

Virtual Manufacturing

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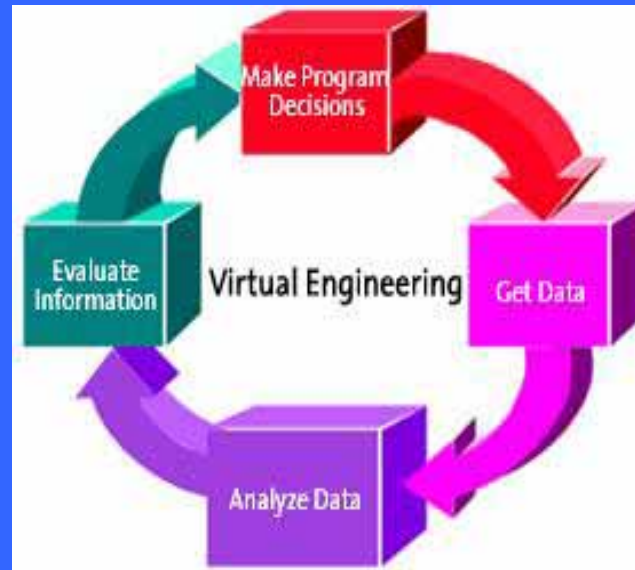
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- Dimensional Engineering
- ELPO film build Analysis
- Robot Simulation
- 3D Factory
- Virtual Assessment
- Formability Analysis
- Ergonomic Simulation
- Emulation
- Electronic Flow Charts

Virtual Manufacturing

Virtual Manufacturing use simulations of processes to evaluate multiple production scenarios at different levels of fidelity

Key Decisions Identified

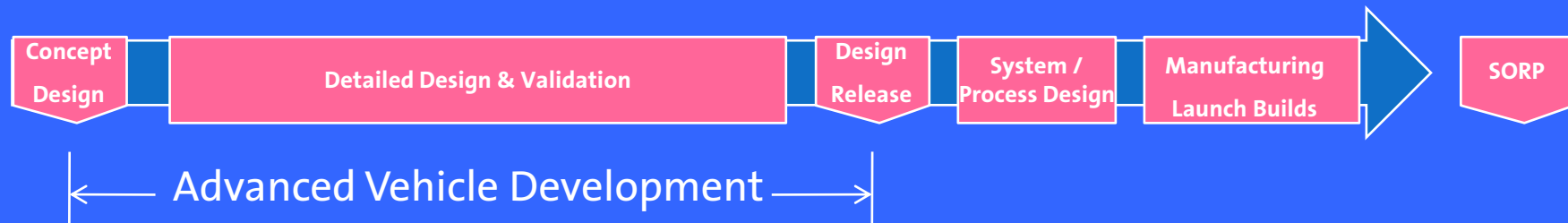


Virtual Assessments aligned to key decisions

Seamless Data flow with Synchronization

Capable People, Capable technology,
Balanced Targets

Virtual Manufacturing – Work Areas



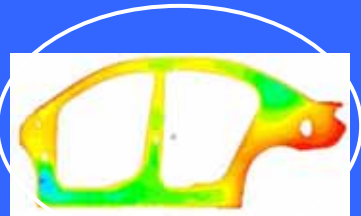
Advanced Vehicle Development



Virtual Vehicle Assessment (BIW & GA)



Dimensional Engineering (BIW)

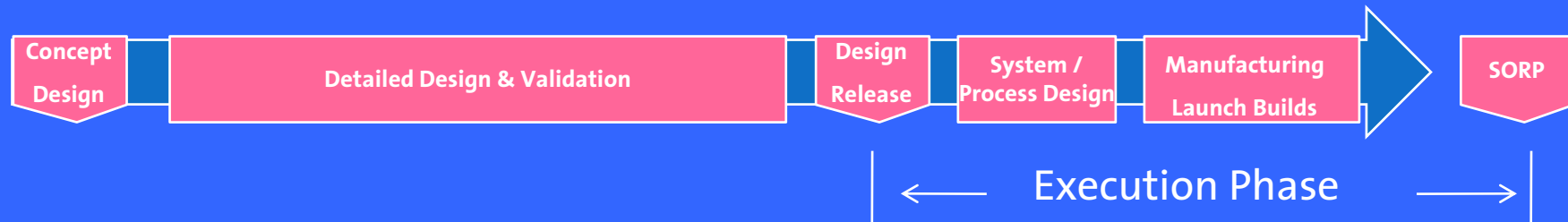


Elpo Film Build Simulation (Paint)



Formability Analysis (Die/Press)

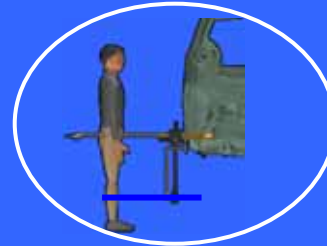
Virtual Manufacturing – Work Areas



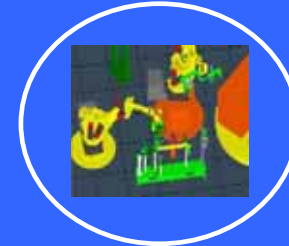
Execution Phase



Robotic Simulation
(BIW & Paint)



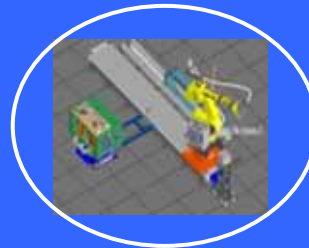
Ergo Simulation
(BIW & GA)



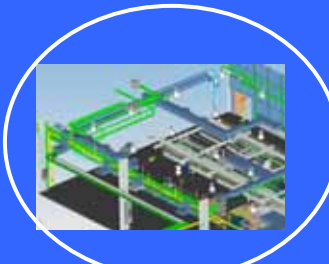
Manufacturing
Studies (BIW)



Emulation support
(CCRW)

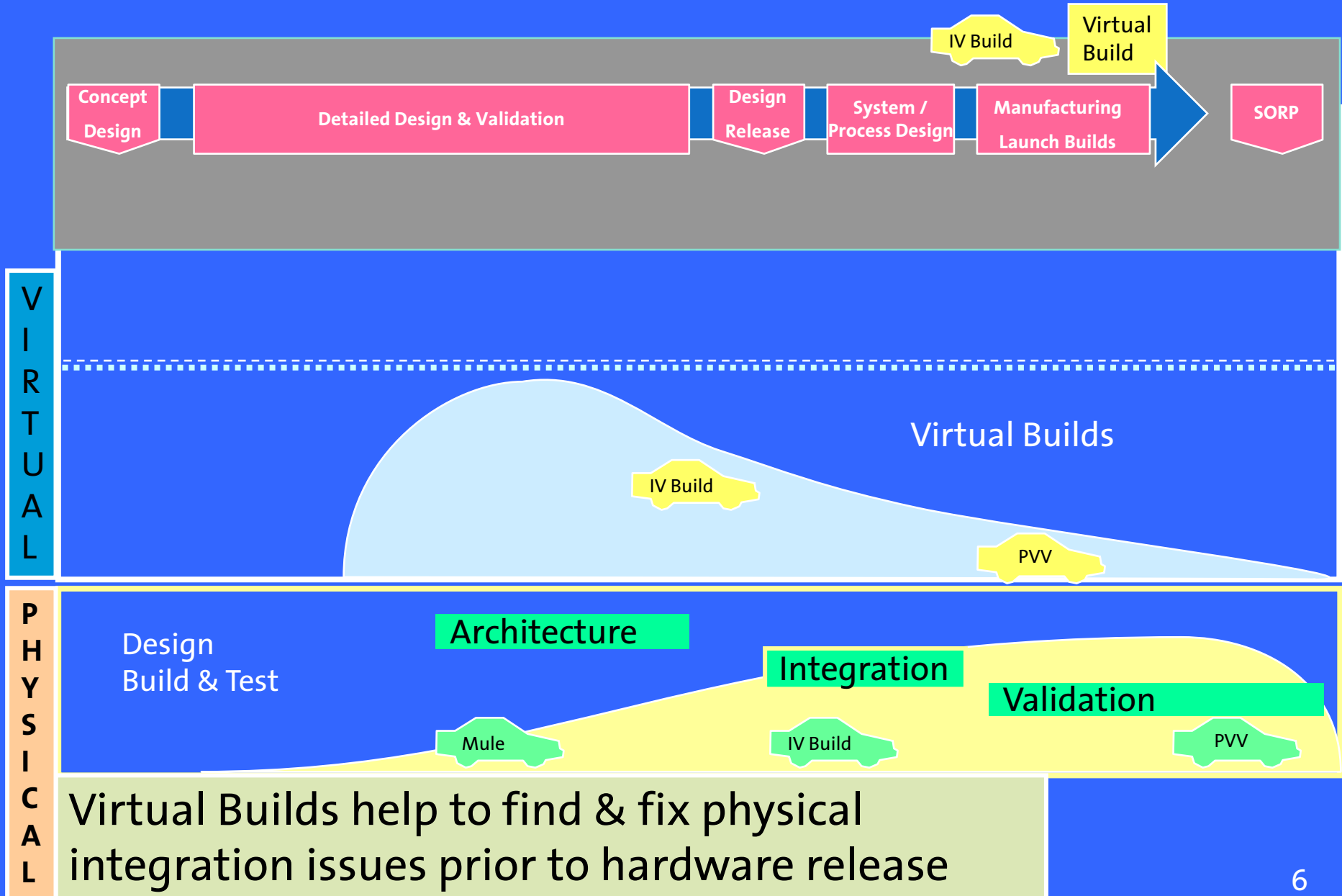


White Light Scanning
(BIW)

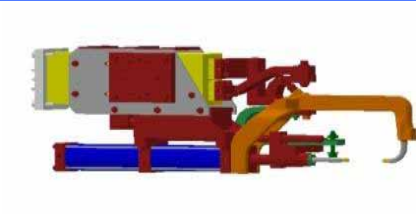


3D Laser Scan &
Plant Modeling

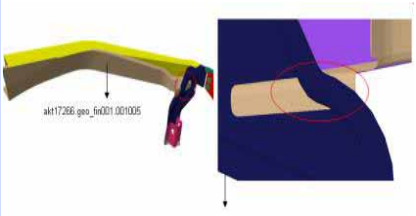
Physical Build Vs Virtual Build



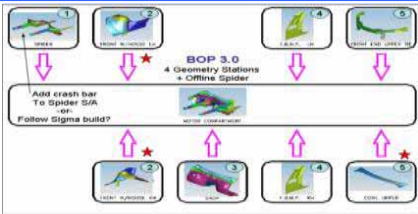
Virtual Vehicle Assessment - Key Focus Areas



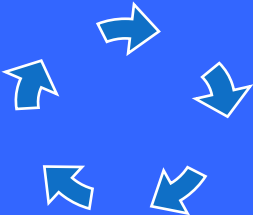
Weld ability
Weld Gun Access



Product Collisions



Assembly Sequence Check



Tooling to Product Interference

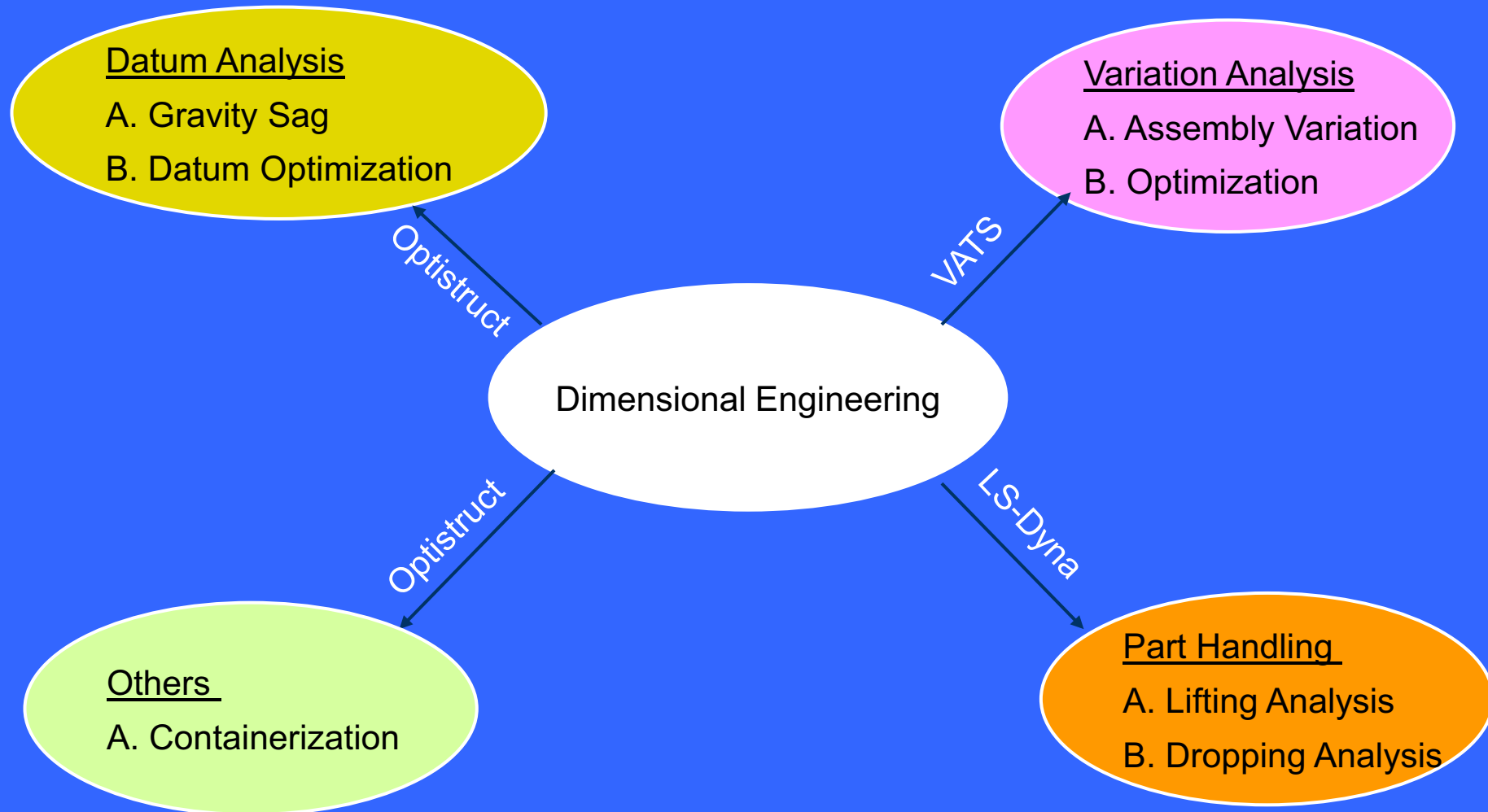


Equipment re-use

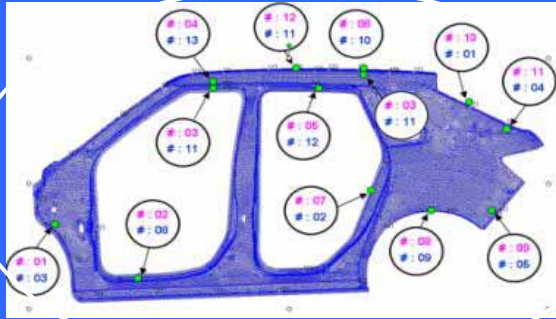


Load path Analysis,
Nut runner Study

Dimensional Engineering Analysis – Key Focus Areas



Dimensional Engineering Analysis



Dimensional Engineering
(BIW)

Purpose :

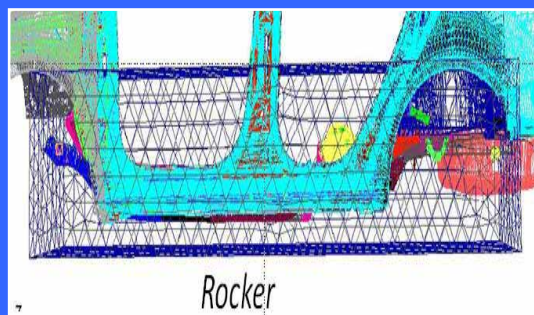
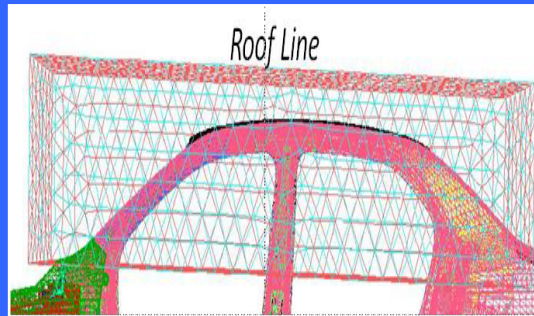
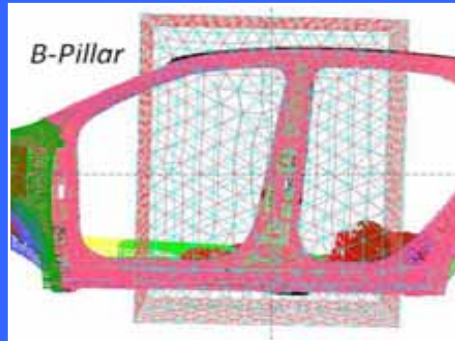
- Analyze the effect of part & assembly variation on final assembly quality & dimension
- Analyze assembly sequence that is responsible for variation
- Optimize weld/clamp sequences & datum locations that reduce variation

Benefits

- Drives changes to Manufacturing processes / Product Design at early stage
- Ensures Manufacturing readiness without affecting quality

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ELPO Film Build (Paint) Simulation



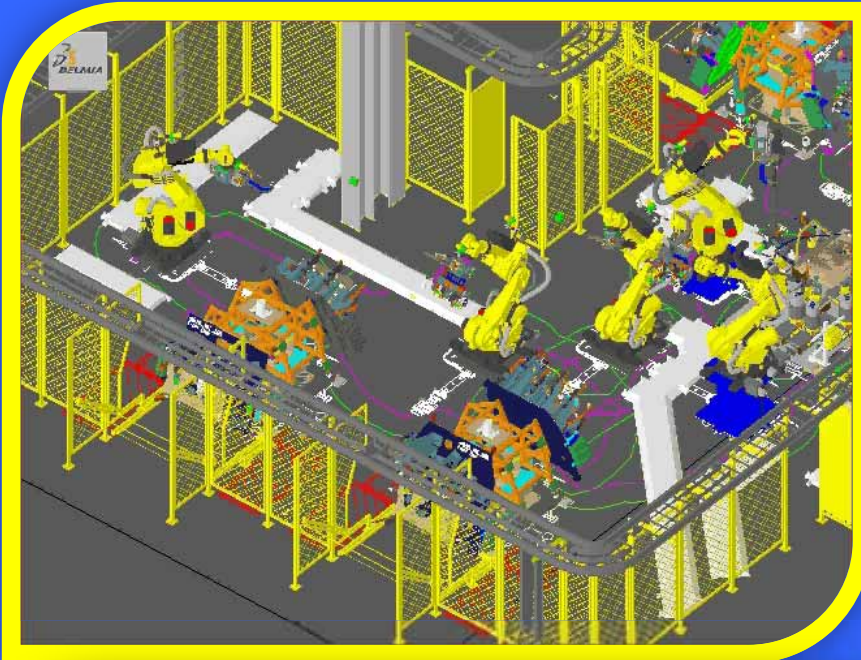
Purpose

- To analyze the ELPO Coating deposition in vehicle areas prone to corrosion

Benefits

- Reduce Physical builds to validate ELPO coat deposition
- Improved corrosion protection and reduce warranty issues
- Reduced cost due to avoidance of late product changes.

Execution Phase - Robotic Simulation

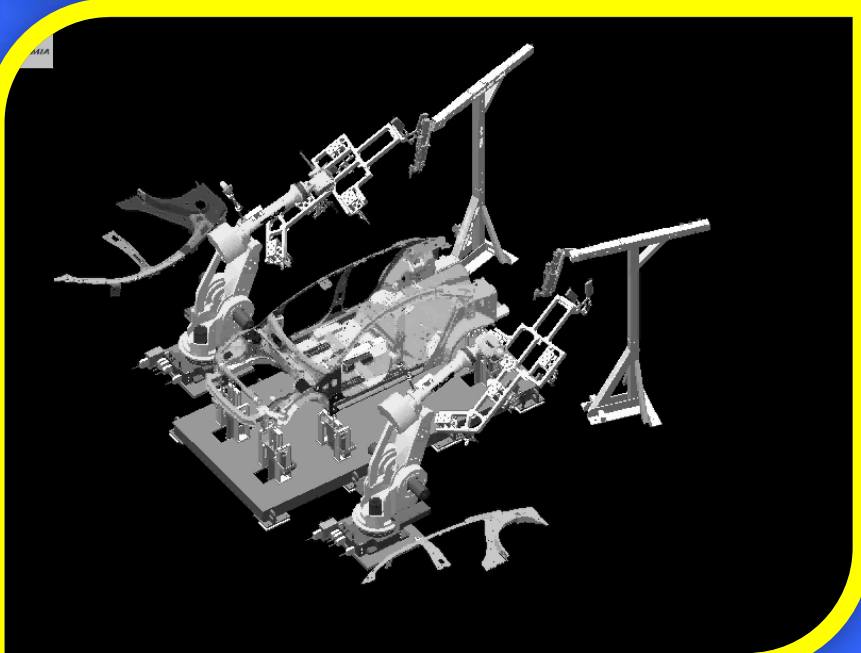


Purpose

- Validation & Optimization of Process, Layout, Cycle Time
- Validate Design of Tooling, Weld gun, M&E and painting programs
 - Check for Clearance, Collision, Robot interference .
 - Offline programming of the Robots

Benefits

- Drives changes to Manufacturing processes / Product Design at early stage
- Ensures Manufacturing readiness for Flawless & Timely launch

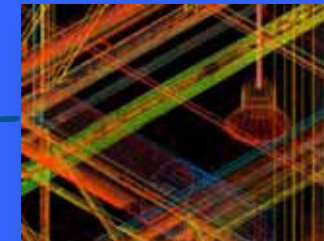
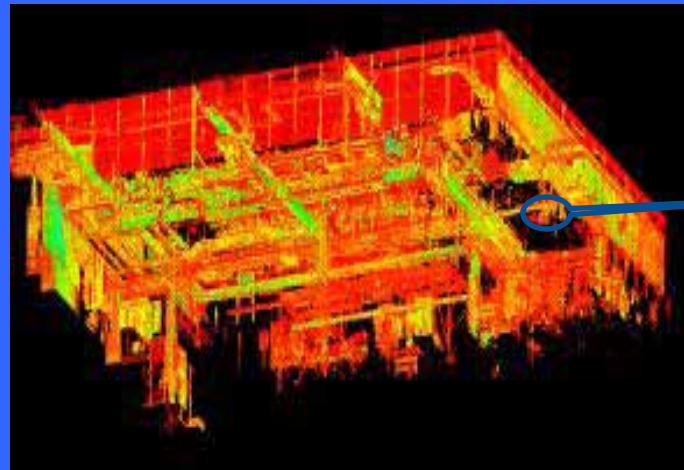


3D Factory

Objective is to bring our plants closer to our engineers. To provide the engineers and planners an accurate plant in as built condition with all information for future planning

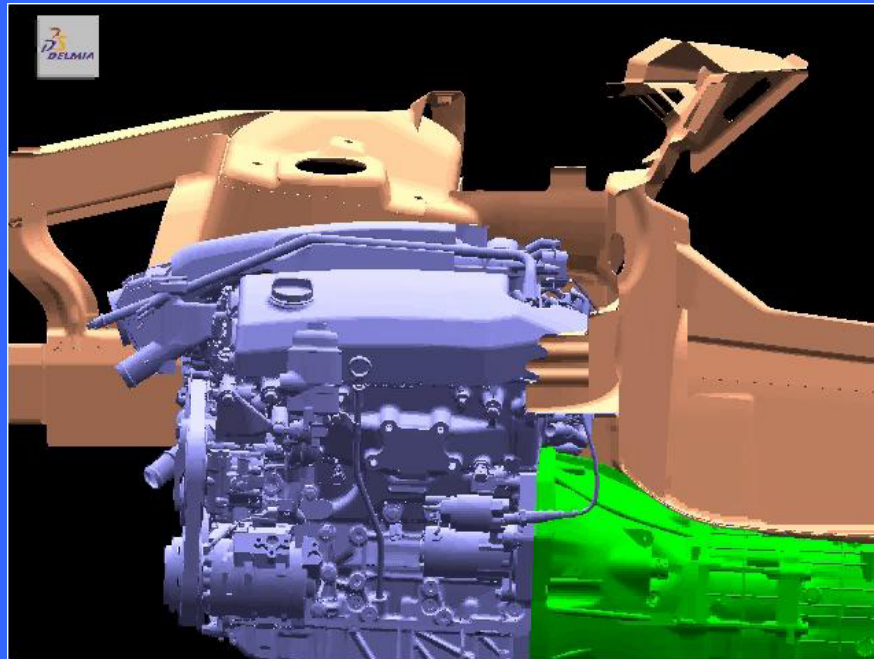
Method:

- First develop 3D drawings of buildings and generate 2D drawings for construction.
- For existing buildings, Laser scanning method is used to create 3D drawings.
- Integrate Utility and equipment into the building 3D data.
- Use virtual walk to identify interferences and avoid costly reworks.



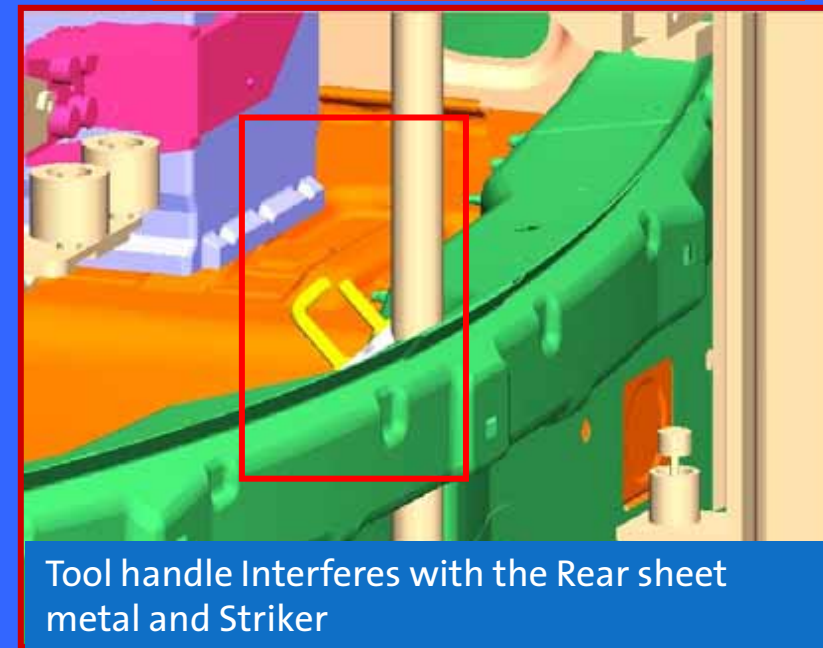
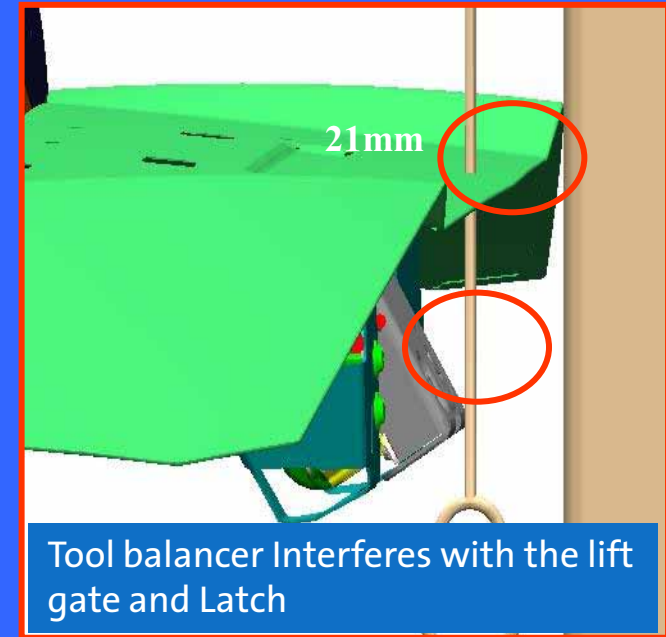
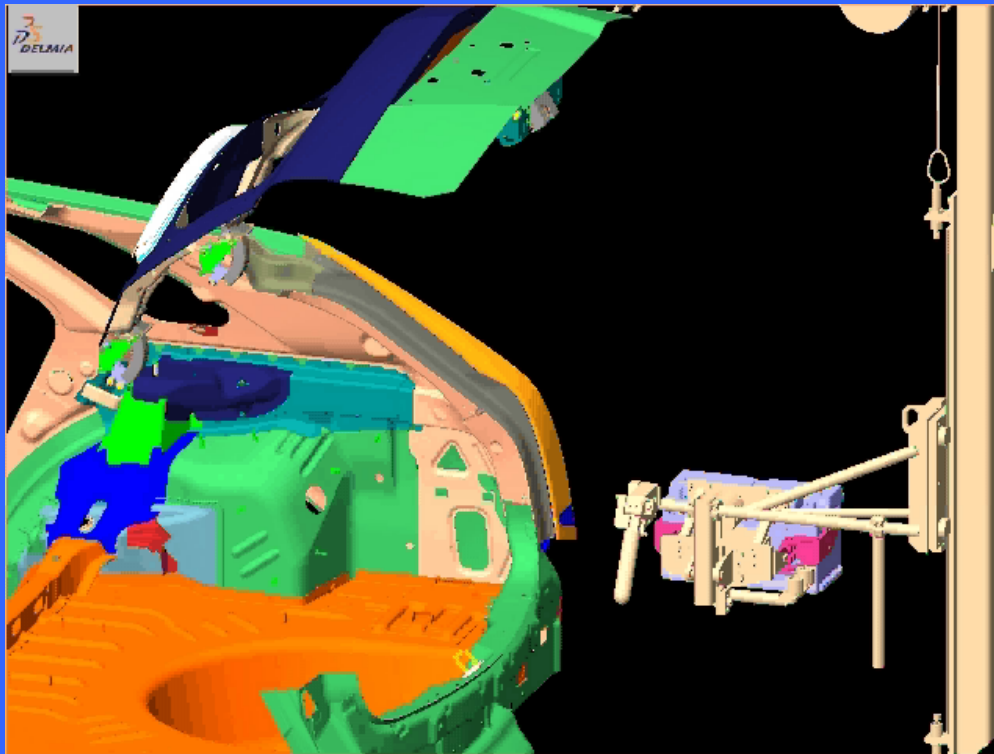
Virtual Assessment

- Operation: Chassis Marriage
- Objective: To validate Clearances & Interferences
- Result: Floor panel need modification



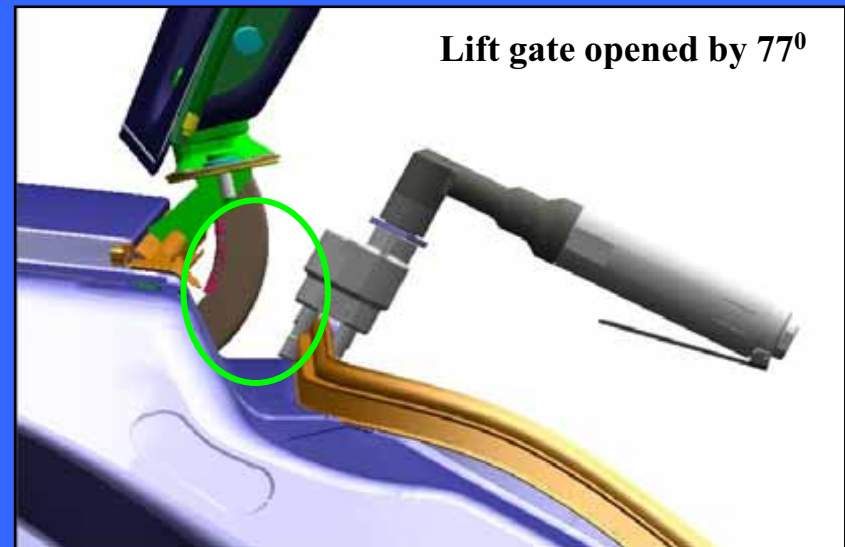
Virtual Assessment

- Operation: Battery Loading
- Objective: To validate the current battery load tool for new program

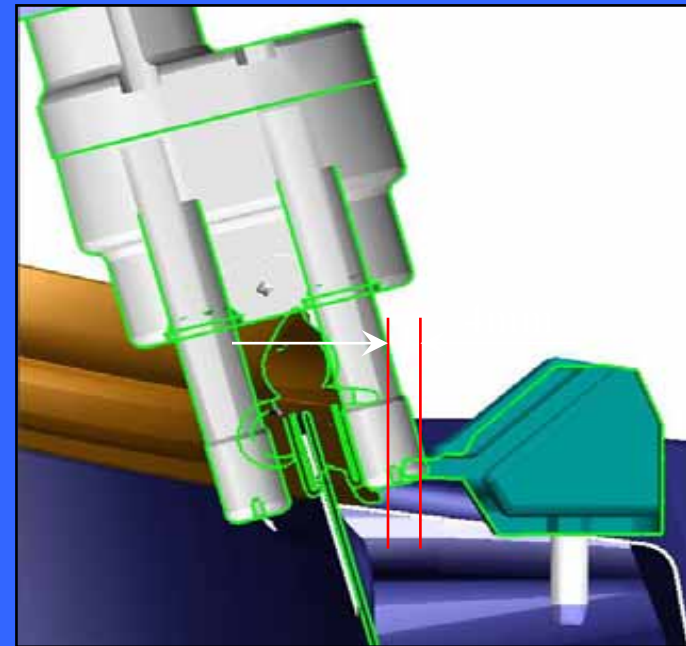
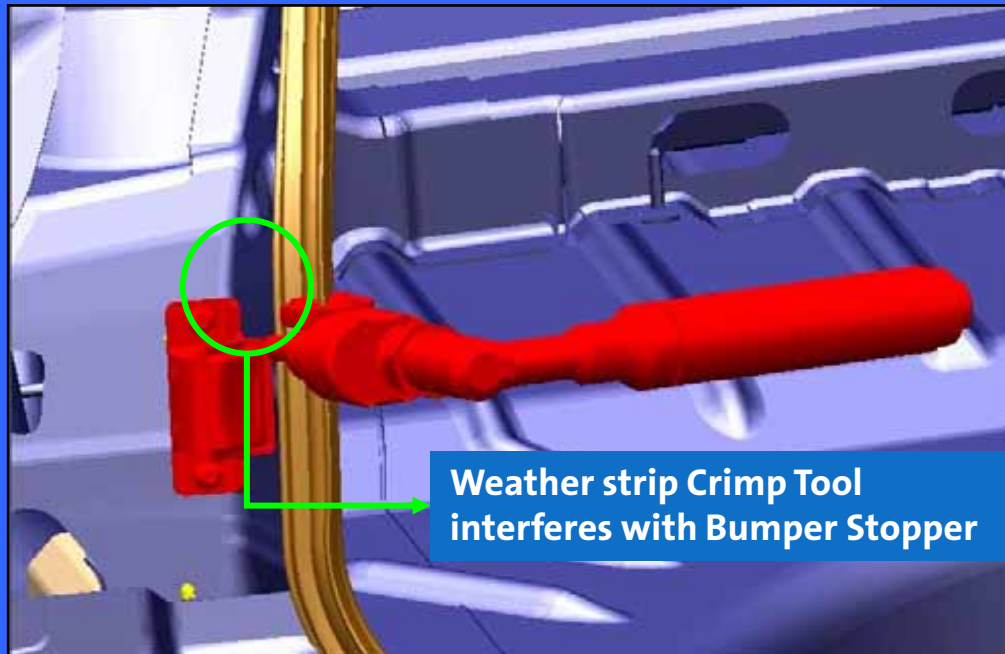


Virtual Assessment

- Operation: Lift gate Weather-strip crimping.
- Objective : To validate the crimp tool access
- Suggestion: Install Bump Stopper after crimping process.



Crimp Tool clears the Lift gate Hinge

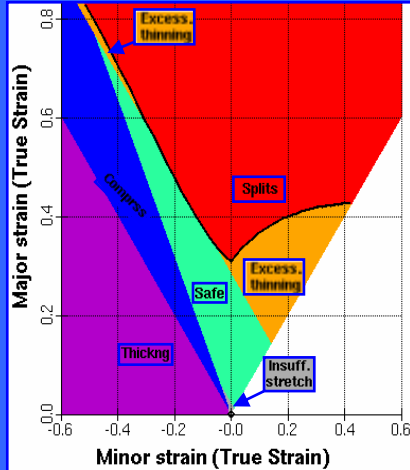


Formability Analysis

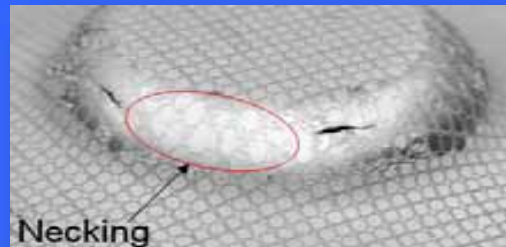
Splits



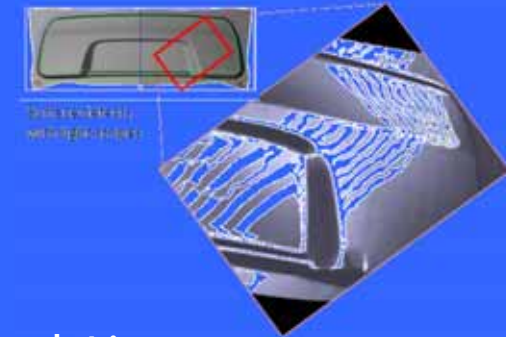
Wrinkle / Thickening



Excessive thinning (Necking)

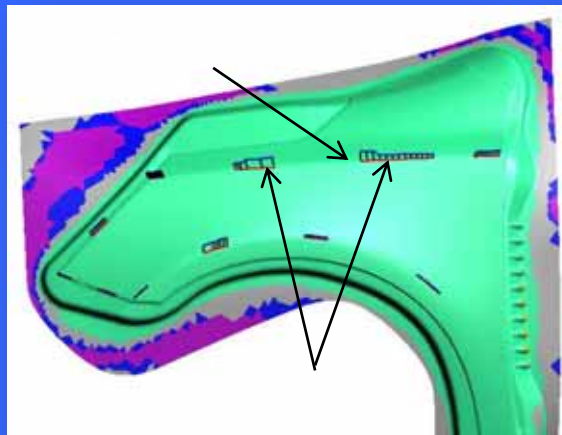


Surface Defect

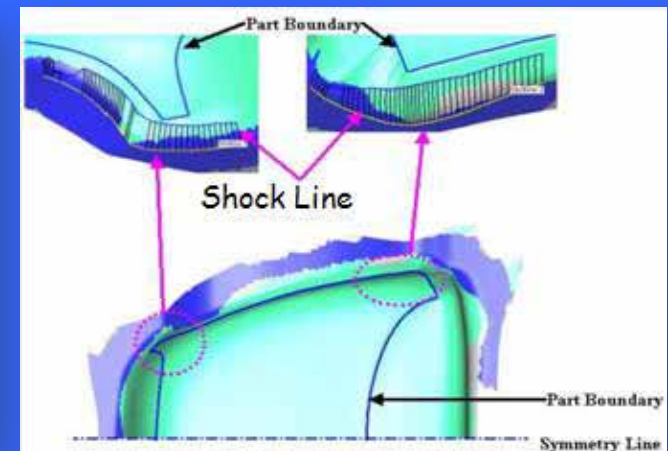


Forming Limit Diagram

Skid Line



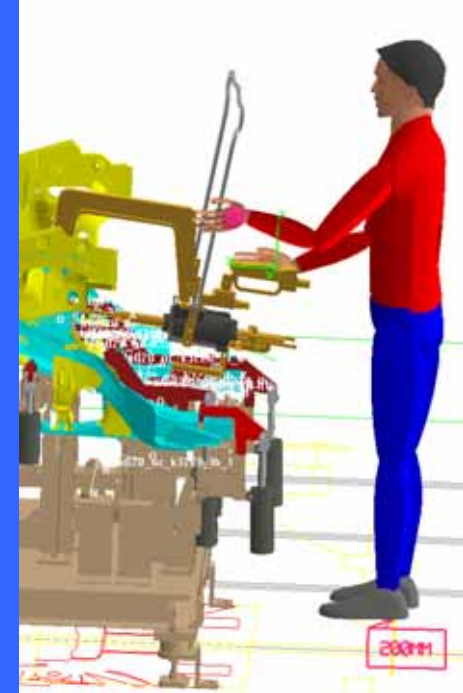
Shock Line



Welding Simulation

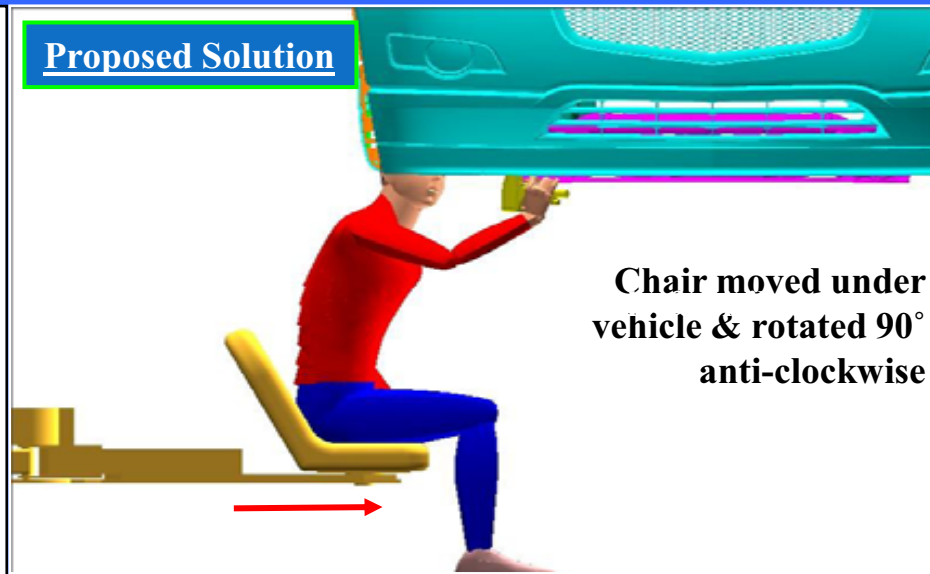
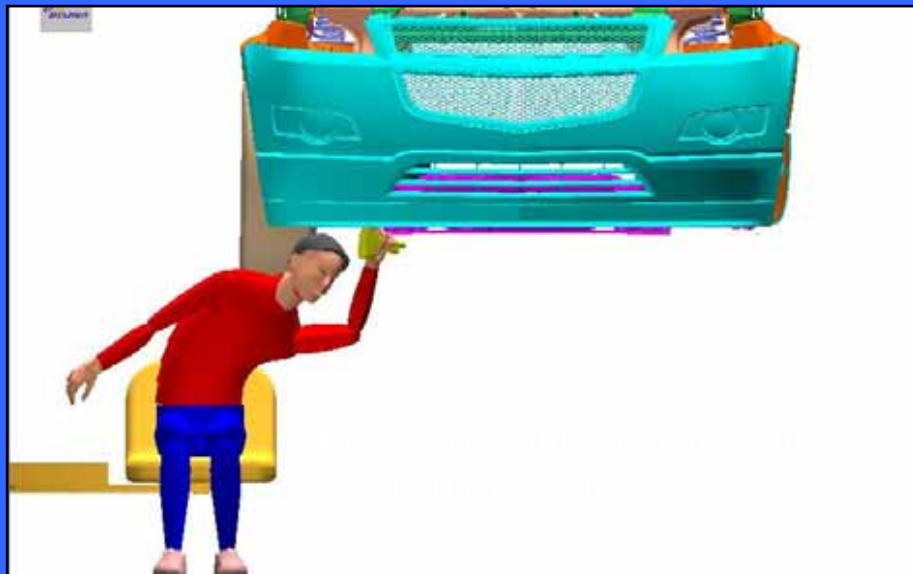
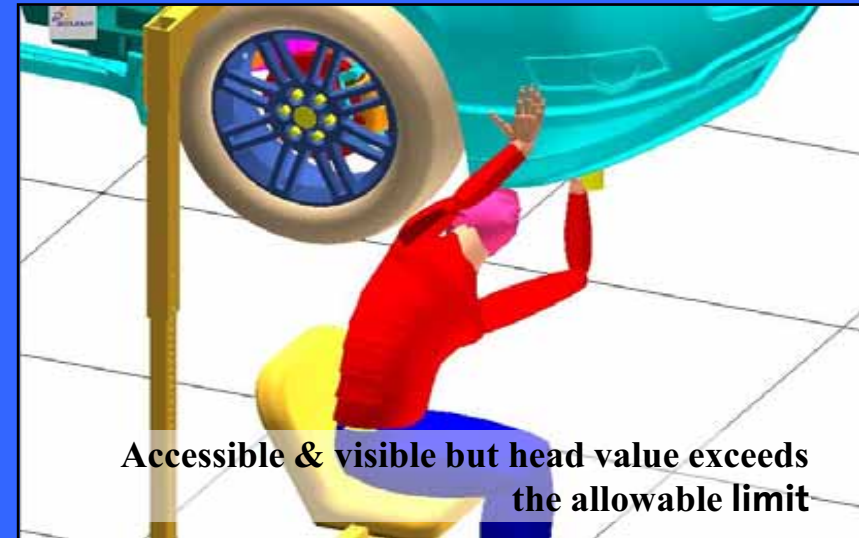
Welding Simulation is carried out to validate:

- Weld Gun Accessibility
- Weld gun Validation
- Gun Trigger And Handle Position
- Welding Sequence
- Process sequence
- Tooling Design
- Reachability of operator
- Work Platform requirement and design
- Identify any ergonomic issues and take timely corrective actions



Ergo Analysis - Examples

- Study: Front Fascia installation
- Objective: To evaluate the feasibility of Front Fascia secure
- Issue : No Visibility
- Suggestion: Modification of the Ergo chair: Extend the Chair



Emulation

Virtual
Logic/Hardware
Validation



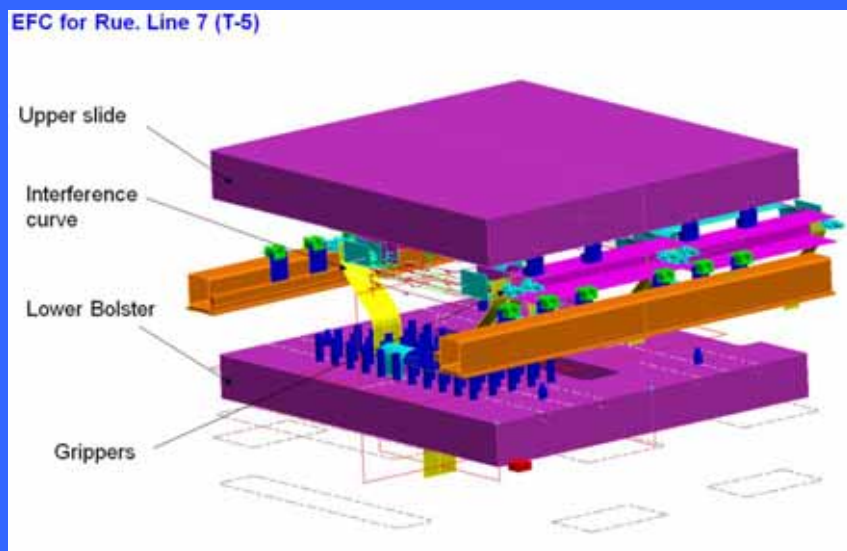
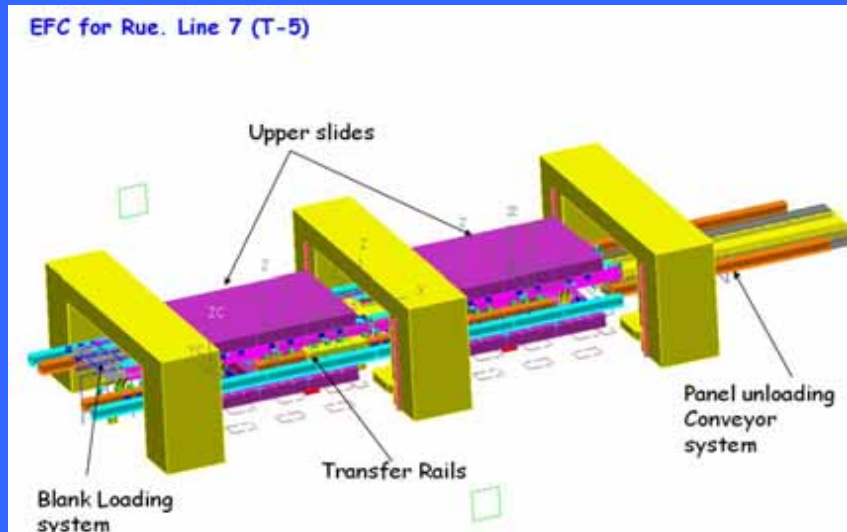
Purpose

- Offline Validation of PLC Logic

Benefits

- Faster development and integration of control logic
- Shorter start-up and debug time at plant.
- Reduced support during ramp up.
- Validation of all possible conditions / scenarios.
- Provides consistent validation process
- Provides virtual training capability for control engineers.

Electronic flow Chart (EFC)



EFC is a standardized 3D representation of transfer press, with conveyor system.

Identify position of the panel at every stage of operations with complete detail of feeding system.

Provides input for the die designing - interference curves, panel feeding system and Die Holding location .

The EFC data is used for Press simulation.

Benefits of Virtual Manufacturing

- Identify Product & Process Issues at early stage.
- Correct issues at early stage.
- Reduced product Development time and cost by avoiding late changes.
- Provides Scope for Product Innovation.
- Higher flexibility in Manufacturing System.
- Better product quality, reduced time to market
- Ability to Integrate Manufacturing Inputs / Requirements into Product Design
- Product development incorporates Design for manufacturing

Summary

- Trends indicate that advances in Simulation technology will merge with advances in CAD systems and Virtual worlds to create robust tools for Virtual Manufacturing
- Virtual Factories developed from 3D plant layout modeling would drive key decisions in Automotive Industries like
 - Future expansion of existing plants
 - Setting up Greenfield Plants
 - Modifications required for any new vehicle program
- Given the benefits of Virtual Manufacturing, the Automotive Industry in future is likely to rely more on Simulation Technologies for
 - Driving Key Product Decisions
 - Reducing Cost & Time to Market
 - Improving Manufacturability & product quality

Thank You !

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