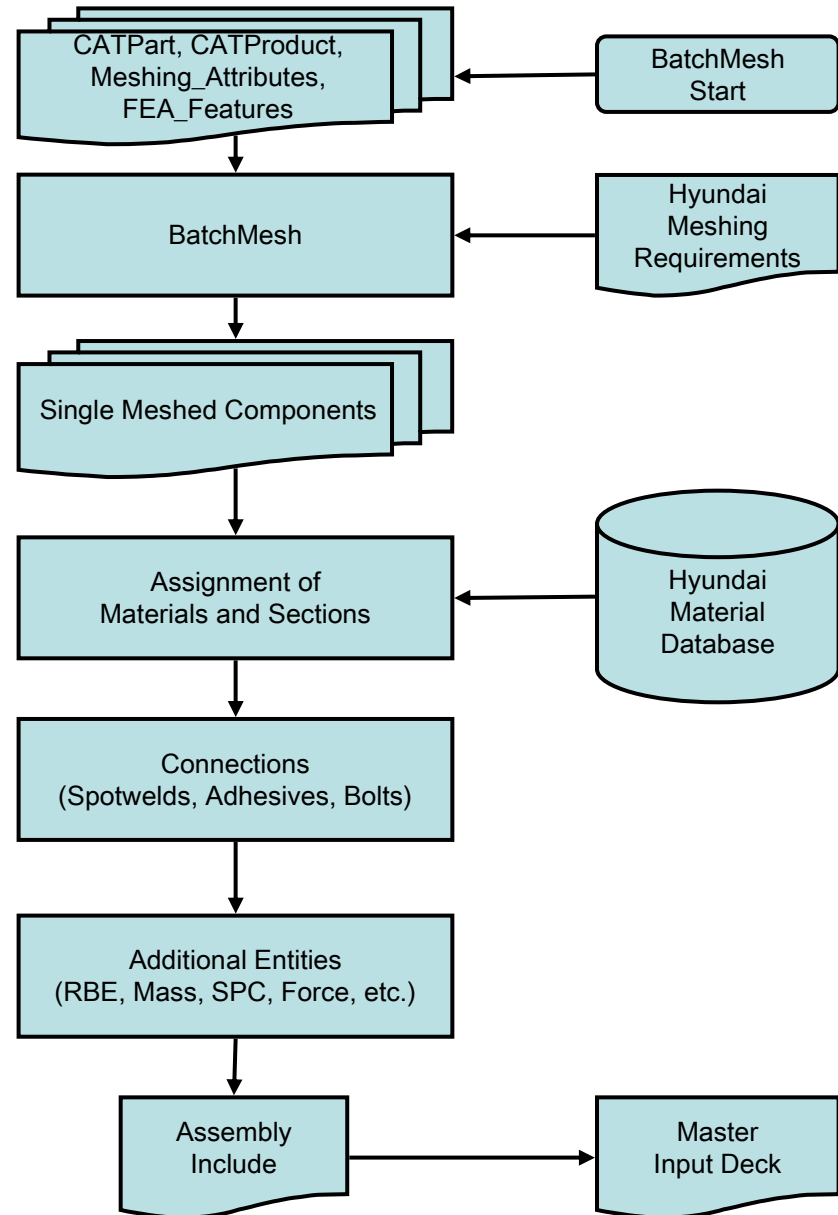
- Additional FEA entities can be defined using FCM:
 - RBE Elements
 - Mass Elements
 - Force Definitions
 - SPC Boundary Conditions
 - Measurements
- These features are geometry based and thus also full parametric
- FCM offers a general FEA interface that exports CAD data and FEA definitions
- A TCL procedure has been developed at Hyundai to generate a ready to run FEA model for a LS-Dyna analysis using BatchMesh and HyperMesh



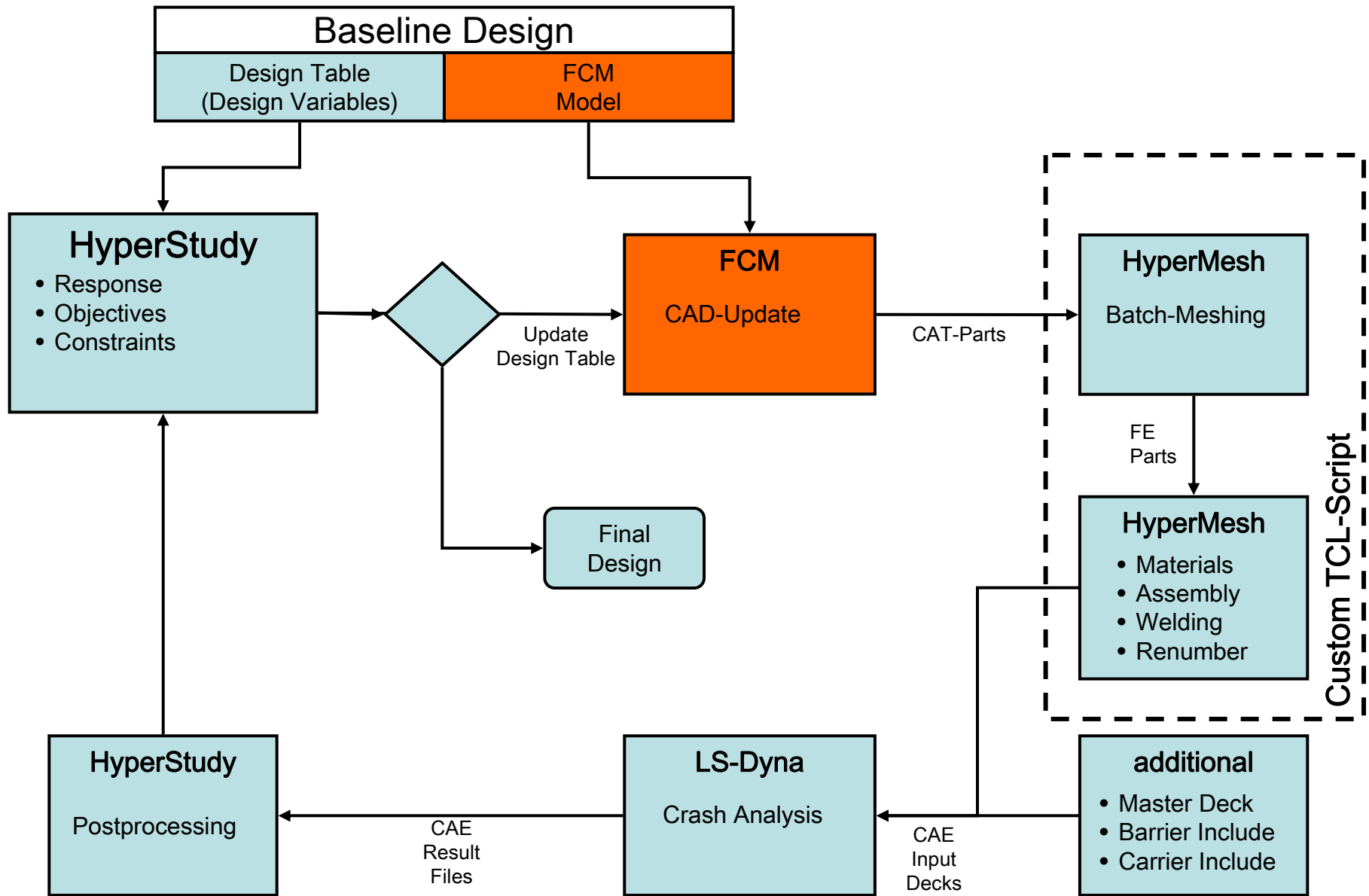
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11						

HyperWorks Process

- The TCL procedure is initiated by FCM
- BatchMesher is used to generate meshes for single components based on Hyundai requirements.
- In HyperMesh materials and sections are read from Hyundai material database.
- Connections and additional elements are generated.
- Model is exported and can be used as include file directly without further user interaction.

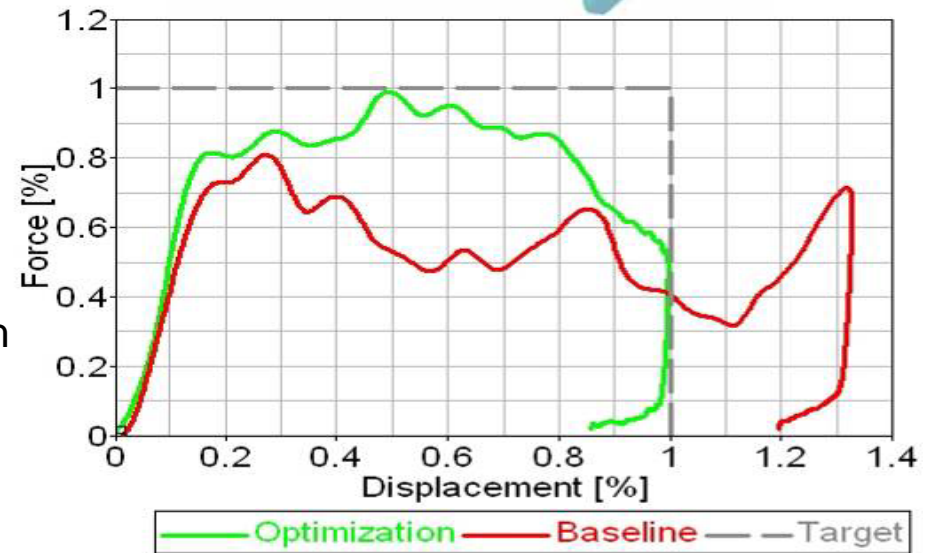
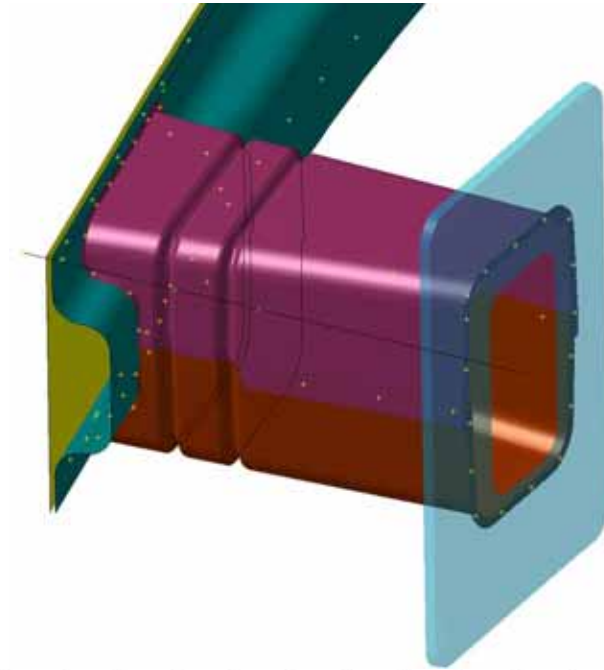


Work Flow Diagramm Optimization Process



Example: Low Speed Bumper Crash Test

- Test conditions
 - 15+1 km/h Rigid Barrier Impact
 - 40% Vehicle Overlap
 - 10° Impact Angle
- Optimization objective
 - Maximize amount of energy being absorbed by the crash box
- Optimization result
 - Energy absorption increased by 26%
 - Force level increased by 19%
 - Intrusion reduced by 32%
- Analysis
 - Model update time: 5 minutes
 - Overall run time for the optimization 24h (25 iterations)



- In order to increase the development process and product quality there is a strong need for up-front CAE
- In the early concept phase the conventional CAE process delivers results often too late.
- A software process has been presented that allows fast modeling and analysis of different designs in the early concept phase.
- Within this software process HyperWorks has been used controlled by TCL scripts in order to generate ready-to-run CAE models without any user interaction.
- An HyperStudy optimization process has been applied using FCM for geometry modification, HyperWorks for modeling and LS-Dyna for crash analysis.
- By application of the optimization process the original design has been improved significantly without any further user interaction.
- The described process can be used for a basic adaptation of a standard CMS design to new vehicles.