



# Simulation Engineering: Assessment & Challenges in Pre- & Post-Processing

Laurent Anné, DISTENE  
Teratec Forum 2014



# DISTENE : who we are !

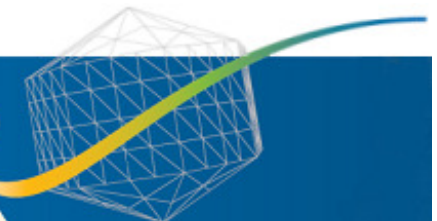
**DISTENE**

The maker of

**MeshGems**  
Leading suite of Meshing  
Software Components

The Representative of  
**EnSight** in South Europe  
Visualization and Post-Processing  
**ENSIGHT**

- Located on the Ter@tec campus
- Innovation in our DNA





# DISTENE : innovation in our DNA

- **INRIA in our DNA**

- “born of INRIA”



- Meshing Lab: common research laboratory shared with INRIA

- **Strong commitment in many National and European Research Projects (Systematic, FEDER, FUI, ANR)**

- CSDL, OpenHPC, IOLS, EHPOC, Collaviz, TIMCO, MIEL3D, ILMAB, ...



**DISTENE**

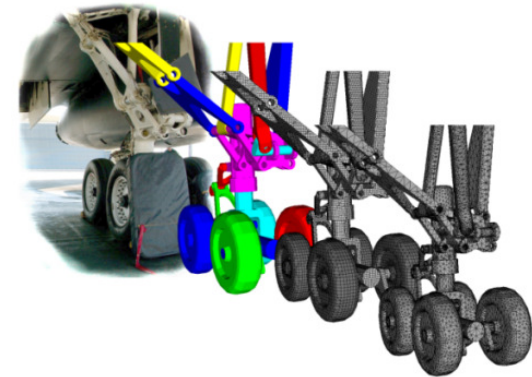
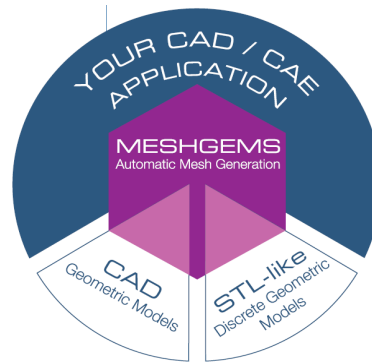
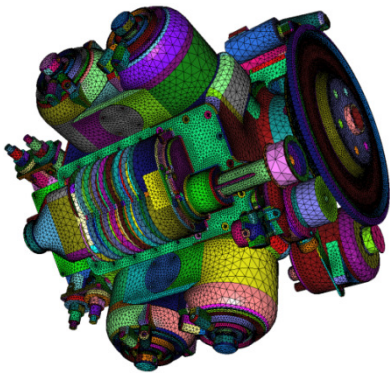
The Leading Provider of  
Meshing Software Components

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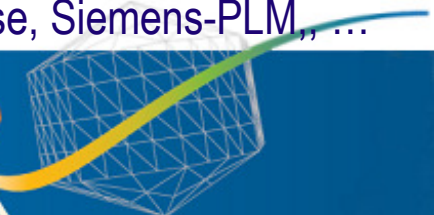
- **Library of Meshing Software Components**

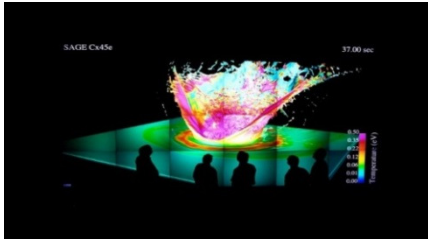
- Targeting the CAD/CAE software developers market
- to enhance & automate the «CAD to Mesh» process



- **A reference expertise & technology**

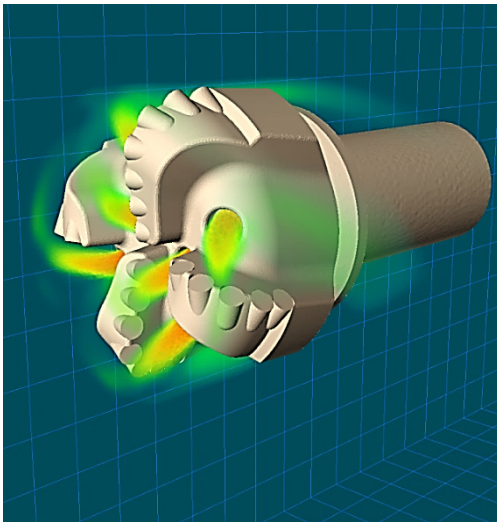
- More than 60 clients
  - ... including *« All engineers already most likely used our technology without knowing it ! »* MeshGems ...
- ANSYS, Autodesk, Dassault Systèmes, LSTC, MSC Software, PTC, Sandia National Labs., Pointwise, Siemens-PLM, ...





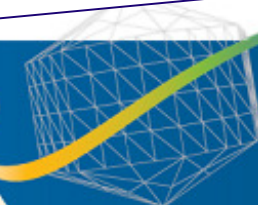
# EnSight

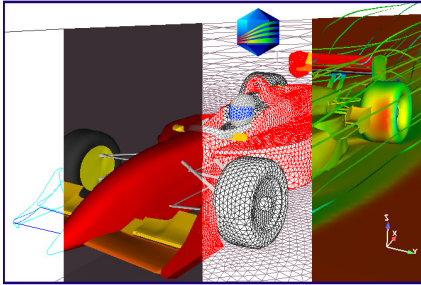
- **Leading Post-processing & Viz package for CAE**
  - +500 customers, + 2000 licences worldwide, mostly industrials: **+400 licenses in France**
  - International reference, especially for **high demanding industries**: High Performance on large datasets



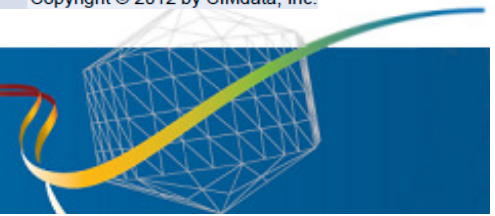
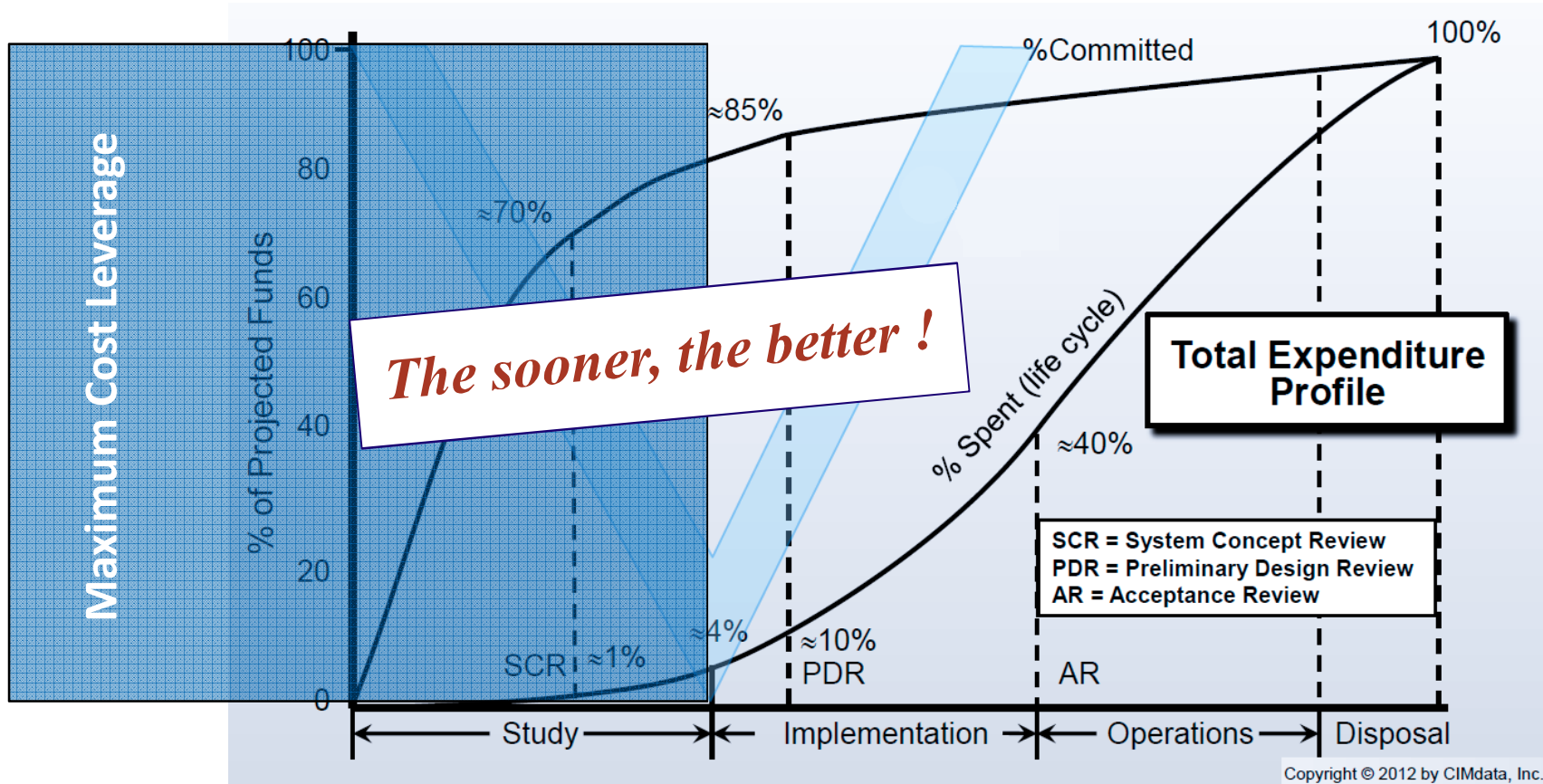
- Main markets: **automotive, aerospace, defense, energy, process**
- Developed by CEI Inc. (NC, USA), 1994 spun off from Cray Research

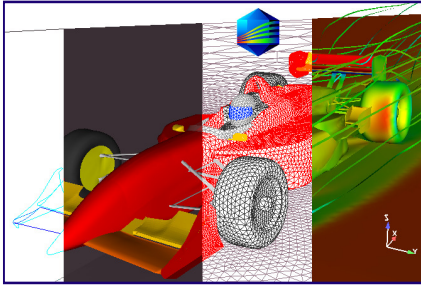
*« Analyse, Visualize & communicate to make the right decision »*





# Simulation Engineering in the PLM

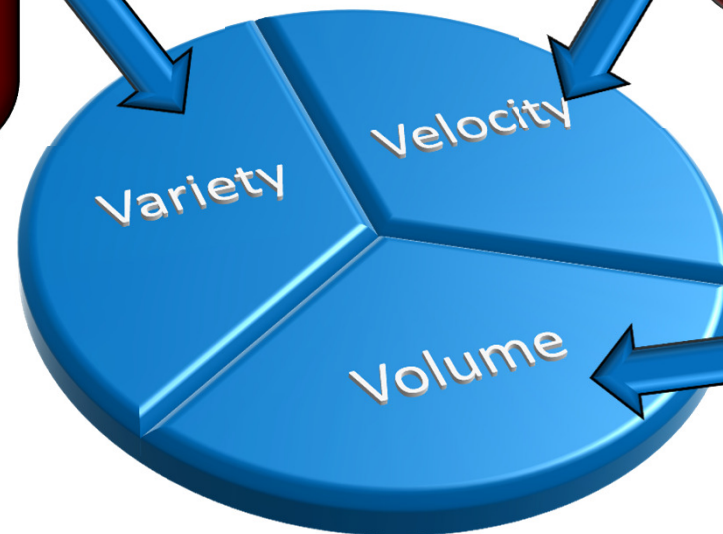




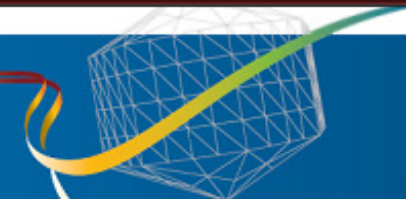
# Simulation (Big) Data

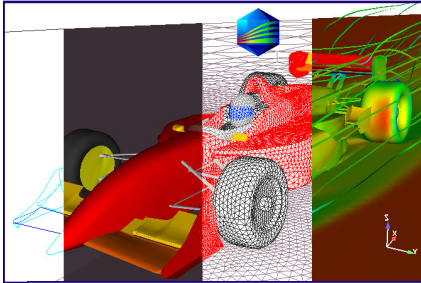
- Various Simulation Disciplines : CSM, CFD, CEM, Thermal, ...
- Coupled Multi-disciplinary Simulation
- 1D, 2D, 3D, 4D, ... nD
- Systems of systems

- Faster time to market
- More virtual experimentation and tests
- More users throughout the industry

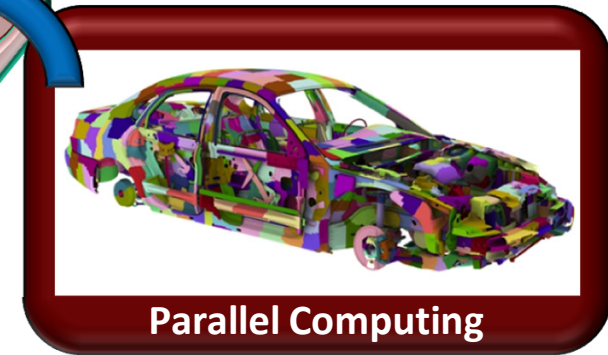
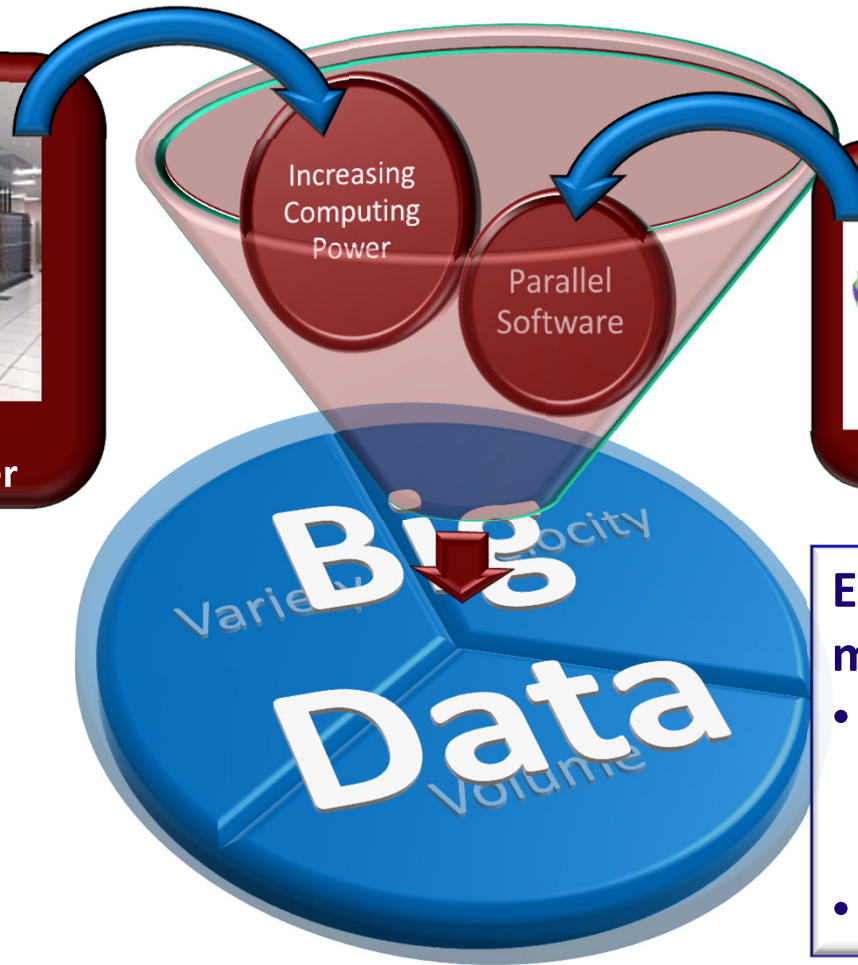


- Larger and more complex models due to better accuracy and multi-disciplinary design
- Massive exploration of Design Space – Optimization





# Simulation (Big) Data

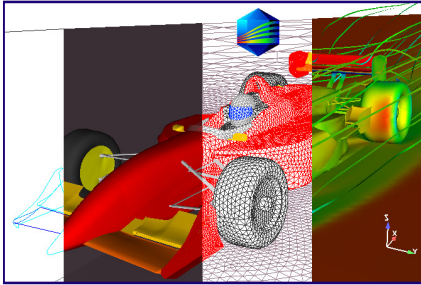


## Example of a car manufacturers :

- 500+ TB of critical Design and Simulation Datas
- + 10 TB of data / day

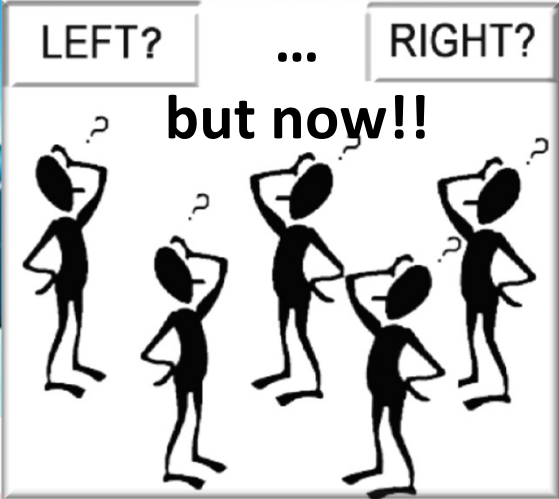


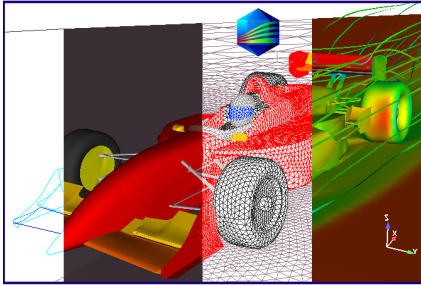




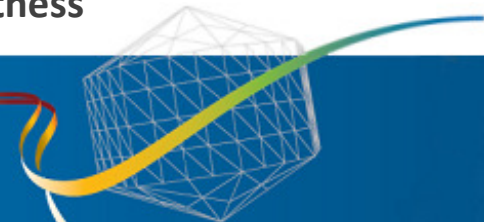
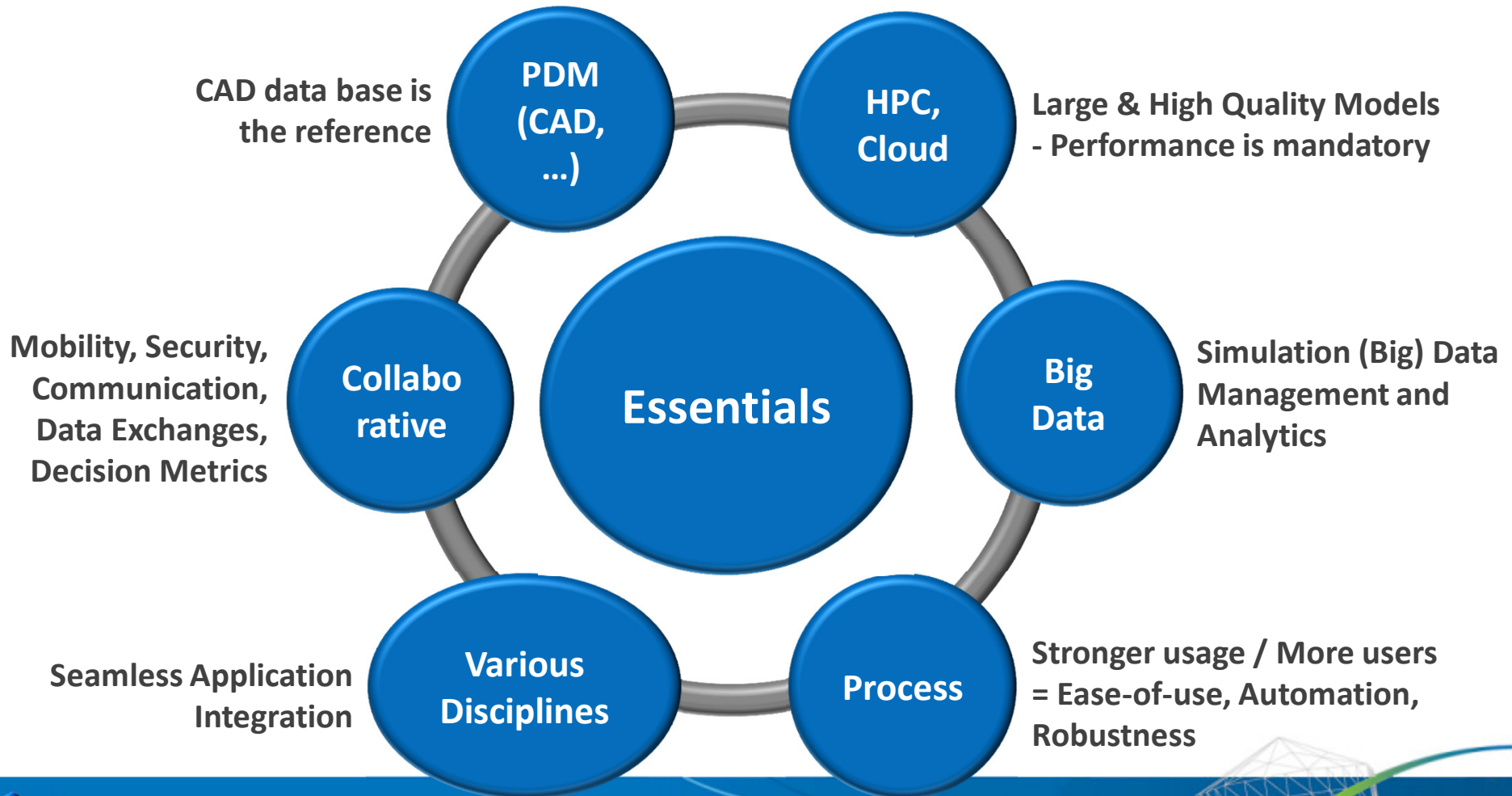
# Decision Making Process is a Collaborative Effort

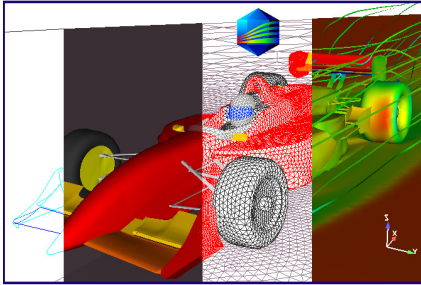
- Growing number of users spread out worldwide
- Many hierarchical levels and projects teams involved in the decision



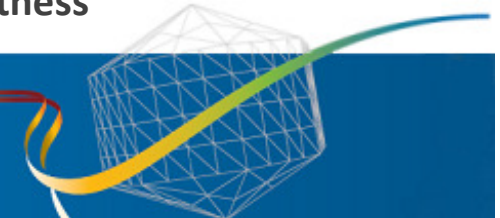
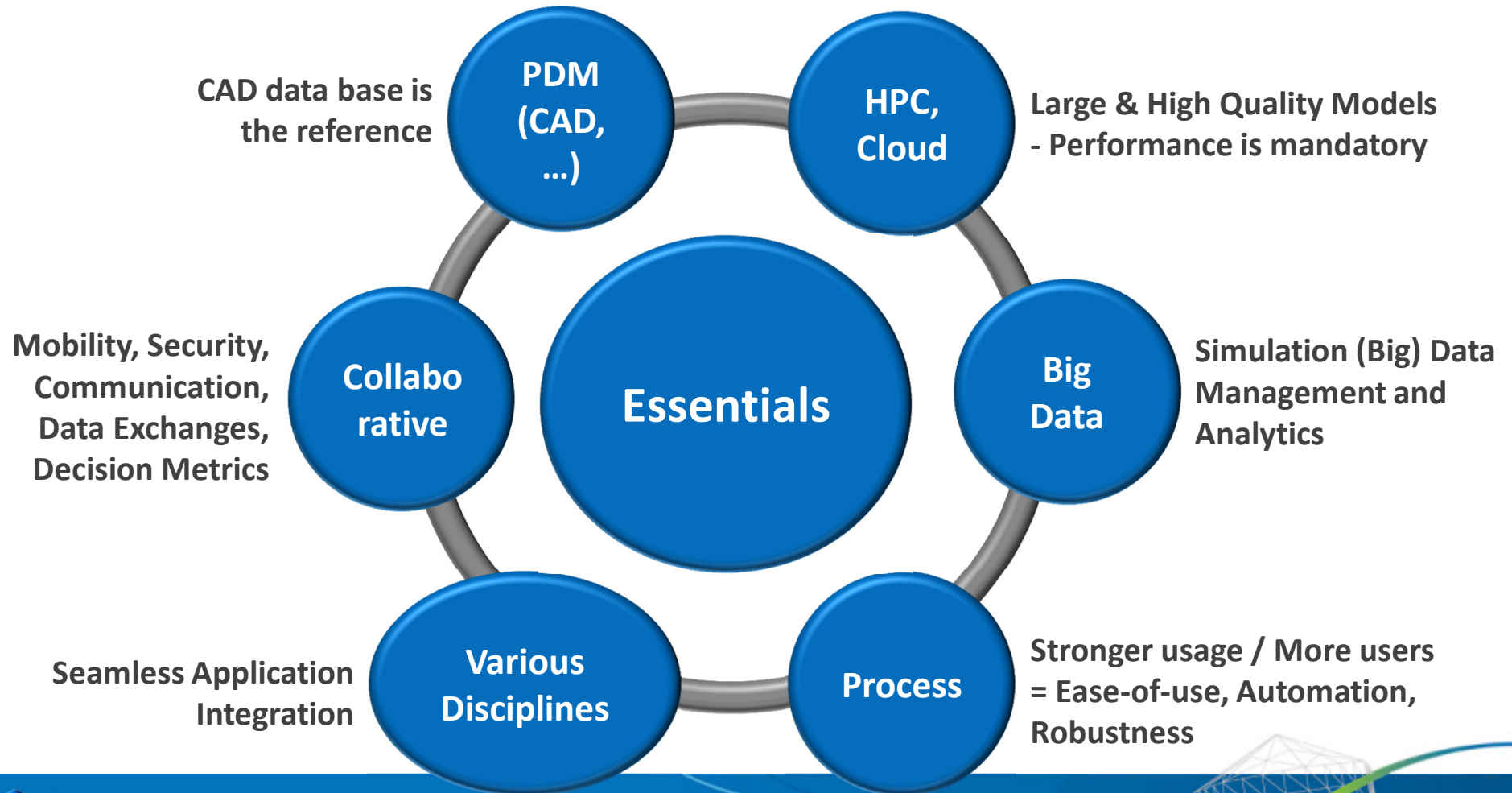


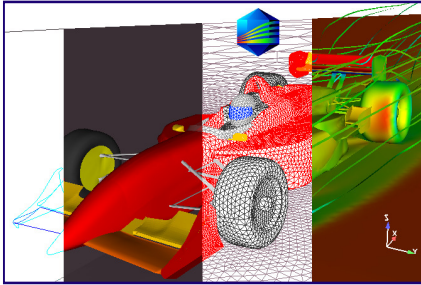
# Essentials for Simulation Engineering



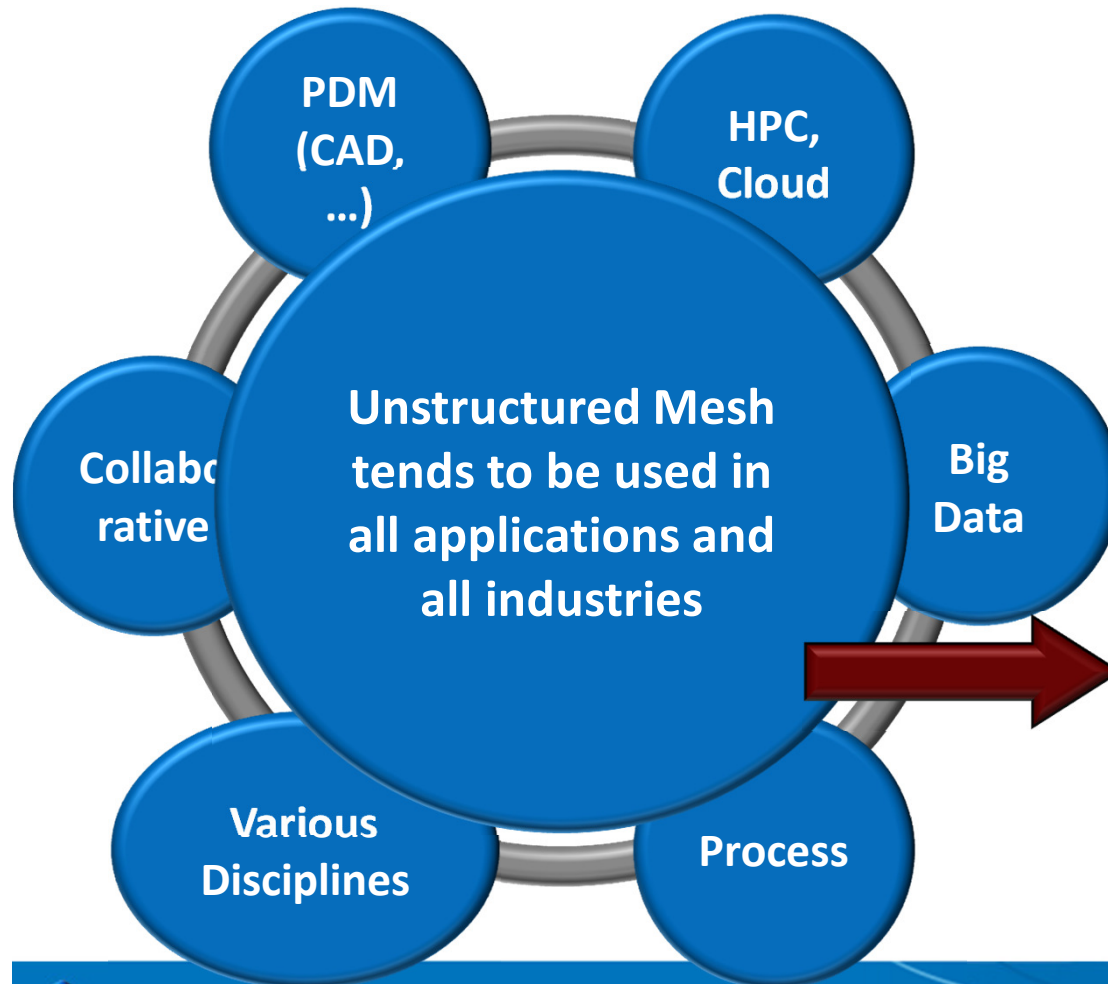


# Essentials for Simulation Engineering

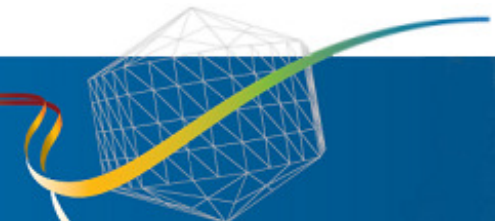


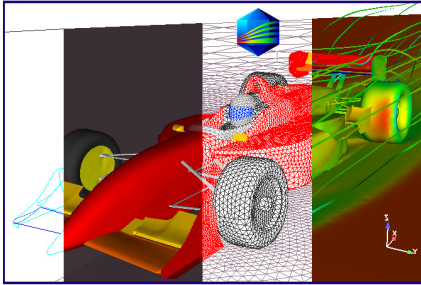


# Assessment of Pre-processing

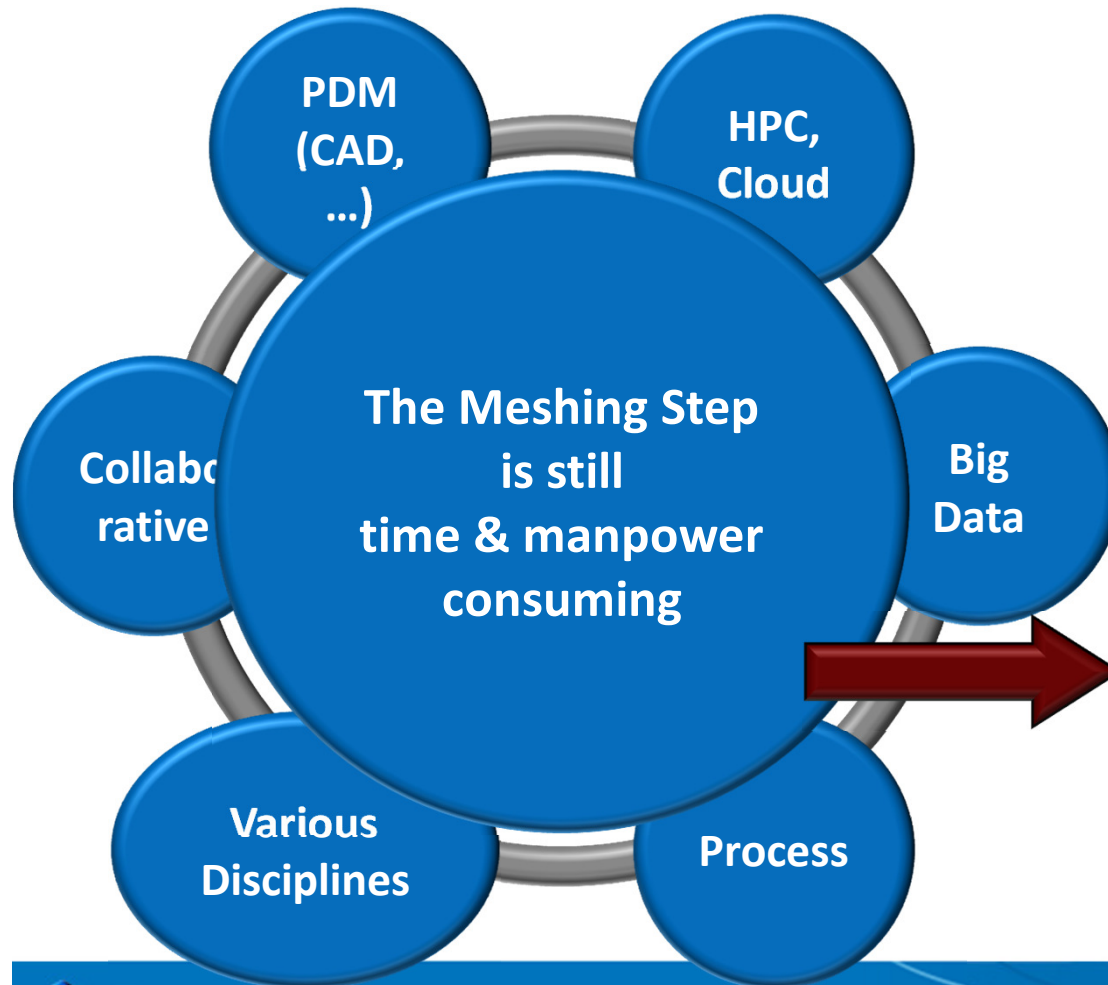


- Need for accuracy
- Helps multi-disciplinary simulation engineering
- Hexahedral mesh is still a request for many applications

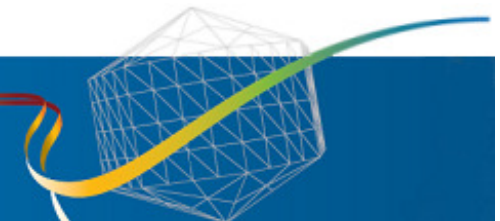


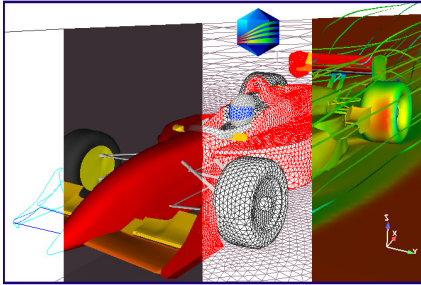


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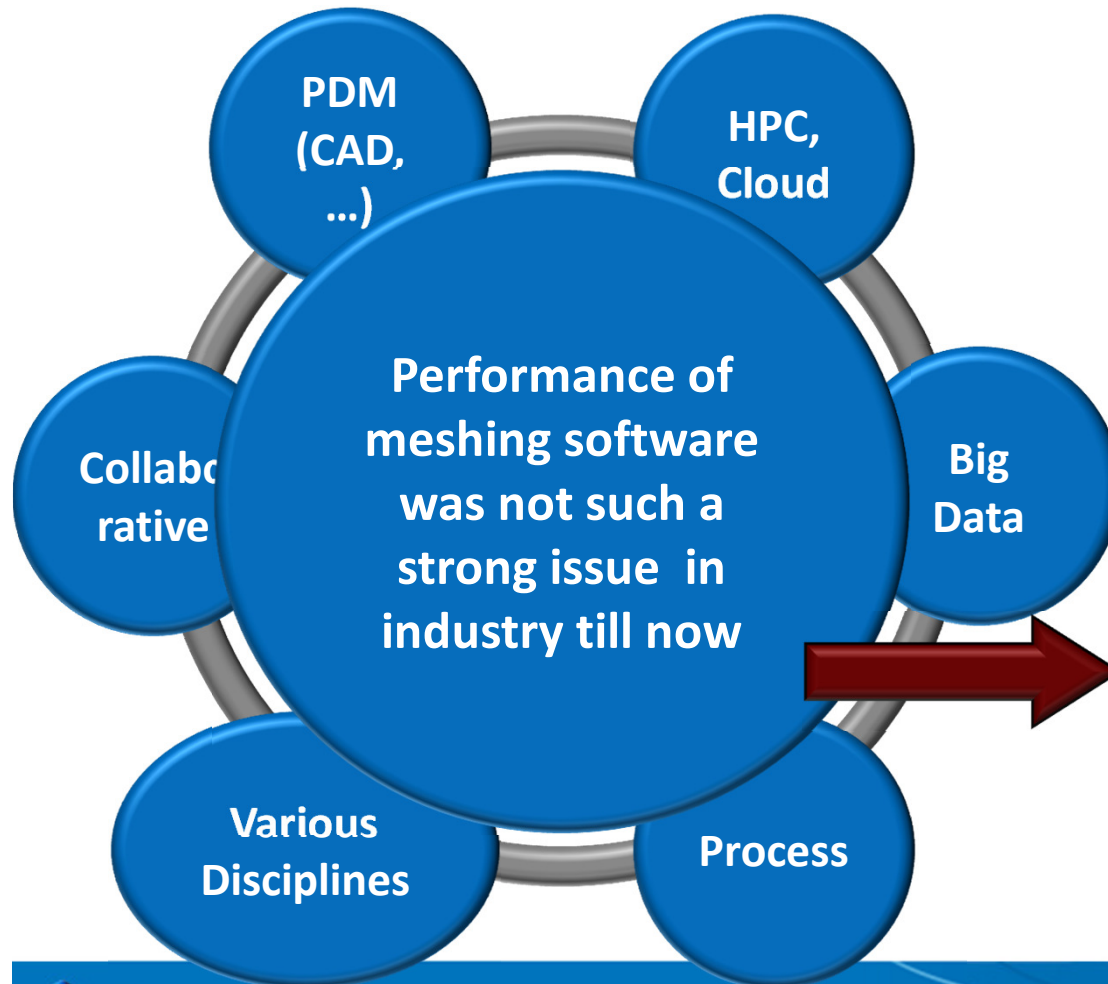


- CAD inputs are mostly not suitable for Simulation (Idealization, Multi-disciplinary)
- CAD exchanges, often through STL-like files
- Mesh can have strong impact on accuracy

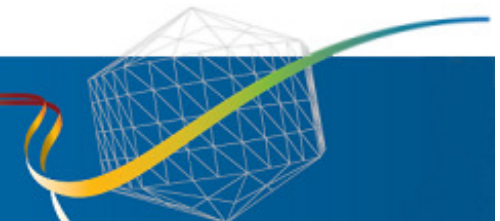


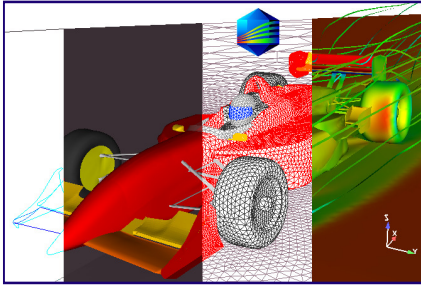


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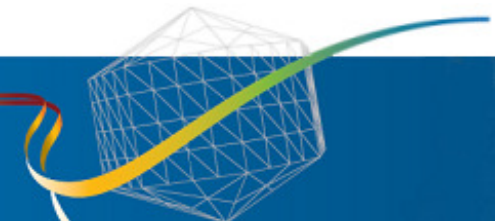
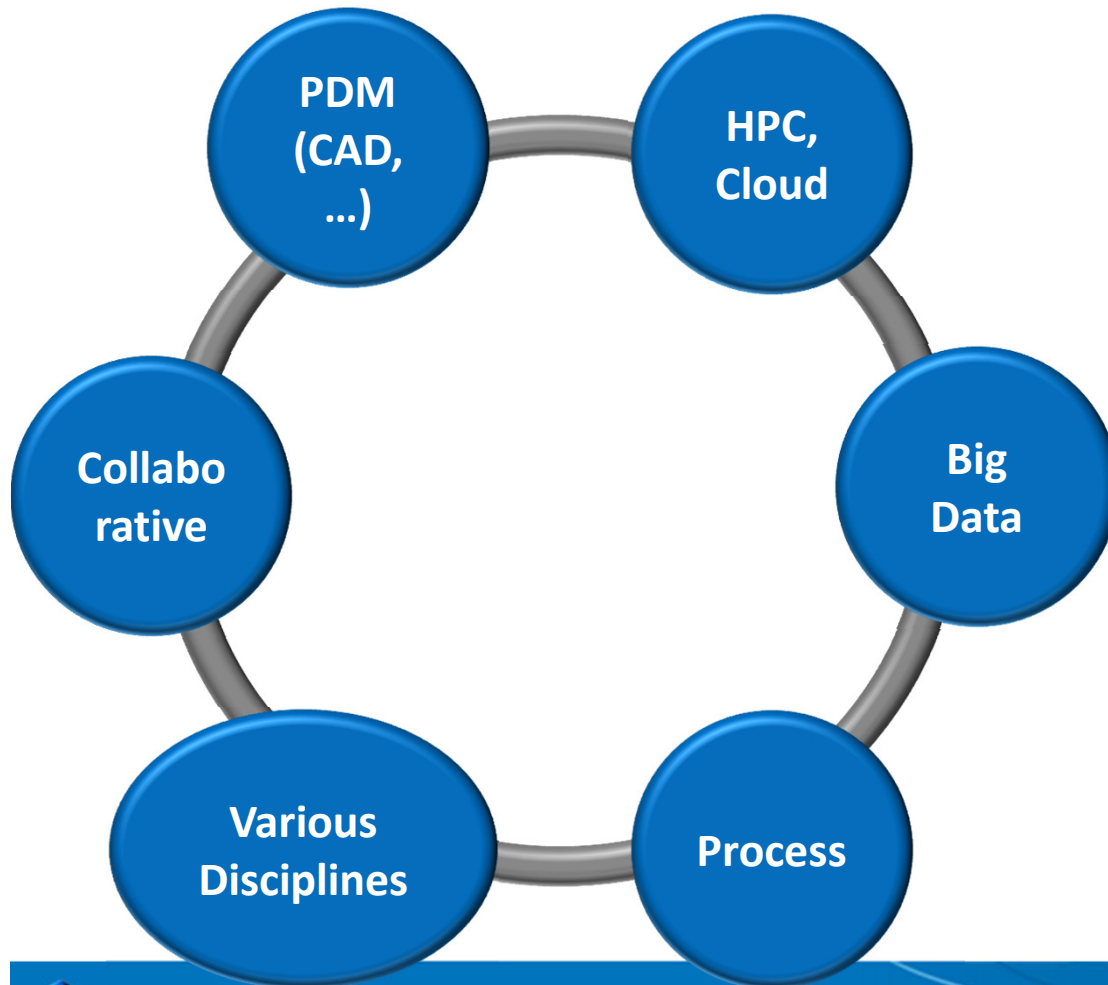


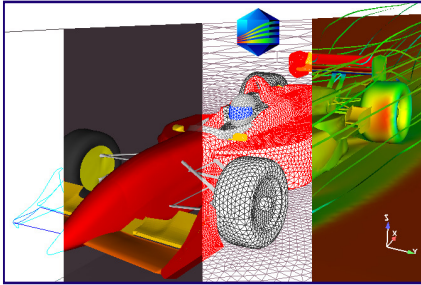
- Process relying on Manpower
- Automatic and Robust process is the priority before performance
- Only multi-threading optimization performed
- Parallel CAD Kernel very recently released





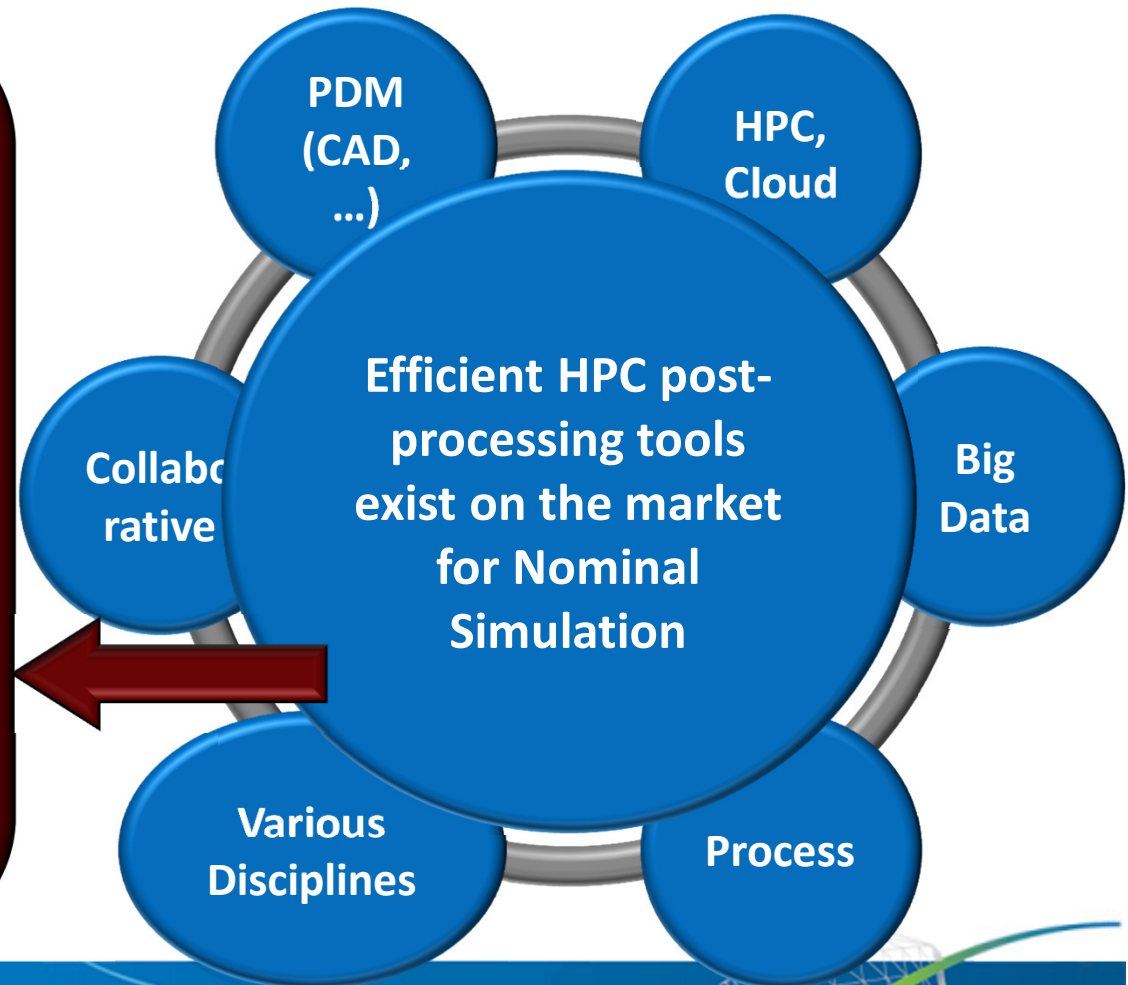
# Assessment of Post-processing



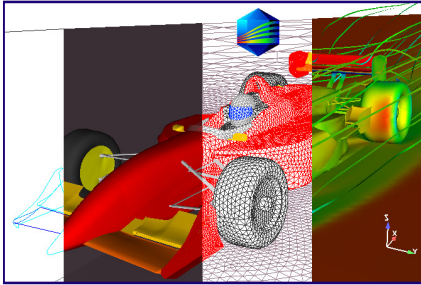


# Assessment of Post-processing

- **Post-processing & Visualization is a good support of Collaborative Project** (*Analyse, Visualize, Collaborate*)
- **Helps the integration of Simulation into the PLM**
- **Efficient for Local (per-site) IT environment**
- **Post-processing can be fully integrated and automatic**

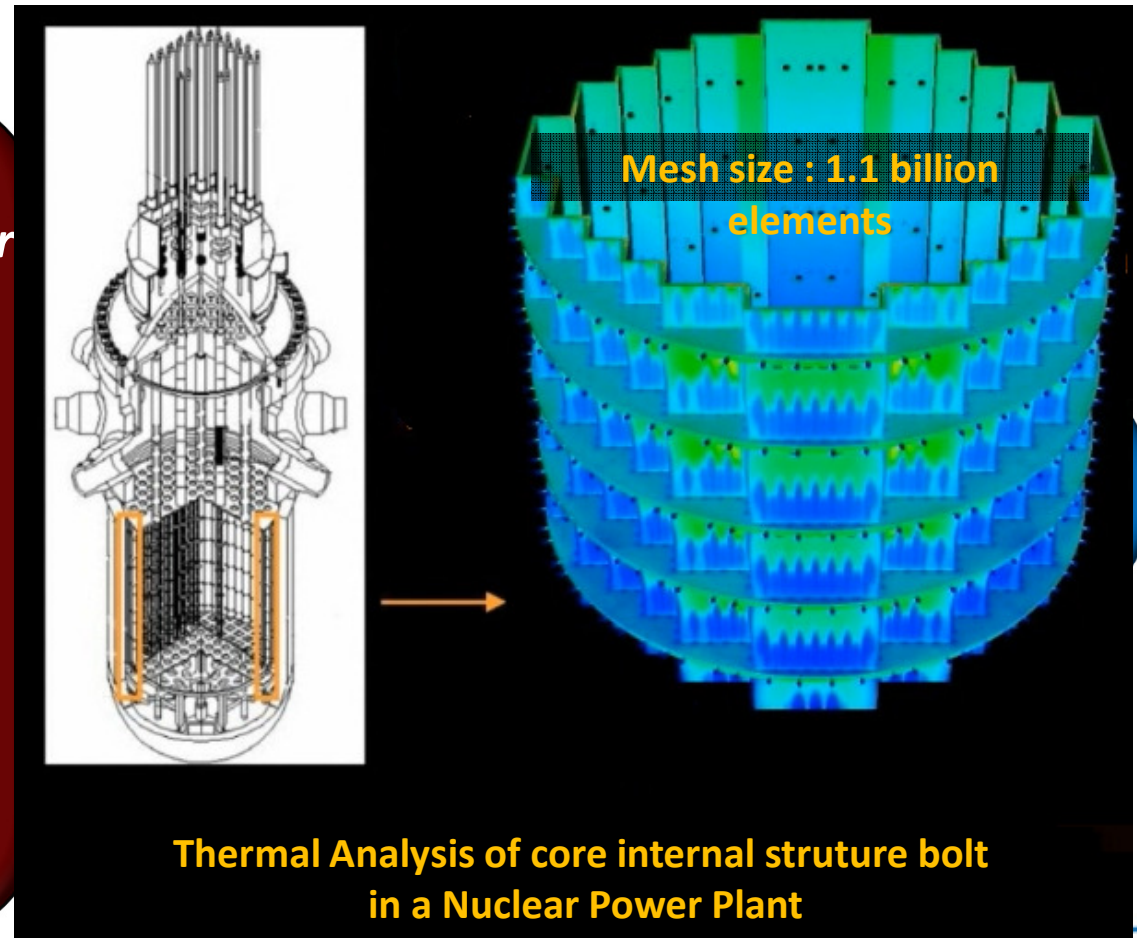


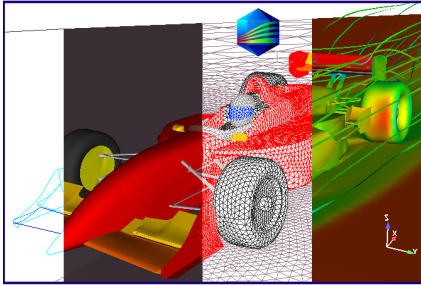




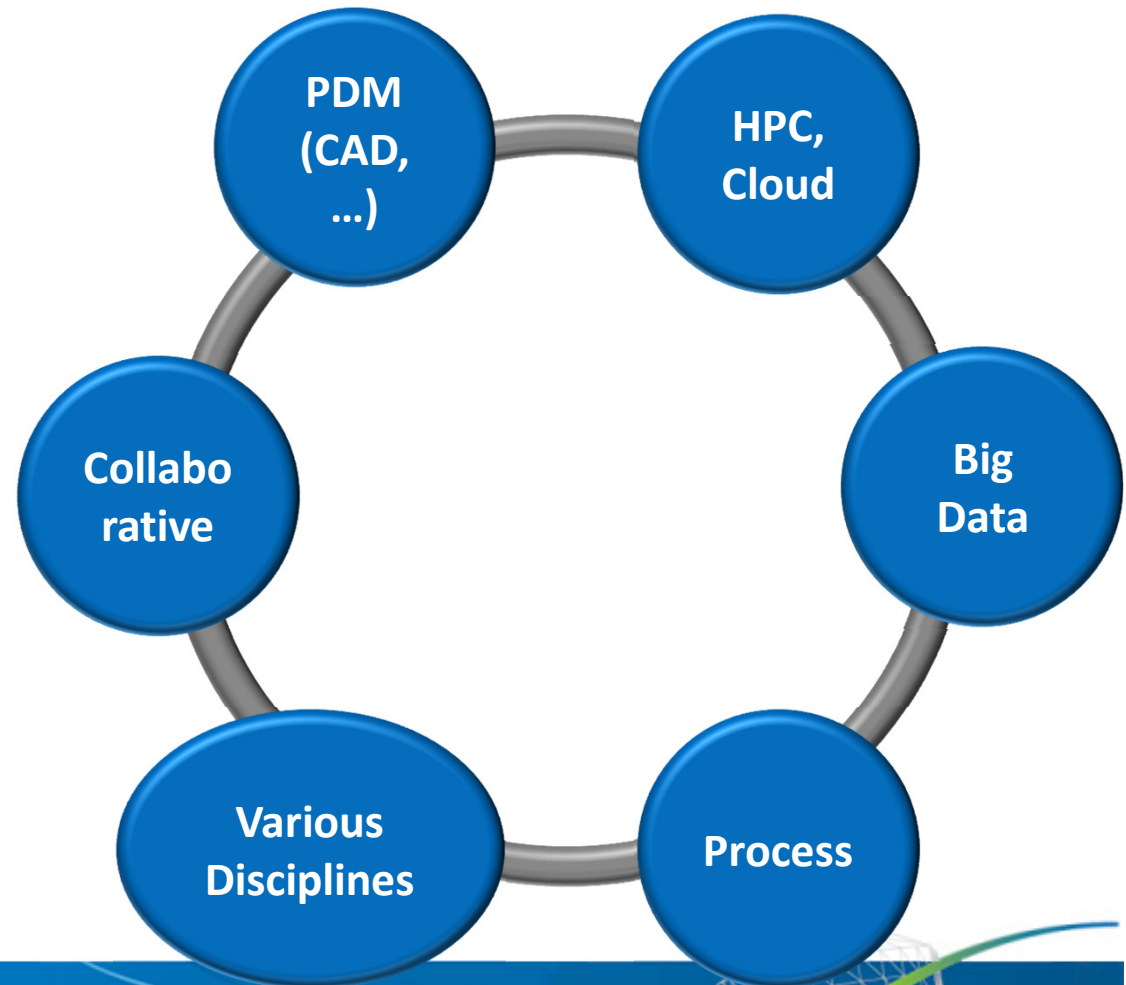
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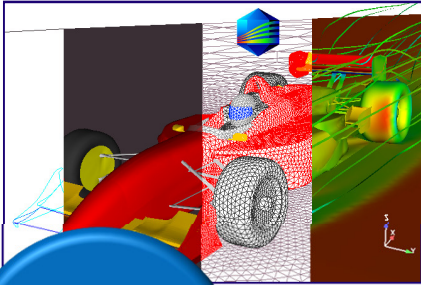
- **Parallel Post-processing and Visualization (software + Hardware) can support very large datasets**
- **Virtual Reality Environments are supported but not strongly used for Simulation**





# Assessment of Post-processing





# Challenges in Pre-Processing

PDM  
(CAD,

HPC,  
Cloud

Big  
Data

Collabo  
rative

Process

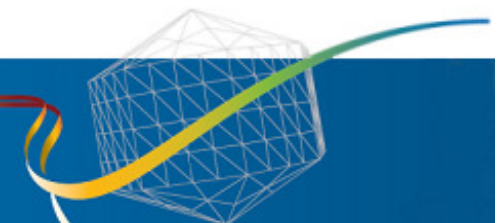
Various  
Disciplines

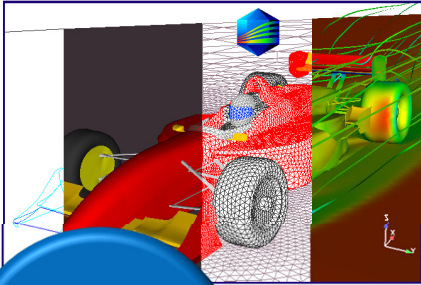
- **Observations**

- Massive Exploration of Design Space & Product Design Optimization is rising up new bottlenecks
- Results Quality & Accuracy is leading to growing complexity and size of the models (CAD, Mesh)

- **Consequences on Meshing solutions**

1. Automatic and robust CAD-to-Mesh process is required
2. Real HPC Meshing
3. Adaptative Meshing





# Challenges in Post-Processing

PDM  
(CAD,

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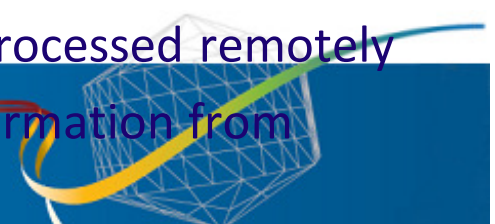
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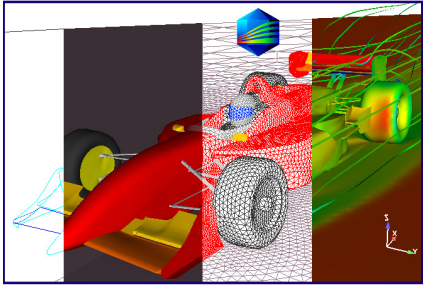
- Massive Exploration of Design Space & Product Design Optimization is creating a deluge of Datas
- Engineers have to analyse multiple simulation results
- Results Quality & Accuracy is leading to growing size of the results and longer time to get it
- Wider audience, larger Project teams spread out worldwide involved in the decision making process

- **Consequences on Post-Processing solutions**

1. Co-Processing to have a realtime access to results while executing
2. Efficient parallel distributed software while ease-of-use of HPC ressources including Cloud Computing ressources
3. Cannot move the datasets: have to be post-processed remotely

4. Data-analytics: extraction of the relevant information from decision metrics





# Conclusion

