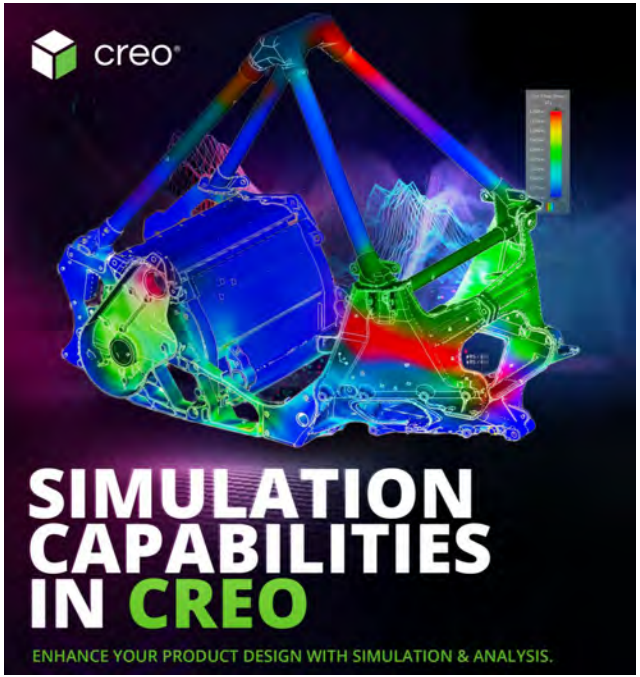
Simulation Driven Design using Creo Simulate and Creo Simulation Live



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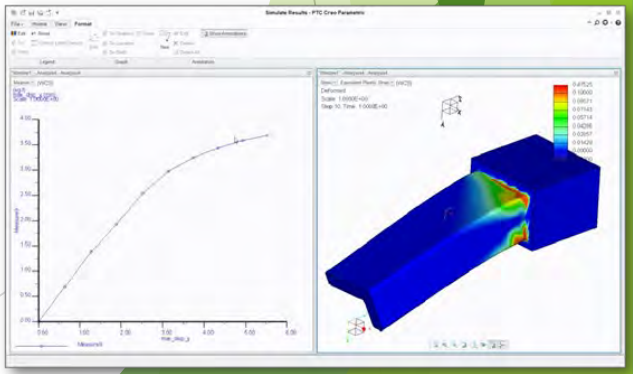
3/6/20

Agenda – Simulation Driven Design (SDD)

- What Is Simulation Driven Design?
- Why Do it?
- SDD Myths & Risks
- How To Do it
- SDD Training & Resources
- Demo of Creo Simulate and Creo Simulation Live

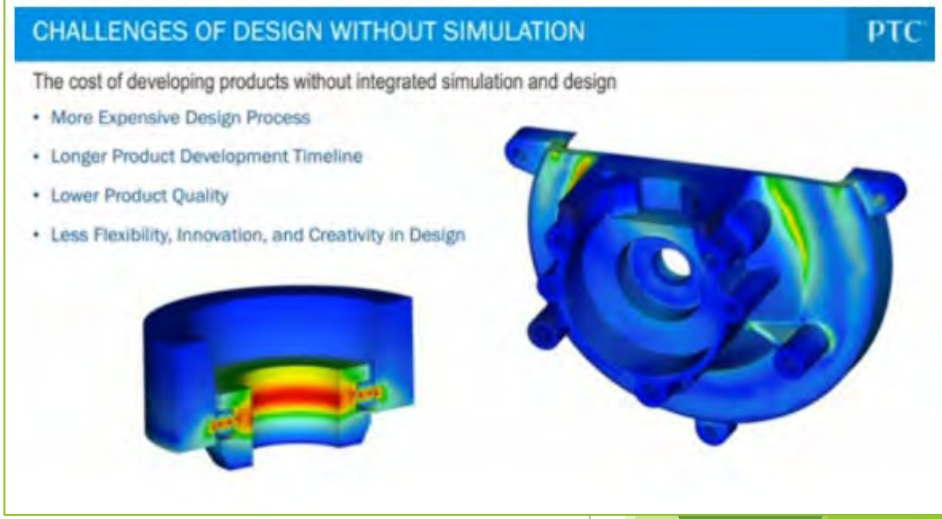
What is Simulation Driven Design (SDD)?

- **SDD is …** "Design engineers using simulation tools throughout the design process to influence and guide the design"
  - Also called – "**CAD-Embedded Simulation" or "Democratization of Simulation (DoS)" or "Finite Element Analysis (FEA) for Design Engineers"**
- **SDD is NOT …**
  - **NOT - "Design it, then throw it over the wall to Analysis and wait"**
  - **NOT - "We don't need FEA analysts anymore"**
- This presentation focuses on SDD enabled by Creo Simulate & Creo Simulation Live



Link to Creo Simulation Live video

Why do SDD?



- **Improve Quality**
  - **Prevent problems or find problems sooner**
  - **Stop *"throwing bad designs over the wall"* to analysis**
- **Design Faster**
  - **Iterate and Analyze designs faster and earlier in the design cycle**
  - ***"Simulation results in seconds rather than months"***
- **Reduce Cost**
  - **Reduce weight and cost by r**emoving material in low-stress areas and reinforcing high-stress areas
  - **Explore Options & Optimize Designs**
- **Others are doing it**
  - "Recent trends in the simulation industry are allowing for the democratization of CAE technology."
  - "Using simulation tools targeted for non-experts, engineers can test their designs earlier in the development process"

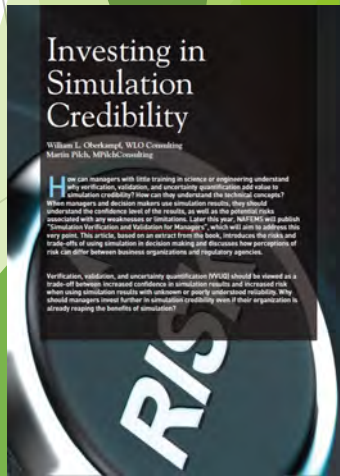
Why Use Simulation During Design?

CONSIDER FOR A MOMENT:

- What could shaving 10% off of your material cost mean for your business?
- If you could release products 14% faster, how would you use that time?
- What if you could improve product quality without adding cost or time?

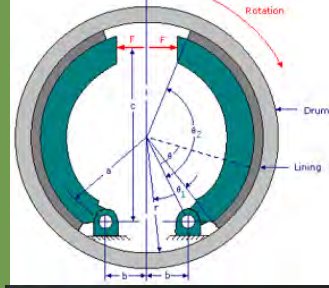
SDD Myths & Risks

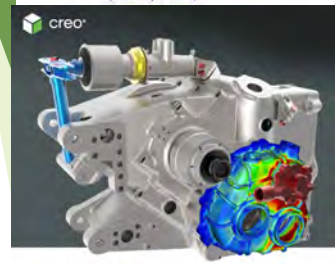
- SDD Myths
  - Myth 1: "It's too Hard; only Analysis experts should do it!"
    - *Hopefully this presentation & demo will dispel this myth*
    - But managers don't want the "Wild West" where designers are doing their own thing and not consulting with experts
  - Myth #2: "It's Easy! Anybody can do it!"
    - *"It's very easy to make pretty pictures that are completely wrong"*
- Risks
  - Consider the "Risk of new tools and techniques being used incorrectly" vs. "Risk of not adopting new methods and getting left behind"
  - Risks should not paralyze us but motivate us.
  - Mitigate Risk with training, expert consultation, and testing/validation

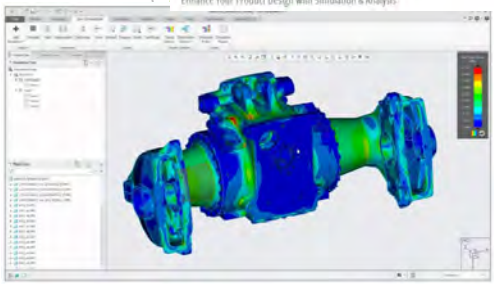


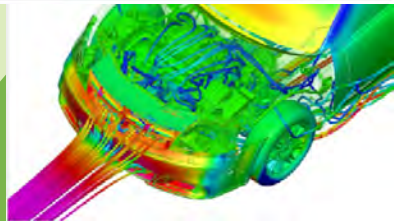
How To Do Simulation Driven Design

- History of SDD
  - **Hand Calcs & FBDs – Still Valid**
  - **Engineering Judgement - Still Valid**
  - **Advanced High-end Finite Element Analysis – Still Valid**
  - **Design it, then throw it over the wall to Analysis - Obsolete**
- SDD Software Tools
  - Creo Simulate, Creo Simulation Live, Creo Flow Analysis, others
- Training and mentoring
  - Design Engineers need to know engineering fundamentals (Strength of Materials, etc)
    - **Recommend Basic FEA class from NAFEMS**
  - **There is a need for practical training and guidance!**
  - Everyone is busy, so management support is critical









How To Do SDD - Best Practices

- Don't just dive in! Plan and document the project first
  - Write a simple scope document and list the project goals
- Fix the CAD model first!
- Start simply with a small analysis project
  - Learn simple analysis methods first before progressing to more advanced methods
- Check boundary conditions
- Use comparative analysis to predict trends
- *"Assume results are wrong until proven correct"*
- Automate as much as possible (Creo mapkeys, report writing, etc)

RESILIENT MODELING STRATEGY™ V9
Solids Modeling Best Practices Manual

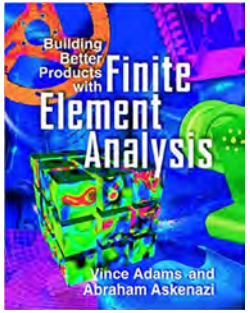
VCOLLAB
Actionable Simulation Insights

SDD Training & Resources

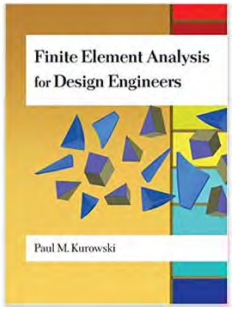
- Industry Groups & Conferences
  - NAFEMS
  - Revolution in Simulation
  - PTC LiveWorx
  - PTC/USER
  - Peoria Creo User Group
- **Training and Mentoring**
  - **Practical Training and mentoring** is essential to ensure engineers can produce high-quality analysis results
    - It is critical to provide **ongoing mentoring & coaching to the students.** The students also need to quickly **put the training to use on pre-planned projects**, so the training is not forgotten.
    - Develop list of potential projects to be analyzed before starting training
  - PTC University & PTC Learning Connector for online Creo training classes and tutorials
  - NAFEMS – Basic FEA Training

SDD Training – Practical FEA Textbooks

- Building Better Products with Finite Element Analysis – 1999

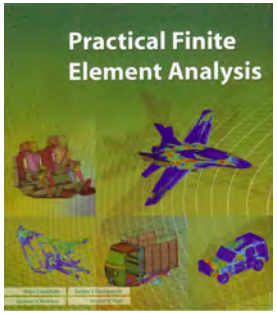


- Finite Element Analysis for Design Engineers - 2004
  - Available on Knovel

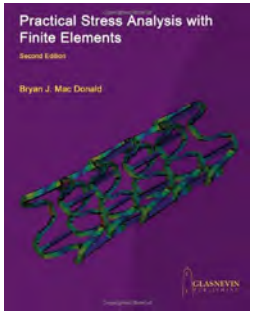


SDD Training – Practical FEA Textbooks (cont.)

- Practical Finite Element Analysis – 2008



- Practical Stress Analysis with Finite Elements - 2011



Demo – Creo Simulate & Creo Simulation Live

- Creo Simulate is a full FEA program intended for design engineers working on low-to-medium complexity analysis projects.
- Creo Simulation Live (CSL) is a new real-time simulation (FEA) tool intended for design engineers that gives near-instantaneous FEA feedback to help engineers quickly evaluate design options.
- Best practice: Use Creo Simulation Live for initial design exploration, then switch to Creo Simulate for more detailed analysis, if necessary.
  - Pre-processing work done in Creo Simulation Live will transfer over to Creo Simulate
- DEMO – Accumulator Mounting Bracket

Steering and Brake Accumulators

In the event that the hydraulic pressure in the steering or braking system drops below an acceptable minimum, nitrogen-charged accumulators will automatically apply the brakes so that the truck may be stopped. There are separate accumulators for the braking and steering systems.