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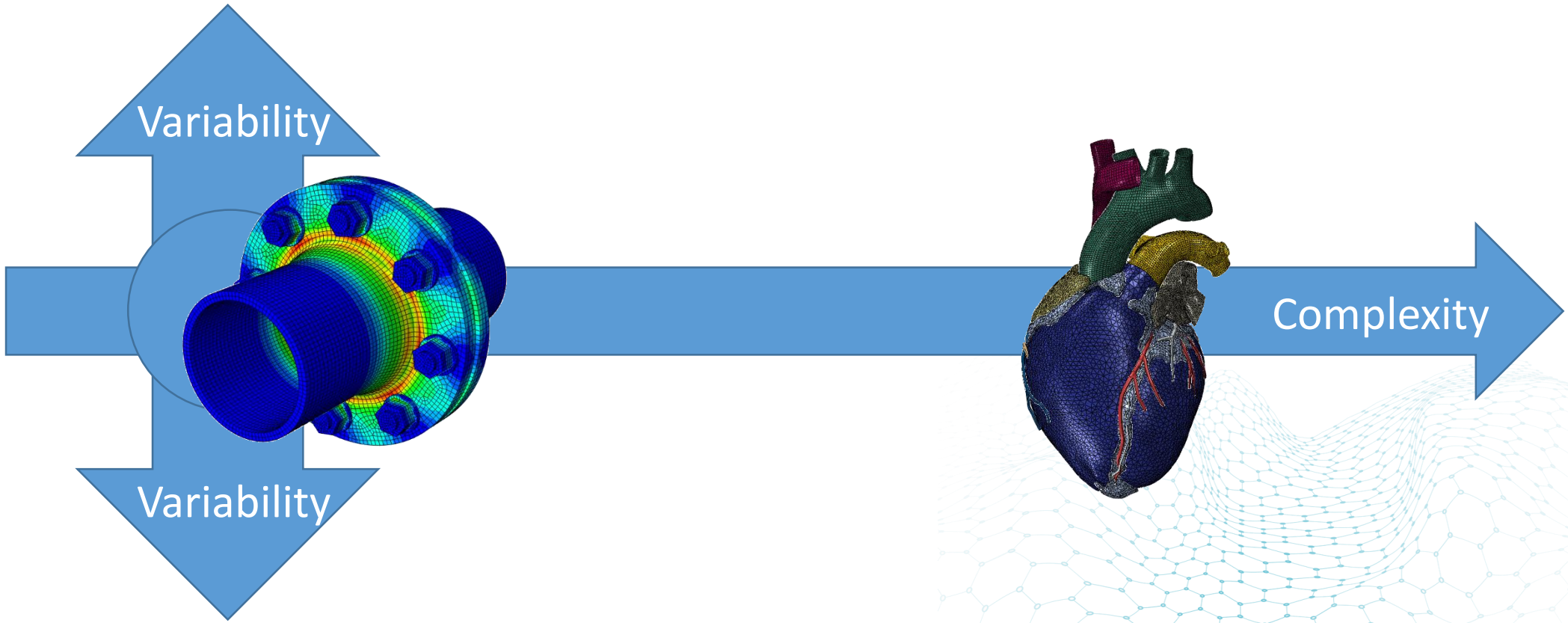
Better, faster, cheaper

EXPERIENCE MATTERS

Better, faster, cheaper

- Exploiting the art of the possible in automating simulation workflows



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More models

Truly scalable
Pre-validated

Automation

Process capture

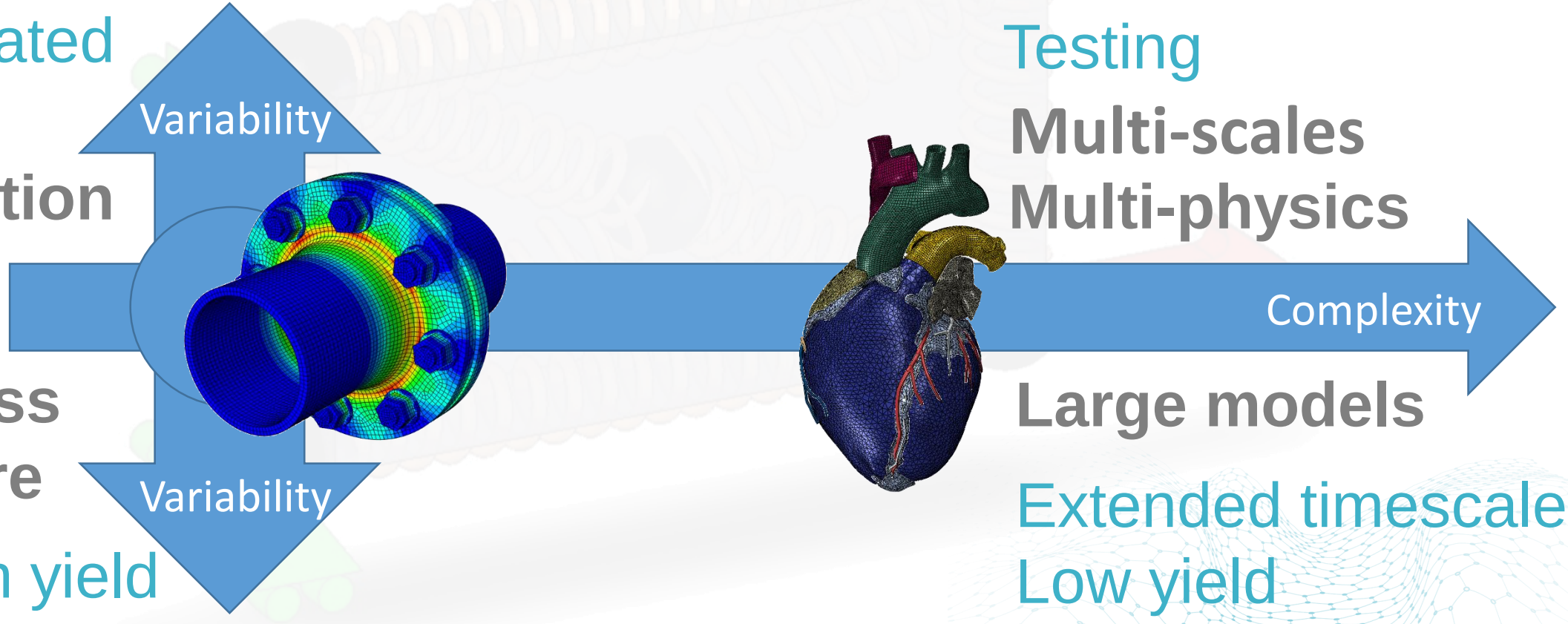
Fast, high yield
Deskilled process

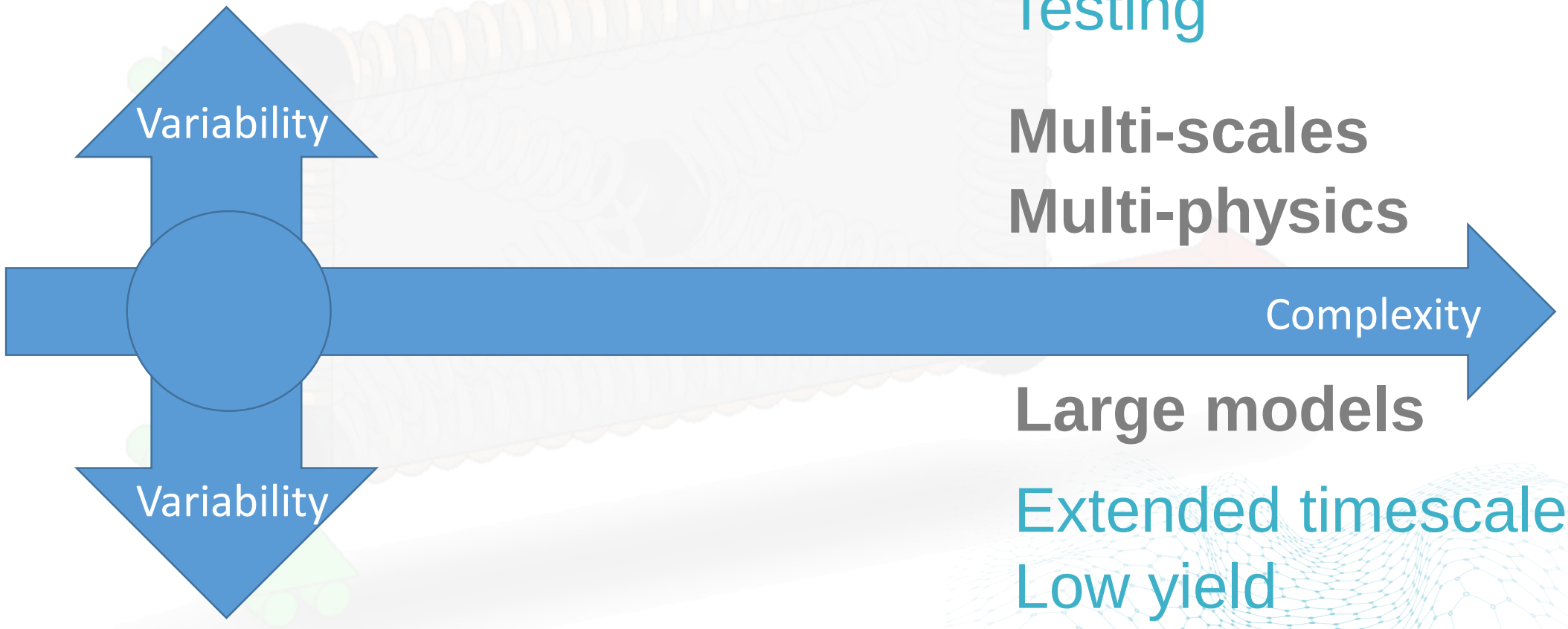
Better models

HPC
Testing
Multi-scales
Multi-physics

Large models

Extended timescales
Low yield
Expert staff





HPC
Testing

Multi-scales
Multi-physics

Large models

Extended timescales
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Expert staff

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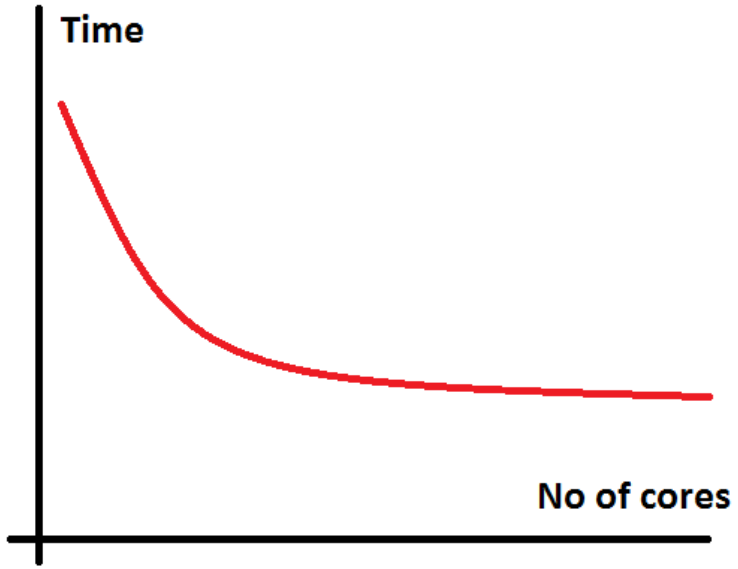
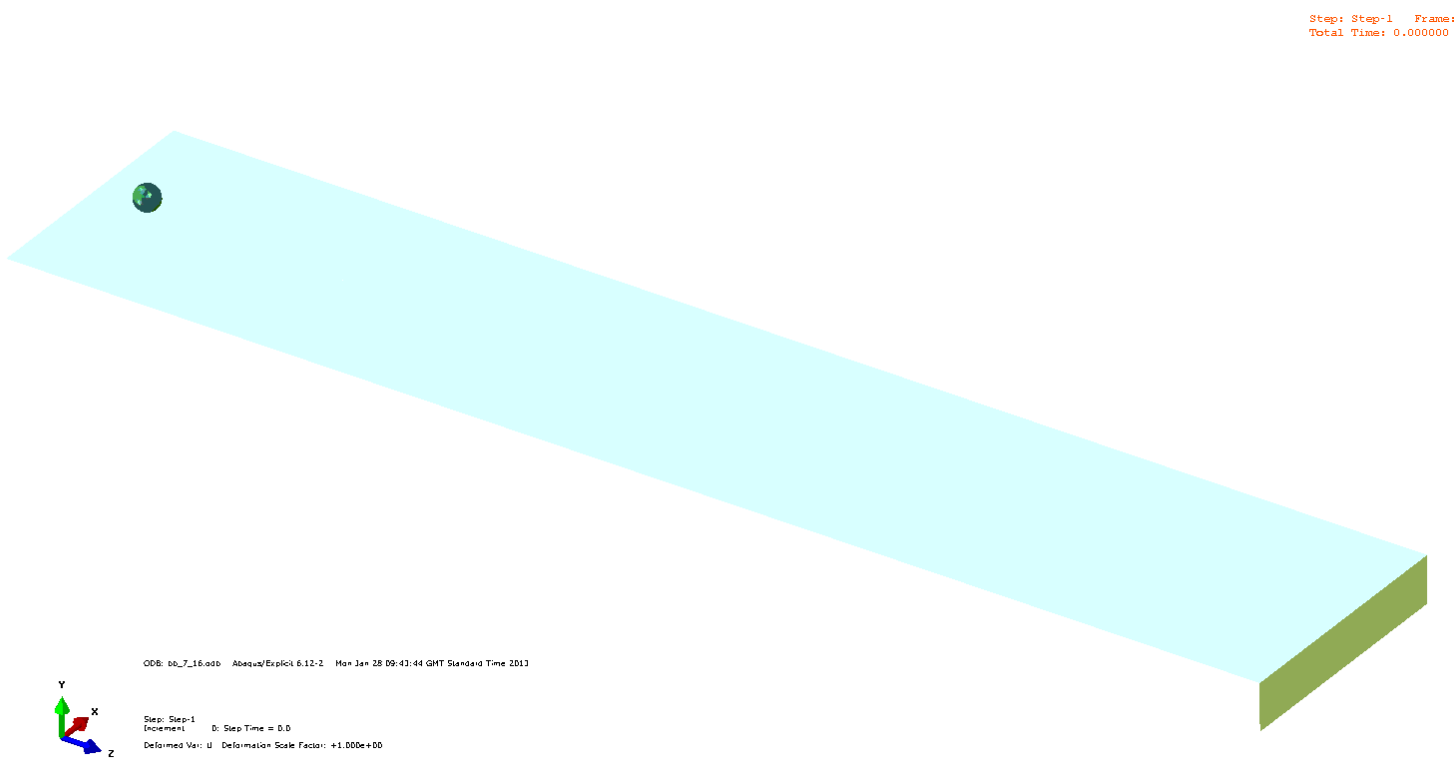
Extended solve times…

- This model took a week to run on 32 cores





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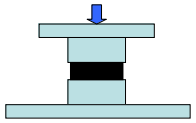
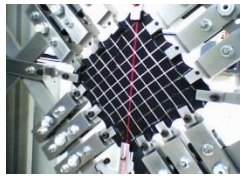
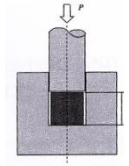
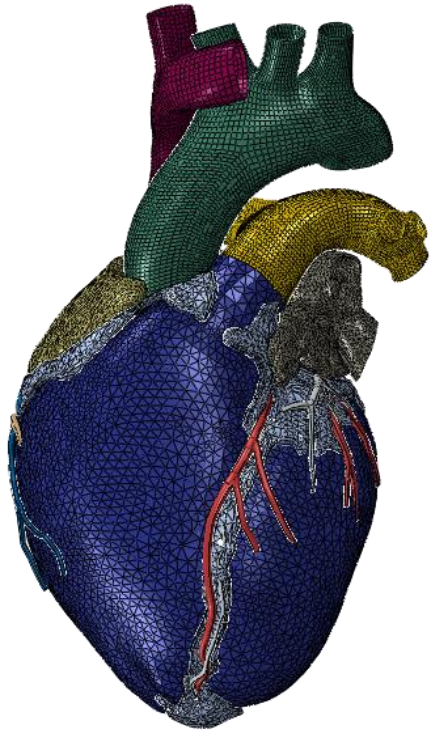
Increased testing overhead



Material data

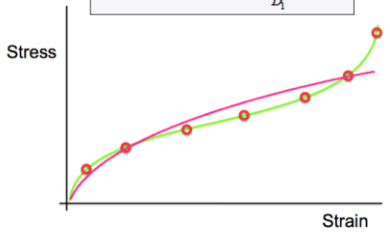


Model validation

Mooney-Rivlin

- Simple model with two or three constants

$$U = C_{10}(\bar{I}_1 - 3) + C_{01}(\bar{I}_2 - 3) + \frac{1}{D_1}(J^{el} - 1)^2.$$



Strain Invariants

$$I_1 = \lambda_1^2 + \lambda_2^2 + \lambda_3^2.$$
$$I_2 = \lambda_1^2\lambda_2^2 + \lambda_2^2\lambda_3^2 + \lambda_3^2\lambda_1^2.$$
$$J = \lambda_1\lambda_2\lambda_3.$$

Including the second strain invariant allows shape change to be considered

Still fails to capture the upturn

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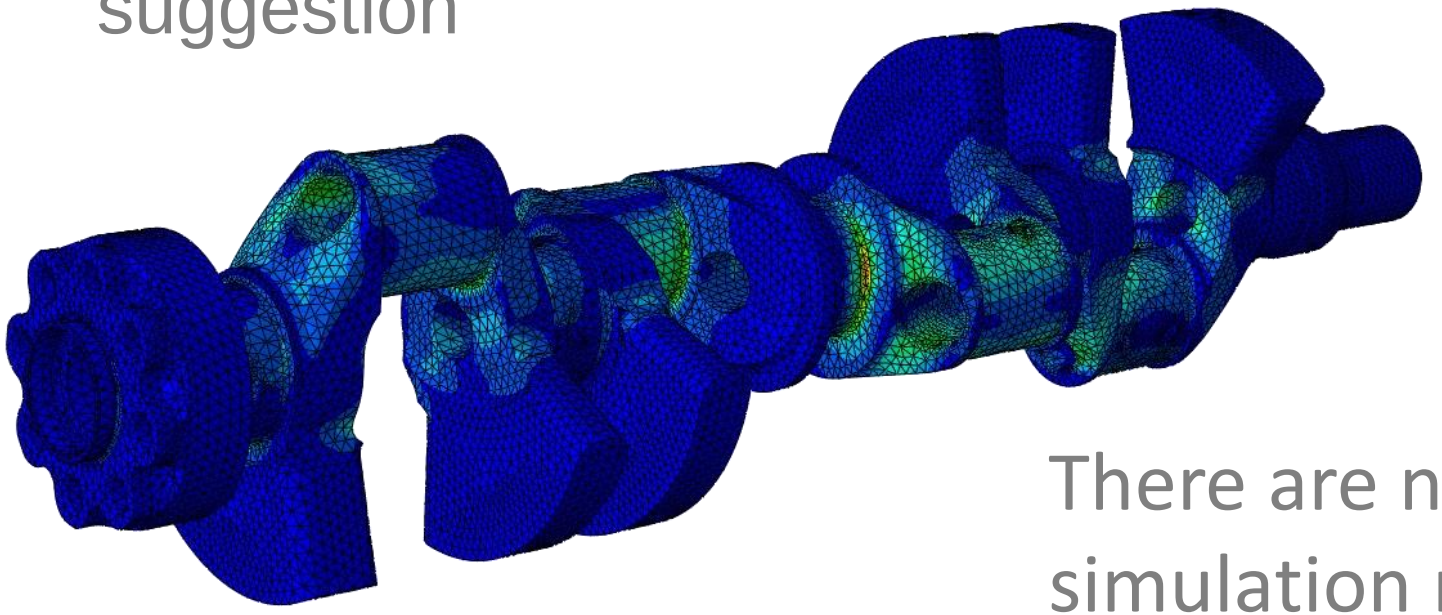
So what are we after with simulation?

- The most cost effective insight or design improvement suggestion



There are no prizes for big or impressive simulation models

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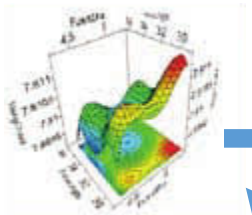
The rewards on the other axis may be easier to achieve

Truly scalable
Pre-validated

Data exploration



Variability

Automation

Complexity

Process capture

Variability

Fast, high yield
Deskilled process

Expert staff

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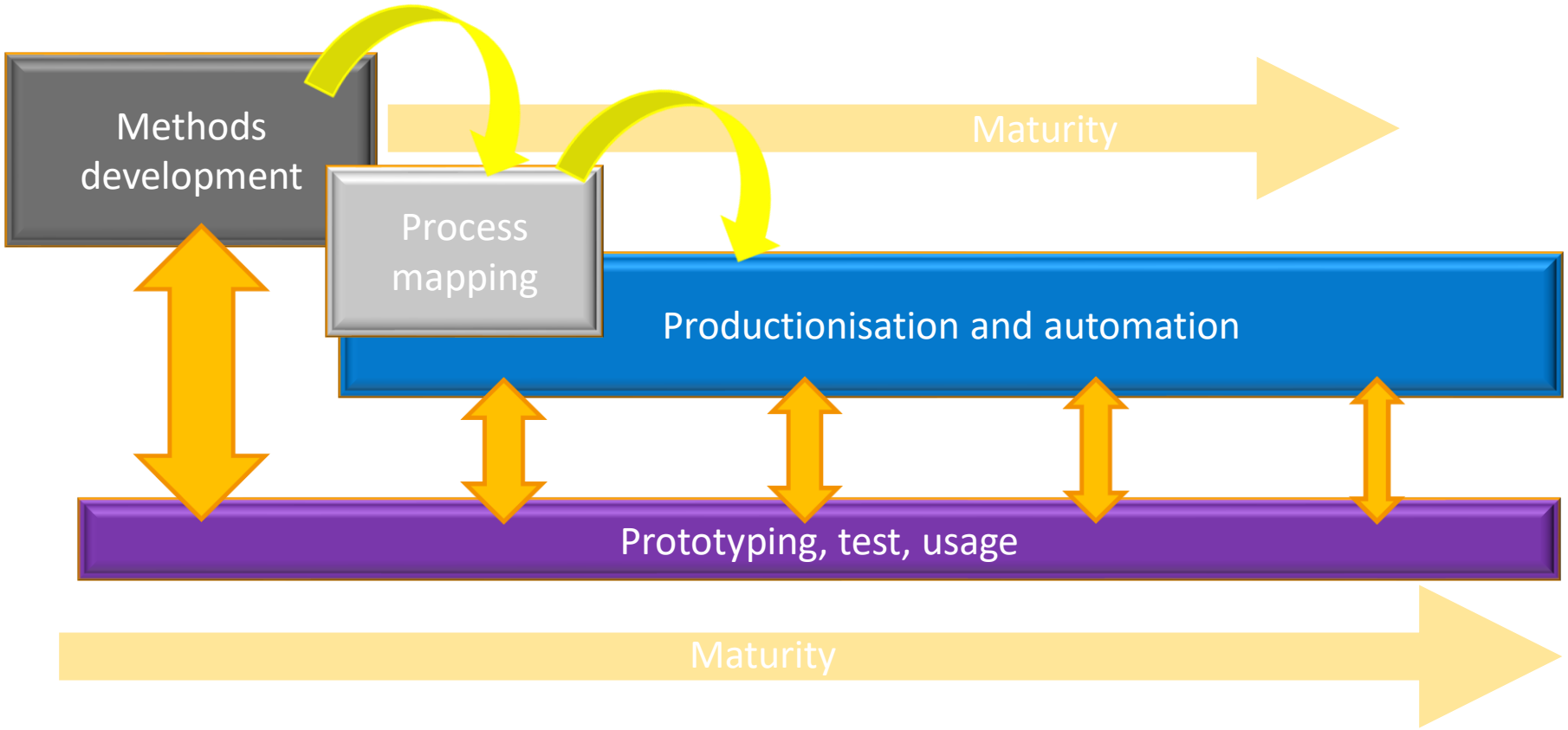
The rewards on the other axis may be easier to achieve

- But require different approaches to model building, methods development and integration across the engineering process



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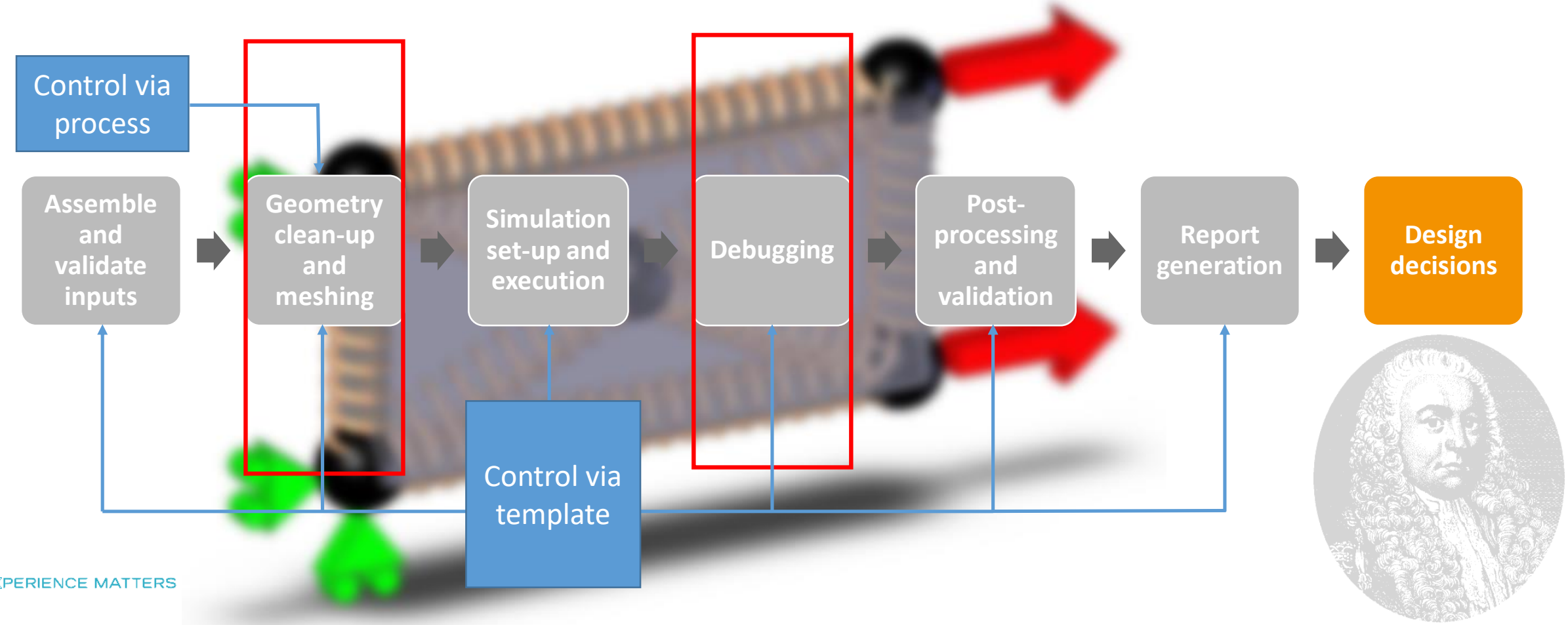

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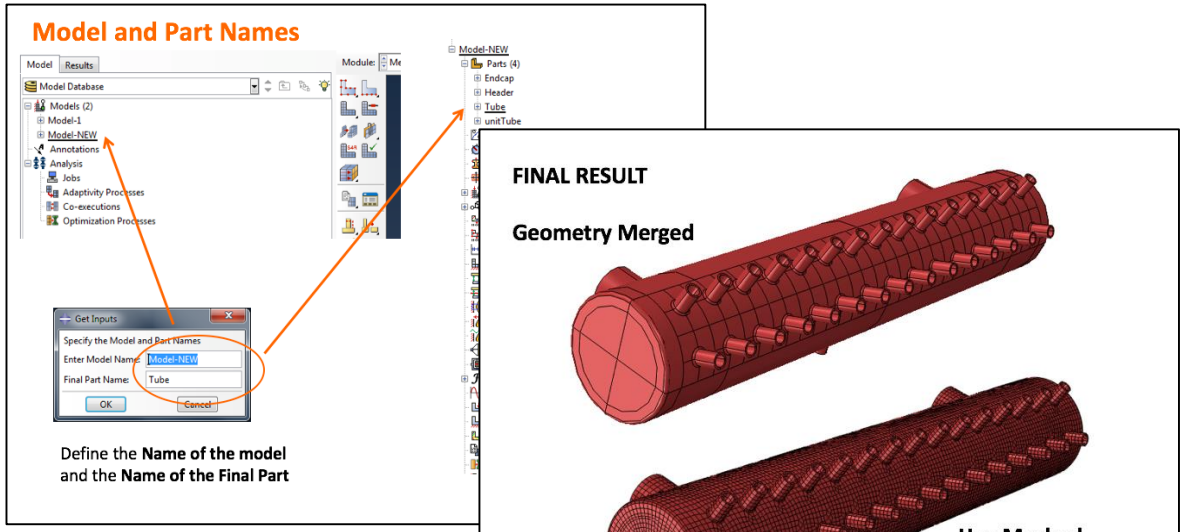
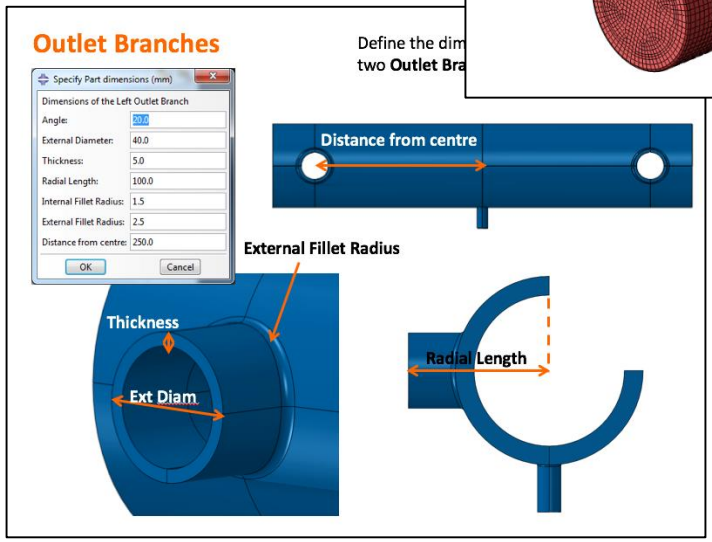
Breaking out of the cycle - Geometry

- Don’t be a slave to geometry
- Idealisation is the key to efficiency and success – you are after a useful answer not a megaplot
- Geometry fed into the system needs to be managed and controlled
- Don’t be afraid to separate the CAD model and the simulation “geometry”





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Breaking out of the cycle - Geometry

- Don’t be a slave to geometry
- Certainly don’t be a slave to bad geometry
- Automatic model clean up and simplification

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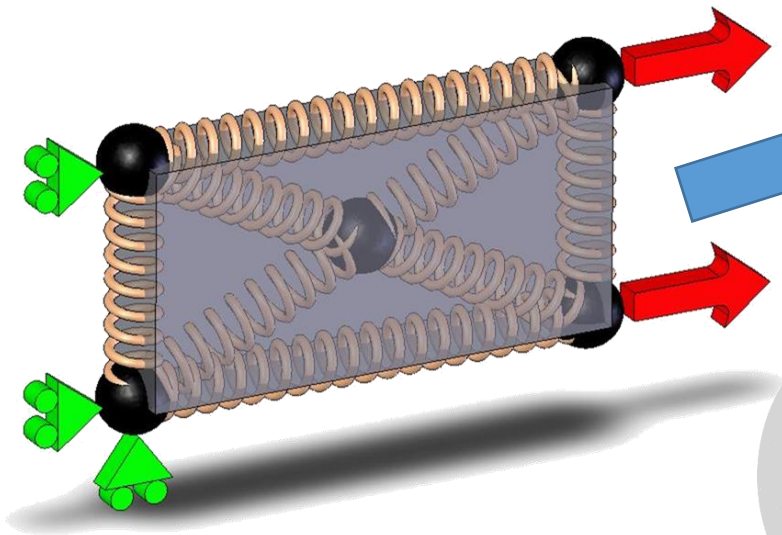
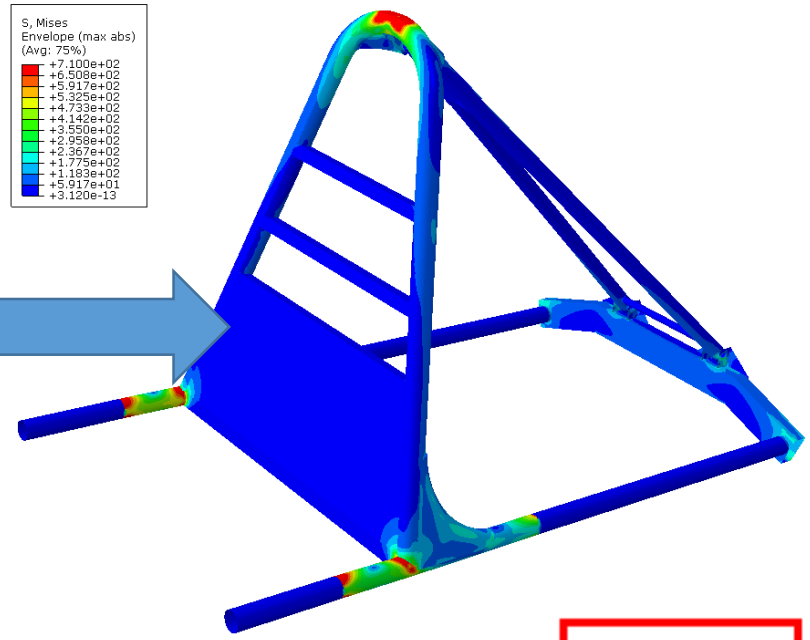
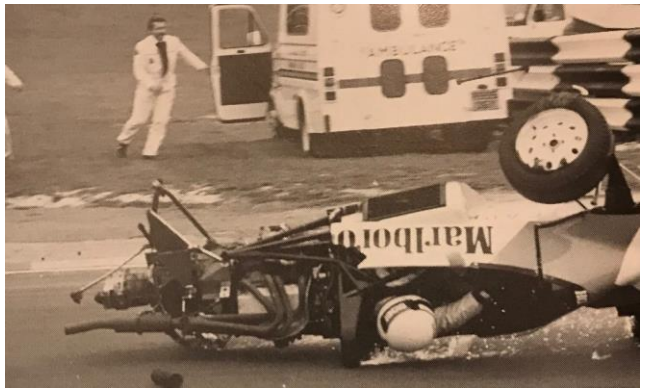
Breaking out of the cycle - Meshing

- If you don't know the mesh is important don't do FEA







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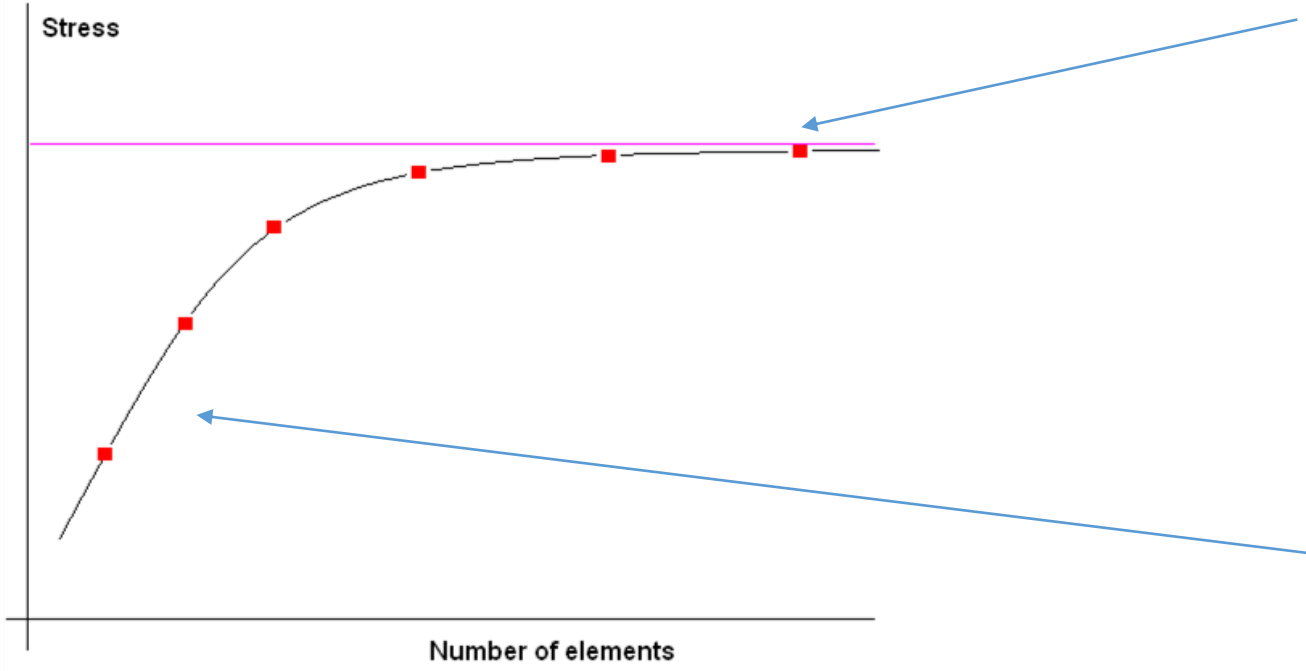
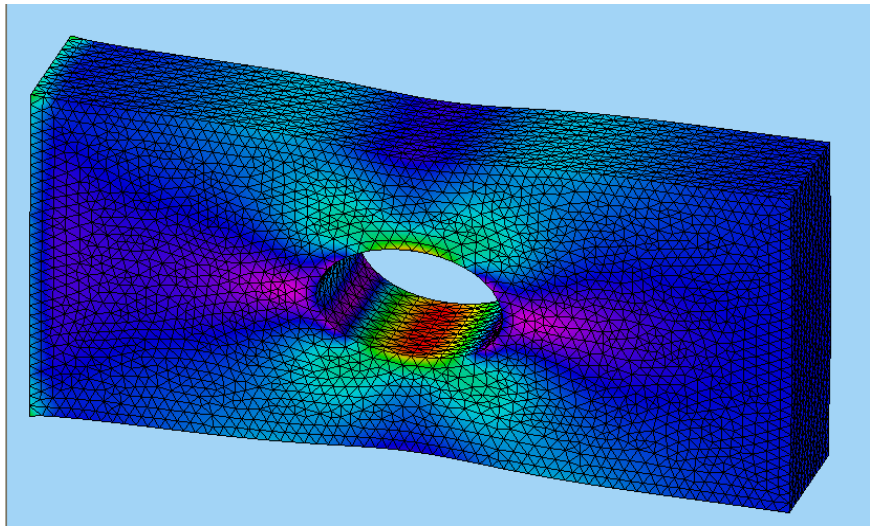
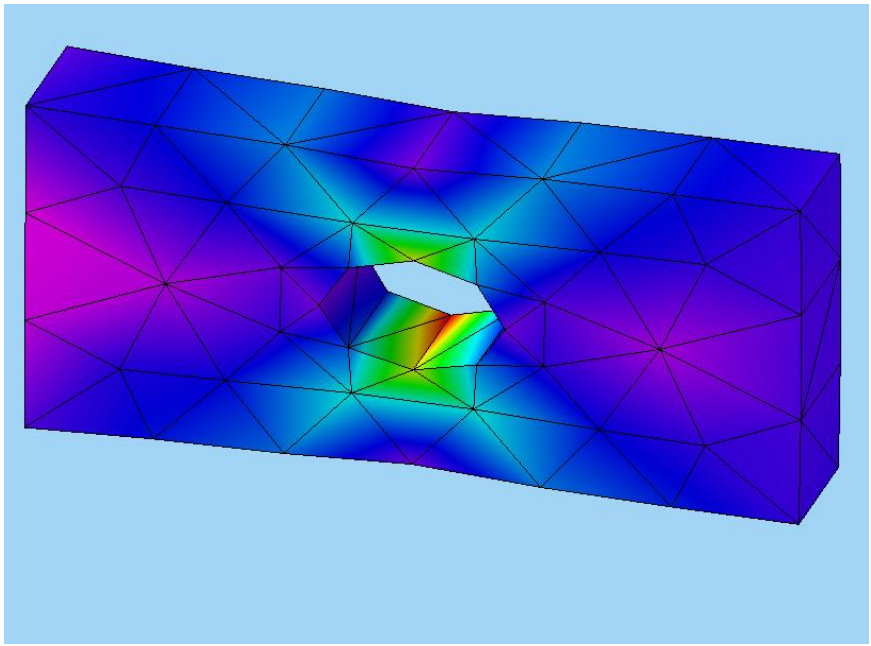
Breaking out of the cycle - Meshing

- The science bit..

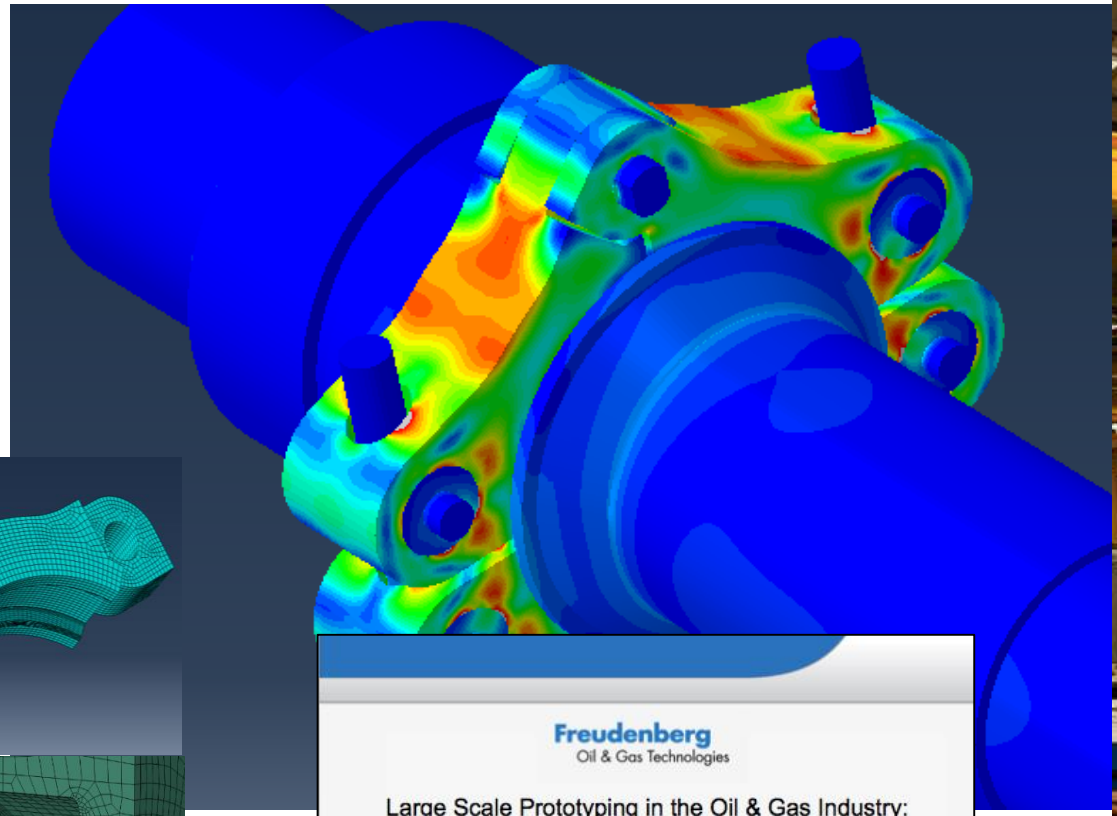


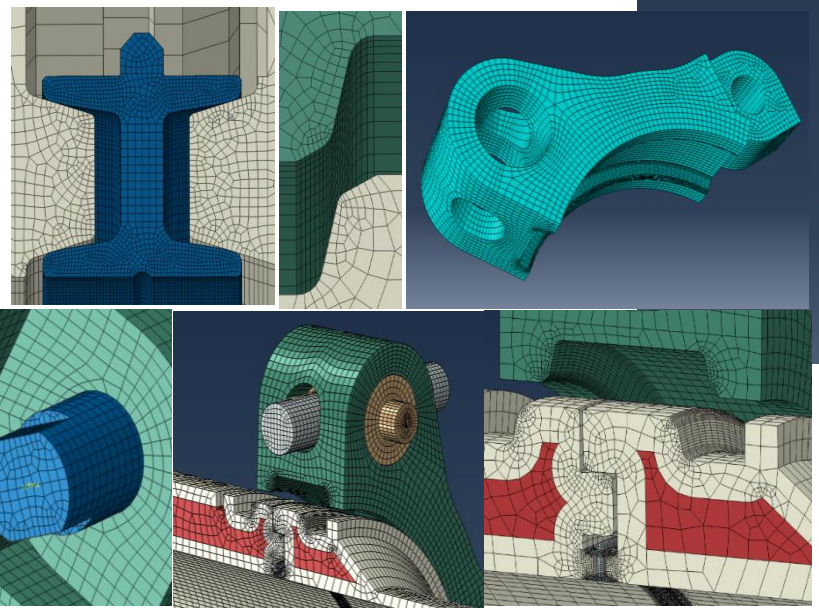


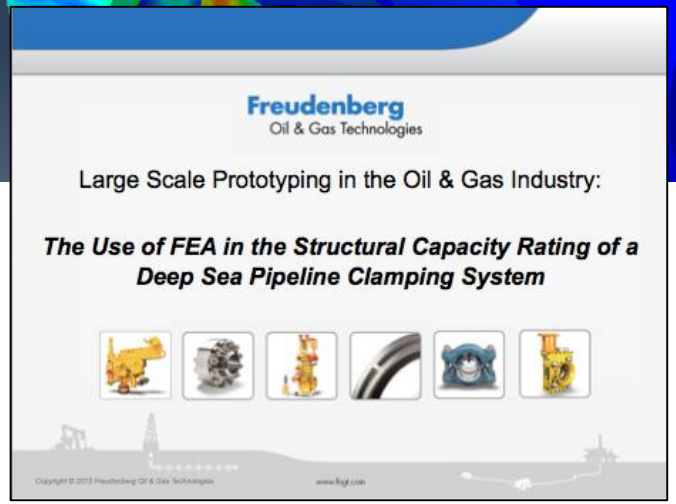


Getting the mesh right – an aside..

Freudenberg
Oil & Gas Technologies







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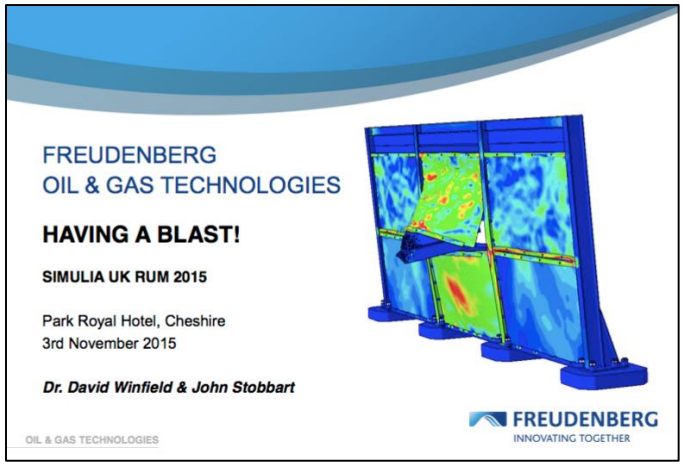

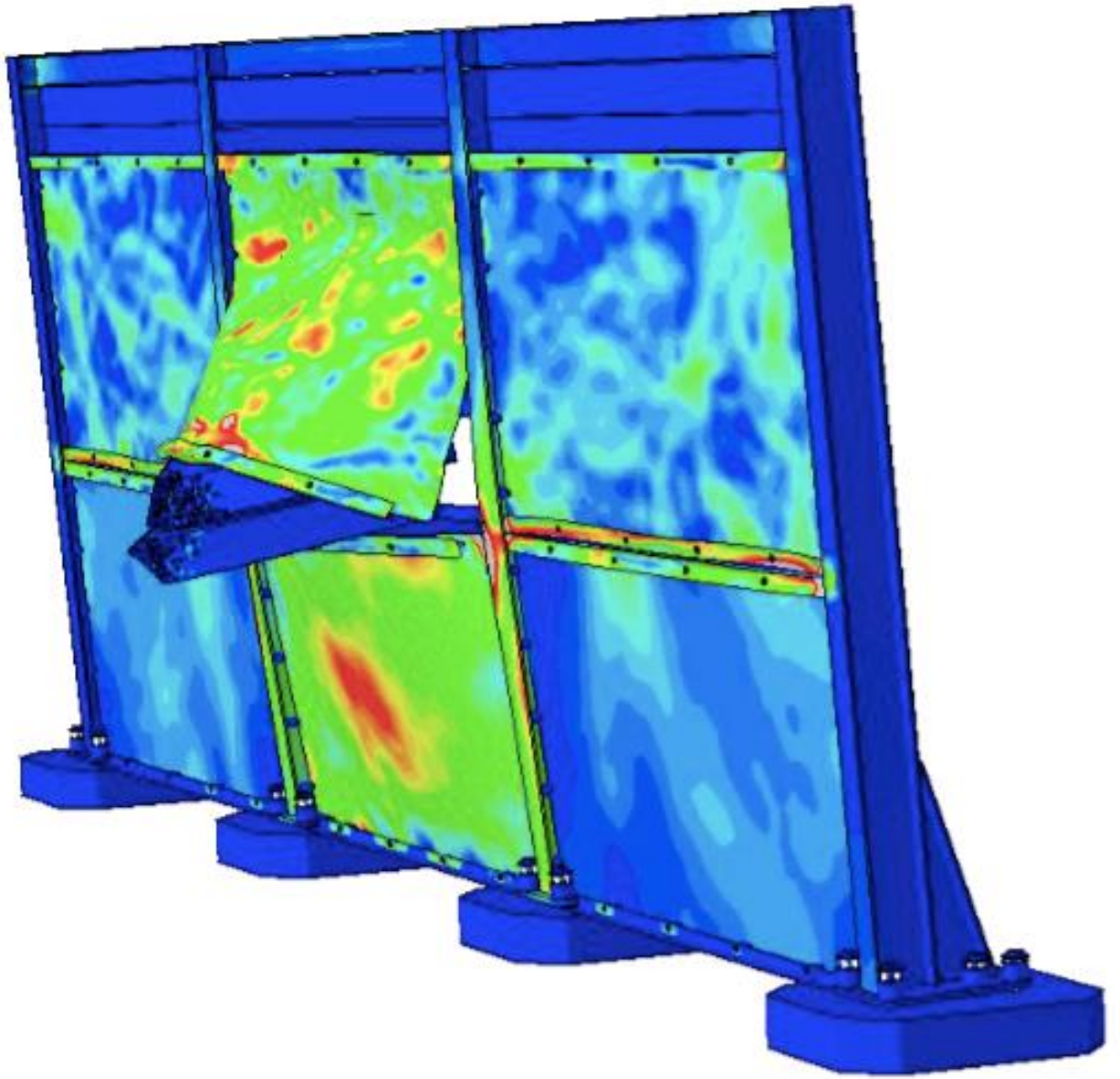

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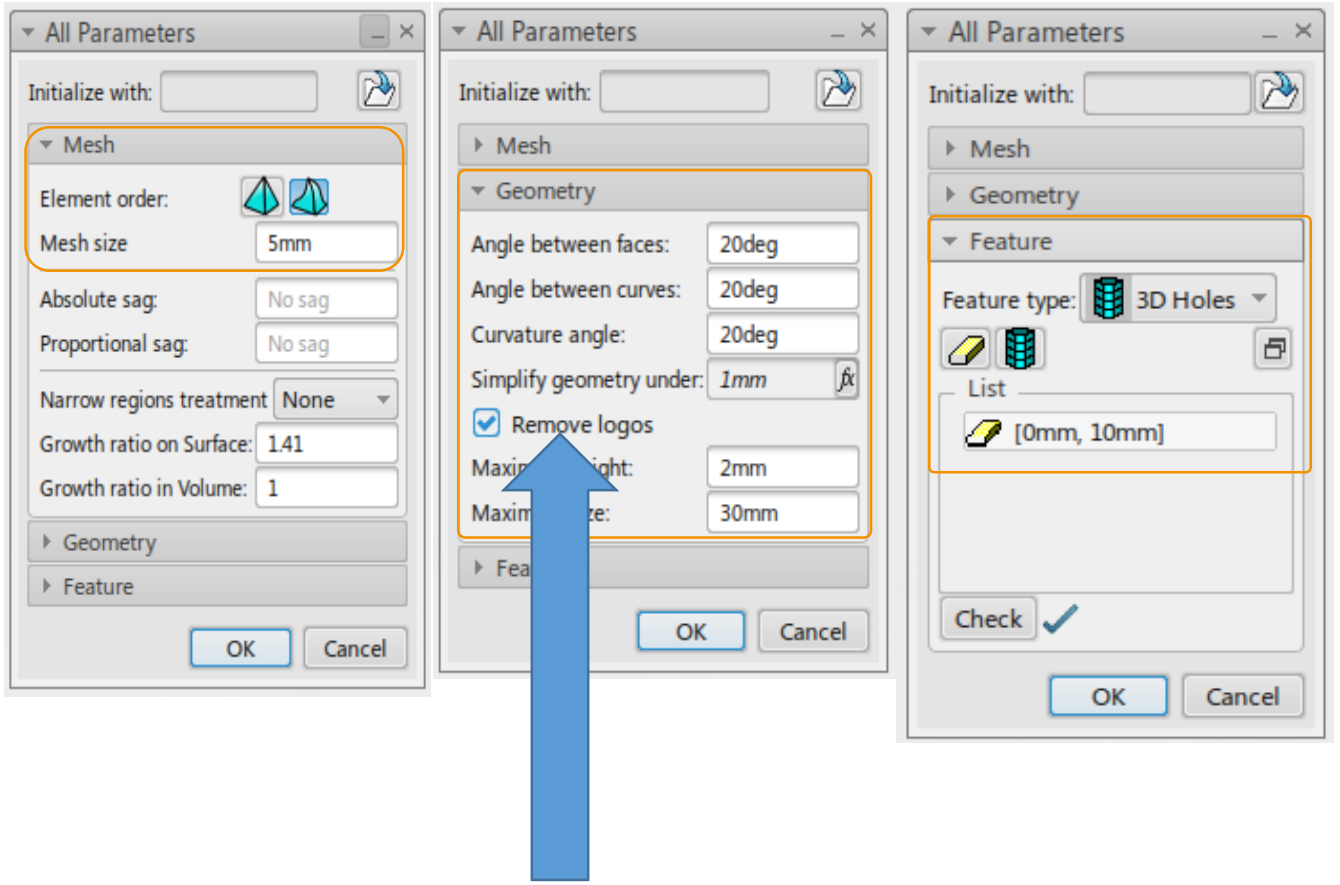
Breaking out of the cycle - Meshing

- Rules based meshing

  Automatically recognises geometric features and applies appropriate pre-defined meshes to them



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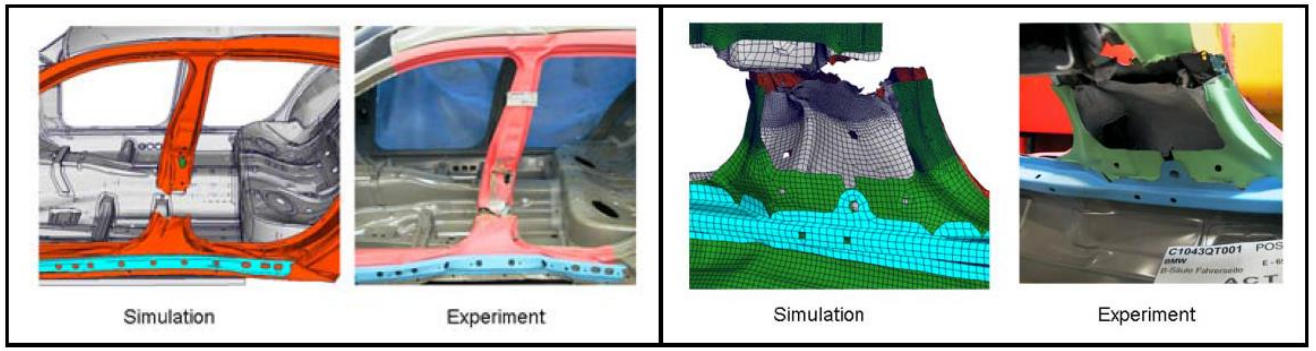
Breaking out of the cycle – Trouble shooting/debugging

- Troublesome solutions kill automation schemes
- Solutions must be well developed and scoped to succeed
- Limit scope to increase delivery/yield/performance
- It really helps to have a decent solver
- Repeated fails will lose the “hearts and minds” battle with users



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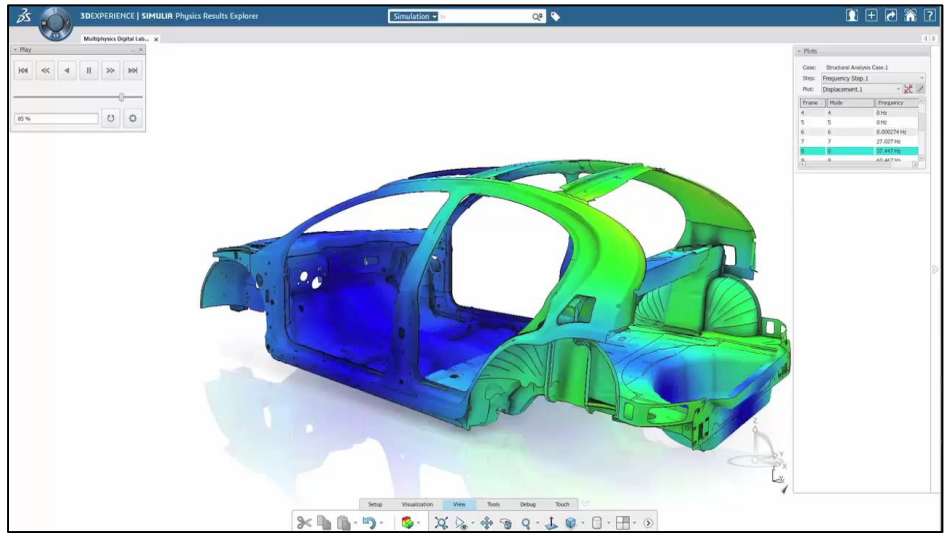
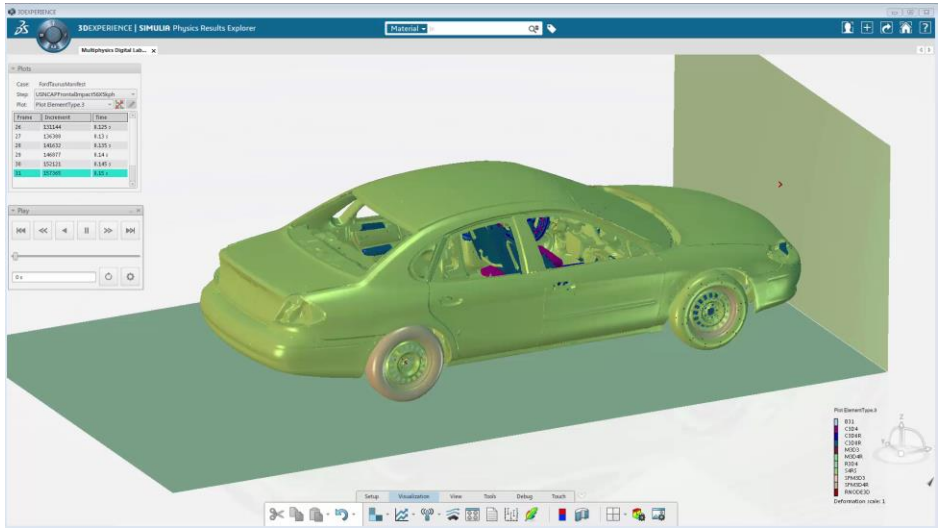
Post processing, report generation and dissemination

- Automated systems need automated results presentation
- No escaping the expert gaze
- Distribution and dissemination
- Are yes/no pass/fail indicators any value?
- Data exploration





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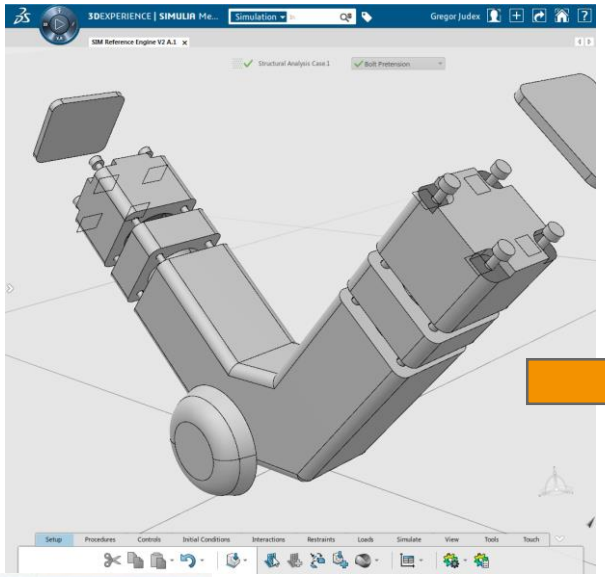
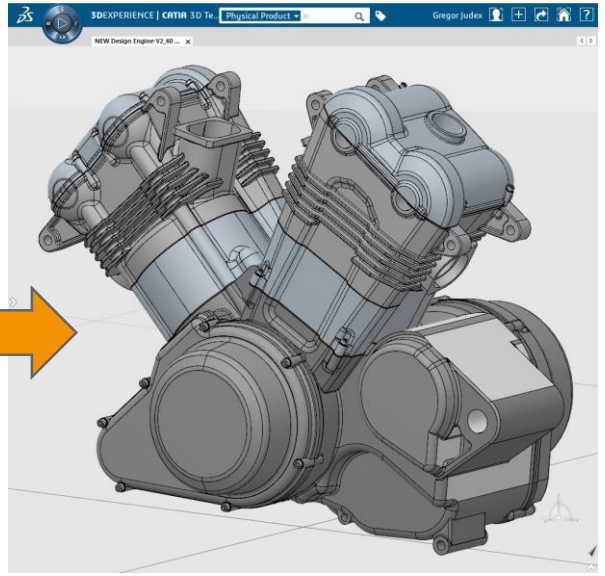
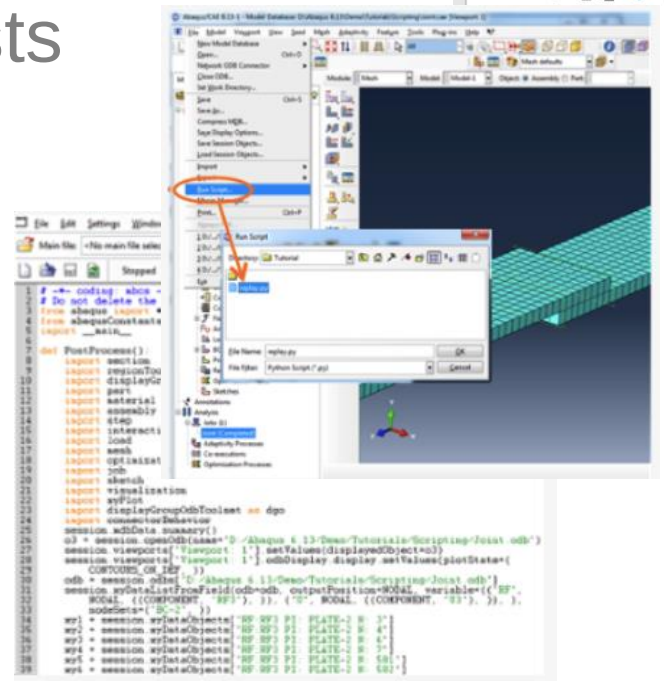
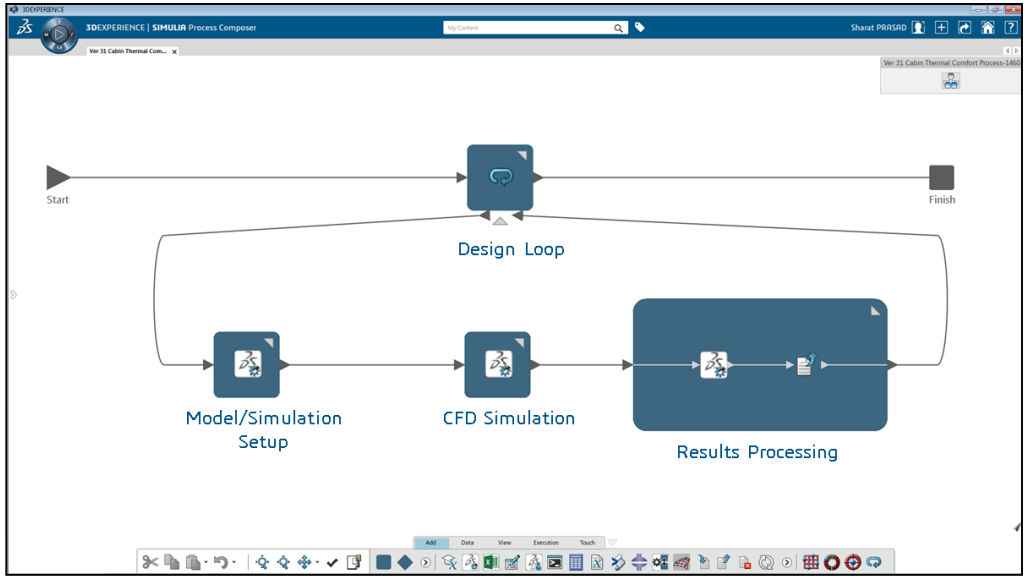
Enabling Technologies

- Templating
- Scripting
- Process mapping
- New skill sets for experienced analysts









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But the big enabler is people..

- Skilled staff are required to create the automation schemes
  - They need specific skills
- Enabled staff are required to operate and use the automated systems
  - They need a general awareness and overall confidence in the technology and its application

- It’s a battle for hearts and minds.

6 golden rules for building simulation models

- **Keep your eyes on the prize:** Every simulation project needs to have a target, What information is the model going to provide and with what accuracy? Write it down. Stick it up by your monitor.
- **Start simple:** Use geometry that can be simplified, modified, and developed. And its not just geometry that should start simple..
- **Don’t be a show off.** If it isn’t critical to getting the result you are looking for don’t include it.
- **Be aware of what your model can tell you.** And what it can’t.. Don’t forget this is engineering.
- **If a trick made a model work in a previous study, don’t be a slave to it.**
- **Meshes still matter**

And these rules are even more important in automation projects