the Hidden Issue
Are we making progress?

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Are we making progess?

- **We are now at an inflection point in potential growth due to recognition of the use of simulation producing real business benefits**

Are we making progess?

- **Real business benefits from Simulation**
  - **Virtual Prototyping** = reduced costs for physical prototypes
  - **Improved Product Quality** = reduced warranty risk/cost, improved competitiveness
  - **Improved Product Performance** = increased innovation, improved competitiveness
  - **Support of Early Design Decisions** = reduced committed cost, quicker time to market, improved competitiveness
  - **Others** = better, faster, cheaper

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Are we making progess?

- **This business benefit recognition brings with it the potential for even more rapid growth with its own set of challenges**
  - Simulation is not limited to a simple set of specific physics behavior
  - Use of physics simulation as an integral part of the design process
- **The *objective is* clearly *to use more complex simulations early and often in the design process* in order to achieve real business benefits**


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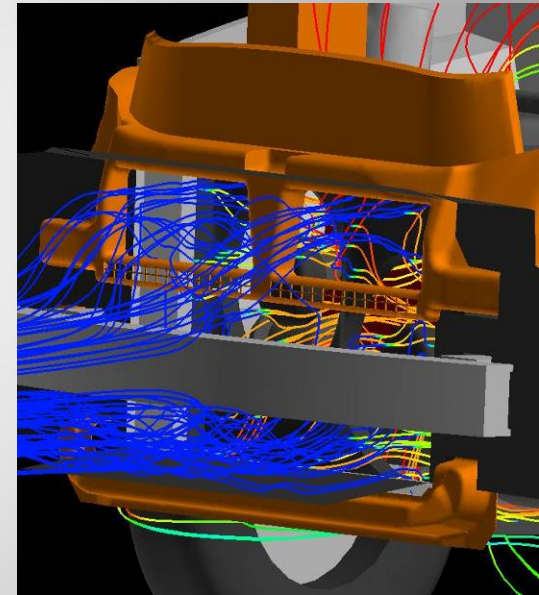
the Hidden Issue

- **Established simulation users** (i.e. automotive, aerospace, …) **have an issue with vanishing expertise**
  - Voluntary and forced retirement
  - Resources not available to replace lost talent
- **Simulation is being used more and more by companies and industries that have little to no simulation expertise**
  - Some new technologies can only be effective with simulation even though experience is not strong (i.e. alternate energy sources, biomedical …)

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the Hidden Issue

- **the level of expertise does not exist to support the potential growth !**
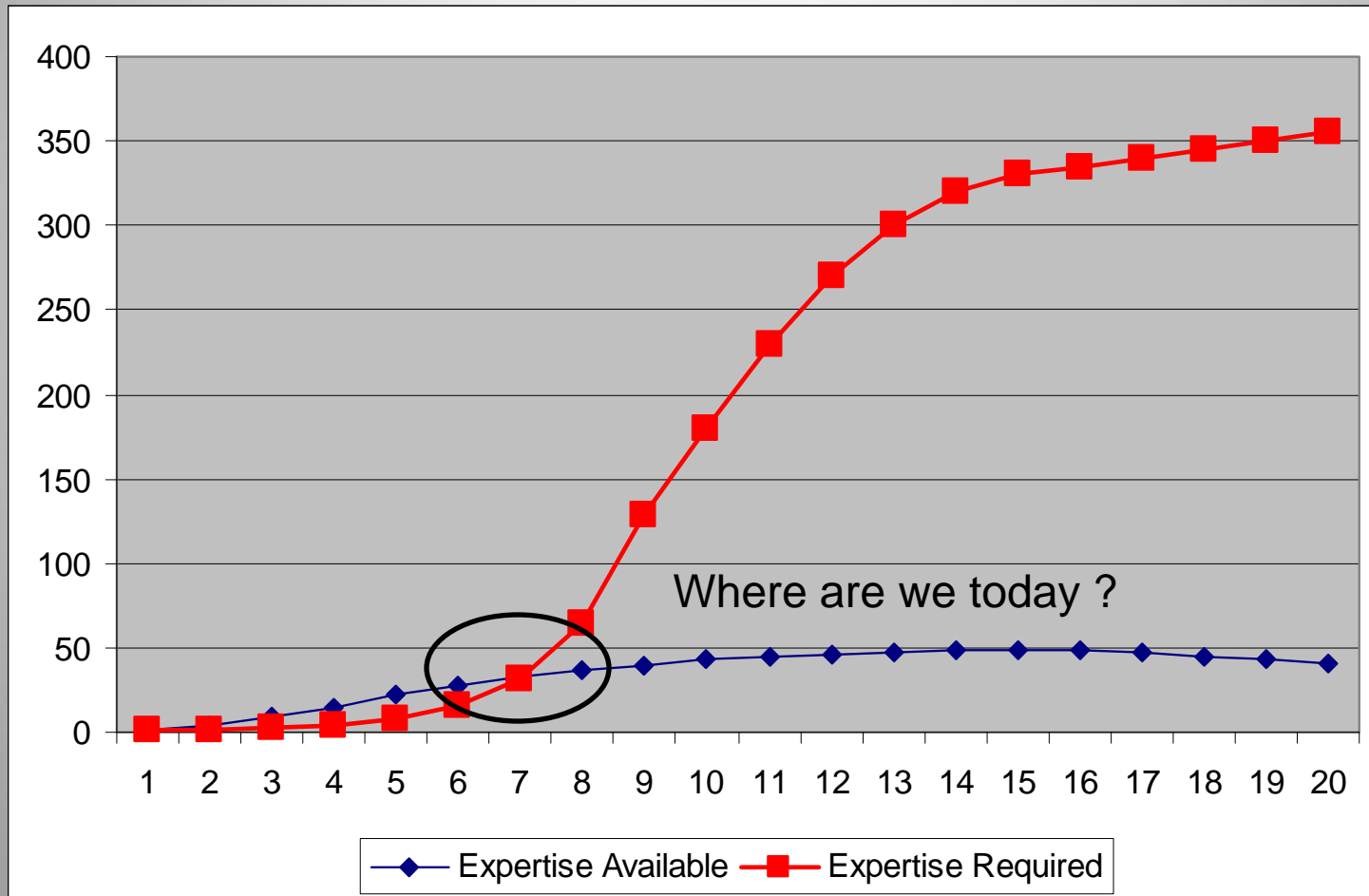
the Hidden Issue

- **Since the level of available expertise does not exist "Houston - we have a problem"**

- **That means that the future growth of simulation deployment will be limited primarily by the available resources with the required expertise to run the simulations**

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the Hidden Issue

- "Non-expert" does not mean non-engineer
- This is an issue for **both vendors and users**
- This is not just an ease of use issue
    - Efforts to drive simulation to less-skilled users at large companies have failed over and over again
    - Dumbing down is proven to not be a viable option

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Are we making progess?

- **We need to significantly decrease the expertise required by making the simulation tools smarter**
  - Not just easier to use
  - Not just automating current processes
  - We will need to think outside the box
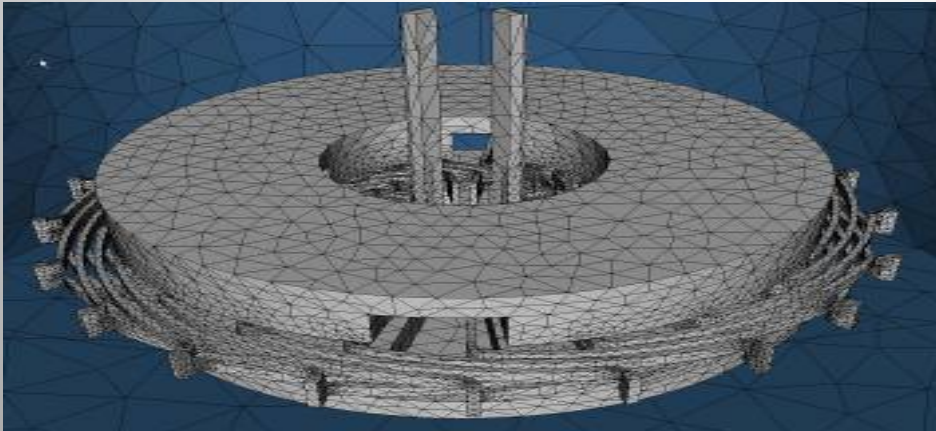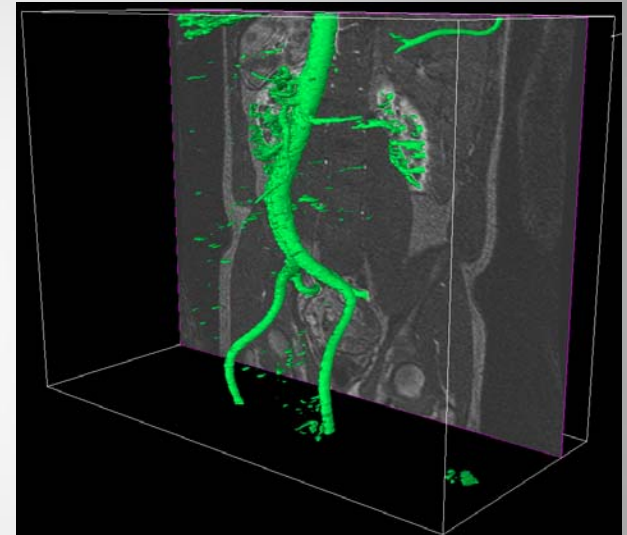
Courtesy Infolytica

Are we making progess?

- **"Intelligent Automation"**
    - Application requirements rather than physics
    - Support for broader range of design variability
    - Hierarchy of models & model abstractions
    - Desired accuracy and adaptive approaches
    - Leveraging Simulation Data Management capabilities
    - Leveraging current automation capabilities
   - **Integration of multiple/all of the above**

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Are we making progess?

- **Application requirements rather than physics based**
  - Non-traditional simulation applications have little to no choice
  - The application should be thought of as the new "master model"
  - **What is the user really trying to decide or validate?**

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Are we making progess?

- **Application requirements rather than physics based**
  - **Vendors are looking into this**
  - **Application focused vendors are becoming more common**
  - **Consultants are emerging to help with implementing custom solutions**
  - **New technologies are becoming available to make this much easier**

 - **Progress is being made but it is fragmented and slow**
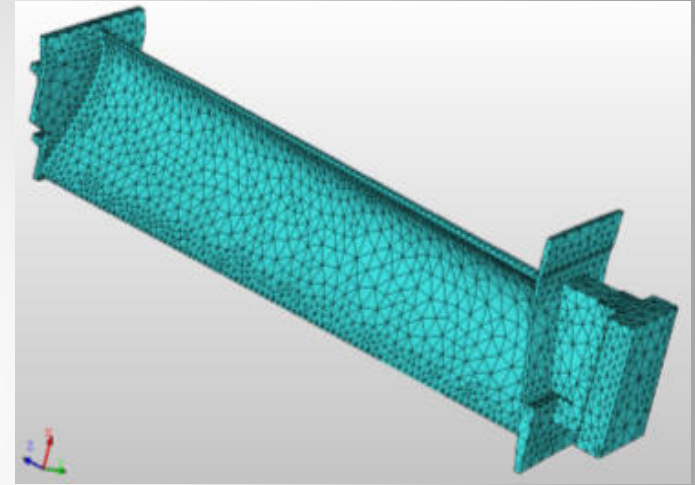
Courtesy Top Systems Ltd

Are we making progess?

- **Support for broader range of design variability**
  - Allow for capture of expertise
  - Allow for reuse through the entire design process
  - Allow for reuse through Design Space Exploration, Stochastics, Robust Engineering
  - Allow for automation of simulation assembly
  - Allow for repeatability
- **Crawl – Walk – Run analogy**
  - Crawl = simulation modeling at mesh level
  - Walk = simulation modeling at geometry level
  - Run = simulation modeling at an Abstract Model level
- **Technology is available at "Run" level**
- **Usage is still at "Crawl/Walk" level**

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Addressing the Hidden Issue

- **Abstract Modeling is a persistent simulation representation**
  - Enables persistent analysis attributes throughout the design process that are invariant to design changes
  - Analysis attributes are assigned to the persistent Abstract Model
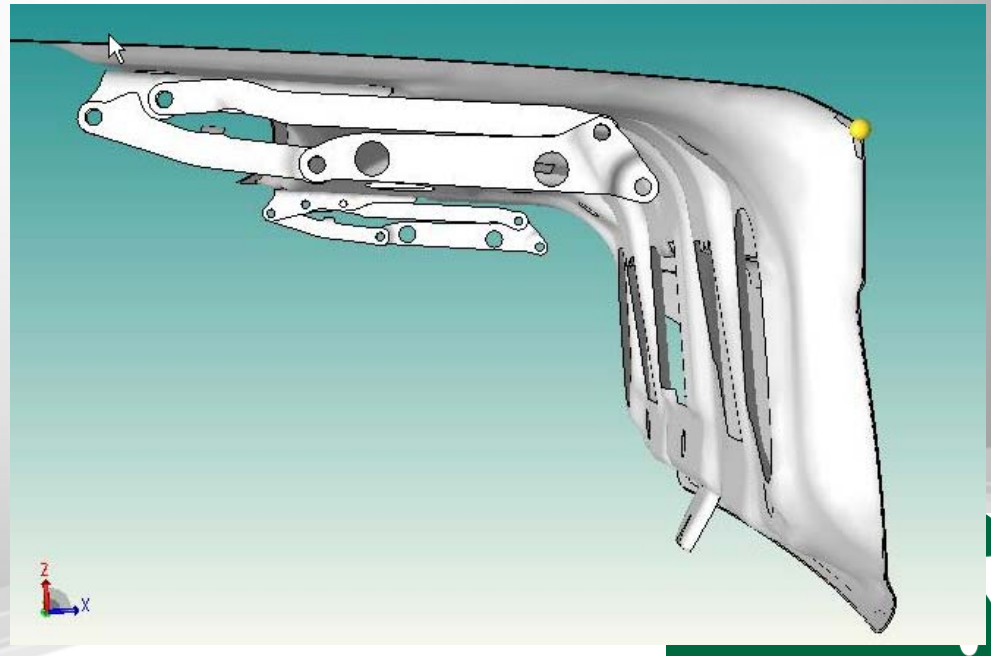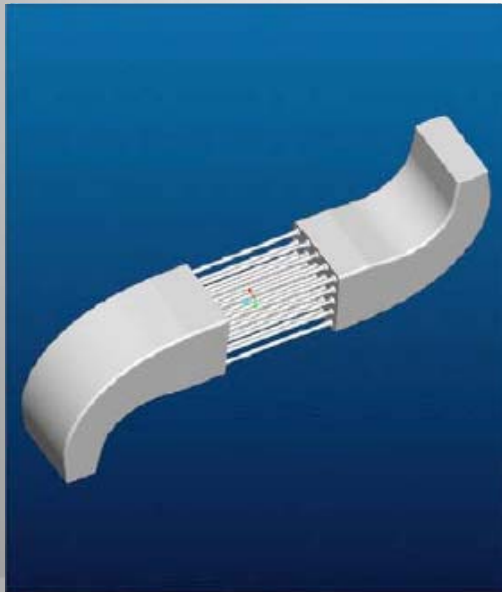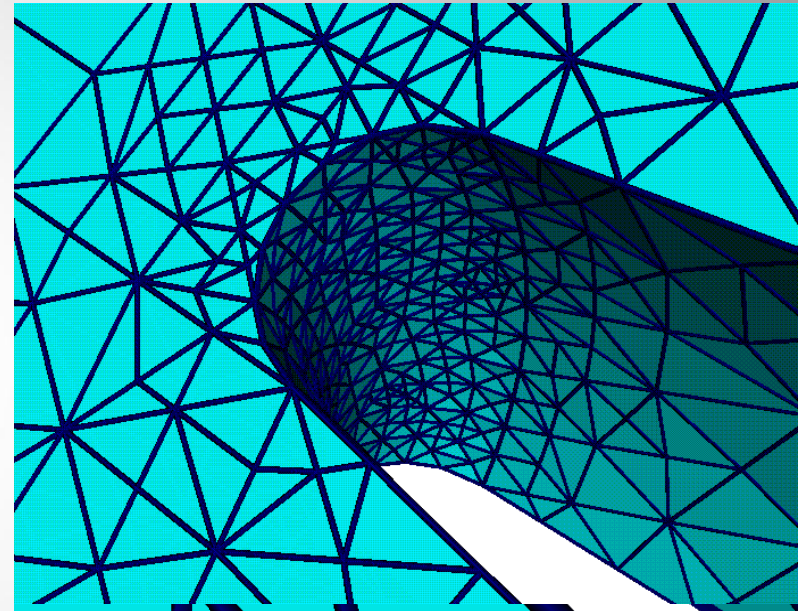
Are we making progess?

- **Hierarchy of models & model abstractions**
- **A Simulation Model of "Everything"**
  - SysML / Modelica
  - Matlab / Simulink
  - Maplesoft / Maplesim
  - ...
- Significant progress being made on low fidelity models
- High fidelity models need Abstract Models
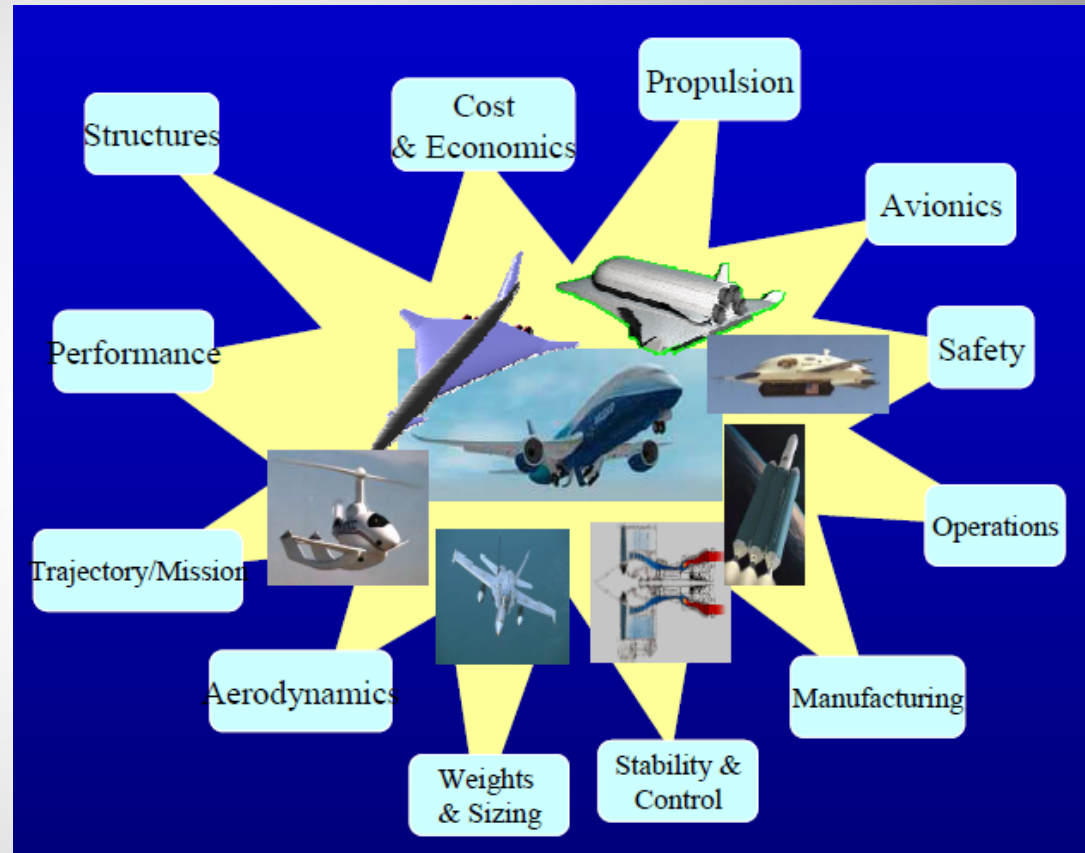
Source: Dimitri Mavris, Georgia Tech

Are we making progess?

- **Desired accuracy and adaptive methods**
  - Required accuracy is a function of the design decision under consideration
  - Mesh adaptivity is a requirement – not a luxury
  - *A-priori element shape metrics generally have little to no correlation with error*
  - Adaptivity has remained a tool only for experts
  - Not currently considered as a priority by vendors
  - Usage still focused on a-priori mesh shape metrics

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Are we making progess?

- **Leveraging Simulation Data Management capabilities**
  - need automated data management for non-experts
  - Support for Work-In-Process is critical
  - Cannot be limited to complex simulation environments that require heavy customizzation
  - **Interest is increasing in SDM**
    - **NAFEMS working group as an example**
  - **SDM solutions are maturing to meet market needs**
    - **Automated meta-data extraction & lightweight visualization**
    - **Reduction in customization required for all vendors**
    - **Easy to implement/Easy to use offerings available**
  - **Implementation and deployment is growing but very slowly**

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Are we making progess?

- **Leveraging current automation capabilities**
  - Automatic mesh generation
  - Process Automation
  - Automated simulation assembly modeling
  - Simulation Process and Data Management
  - Design Space Exploration
  - Best place to start is "Intelligently automate what we can today"

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Are we making progess?

- **Suggested updating of processes to support "Intelligent Automation"**
  - **Leveraging simulation data management capabilities**
  - **Remove unfounded focus on a-priori shape metrics**
  - **Remove unfounded focus on idealization/simplification**
    - Minimizing the need for idealization/simplification is key to reducing required expertise
    - Idealization/simplification are extremely difficult to automate
  - **Continue to push vendors for solutions that support "Intelligent Automation"**
  - Leverage current automation capabilities now !!
    - Do what can be done now !!!!
    - Think in terms of applications not physics
- **Become the "Intelligent Automation" champion**

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the Hidden Issue

- **Conclusions**
  - **The use of simulation is at an inflection point with potential growth driven by business issues**
  - **There is a simulation expertise issue that will limit the spread of effective use of simulation technologies**
    - The level of expertise required for simulation needs to be reduced significantly to attain deployment growth to meet business goals
  - **"Intelligent Automation" is the means to make a radical reduction in required expertise**
    - Most technology exists but not in an integrated form
  - **"Intelligent Automation" means change**
    - Vendors need to focus on reducing required expertise
    - Users need to embrace the concept, do what they can today, push for capabilities and be willing to accept change
  - **Champions have to come forward**

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