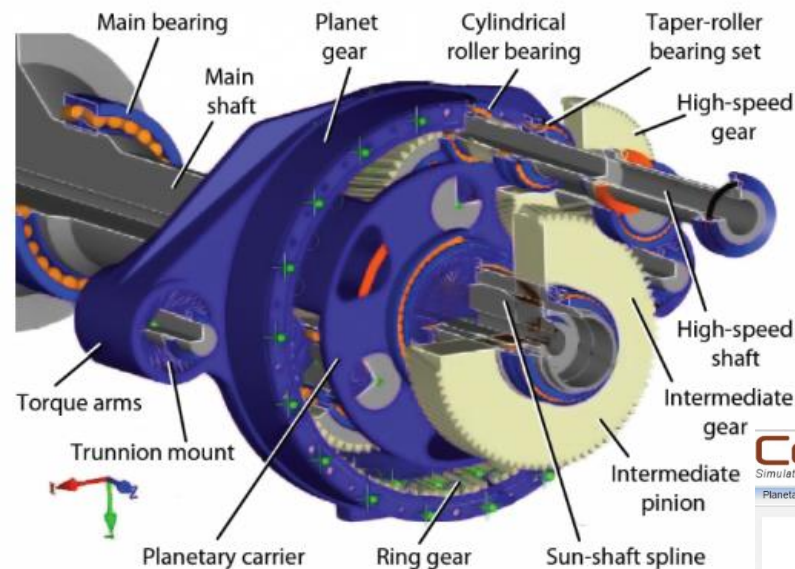


A Hidden Goldmine

Find Untapped Value in Simulation Investments and Ways to Unlock It

Malcolm Panthaki, *Founder & CTO, Comet Solutions, Inc.*



Comet

Comet
Simulation-Driven Design Apps
Planetary Reduction Gearbox

Planetary Reduction Gearbox SimApp



The screenshot shows the Planetary Reduction Gearbox SimApp interface. On the left is a 3D model of the gearbox with labels for 'Housing Wall Thickness', 'Carrier Wall Thickness', 'Housing Bearing Seat Thickness', and 'Bracket Thickness'. On the right is a form with the following sections:

- Design Parameters**
 - Housing Wall Thickness [mm]: 4
 - Carrier Wall Thickness [mm]: 4
 - Housing Bearing Seat Thickness [mm]: 10
 - Bracket Thickness [mm]: 5
- Loading Parameters**
 - Duration [hours]: 1000
 - Speed [rpm]: 500
 - Torque [N.m]: 200
- Reporting Options**
 - Notes to include in the report: (text area)

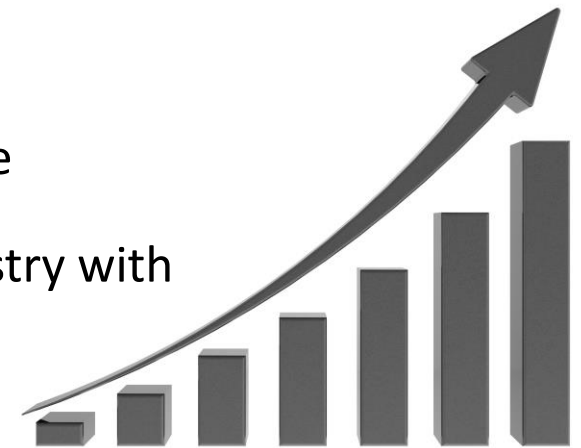
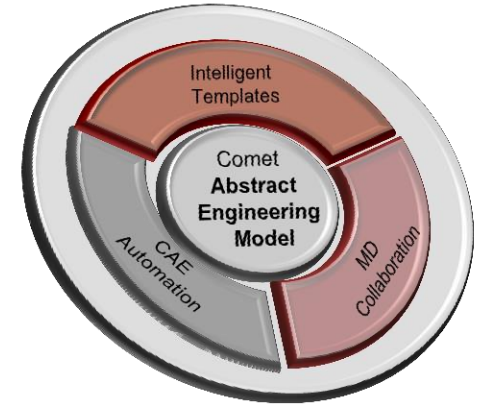
At the bottom right are buttons for 'Calculate', 'Exit', and 'Help'.

Intelligent Templates for automated Design Space Exploration

Comet Solutions Company Overview

Pioneer in Simulation Automation Using Abstract Modeling Technology

- Formed in 2001 in Albuquerque, NM
- >150 man years development of proprietary Abstract Engineering Model® (AEM)
- Initial commercial product release in 2008 (space-based optical sensor design)
- Experienced leadership team
>75 years combined PLM/CAD/CAE industry experience
- One of the fastest growing companies in the PLM industry with multiple Fortune 1000 companies as customers

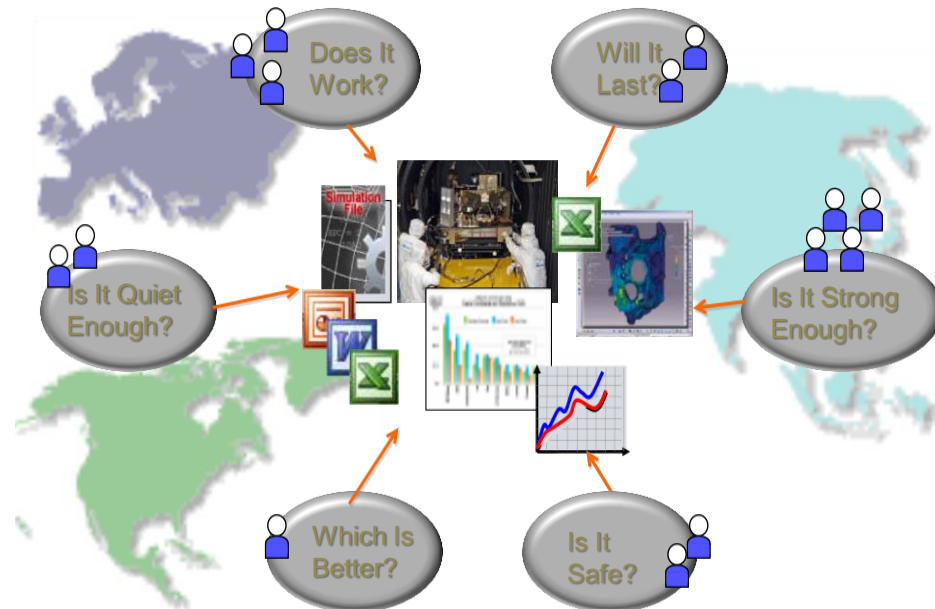


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Intelligent Templates for automated Design Space Exploration

All Products Are “Systems”

- Their engineering is complex
 - Even when the product is not
 - Often need sophisticated CAE tools
 - Need good engineers *and* tool experts
- They are multidisciplinary
 - In their performance attributes
 - In their Interaction with the environment
- They require teams
 - To design, validate & support



Product Development *is* Design Space Exploration

Goal: Effective *Design Space Exploration*

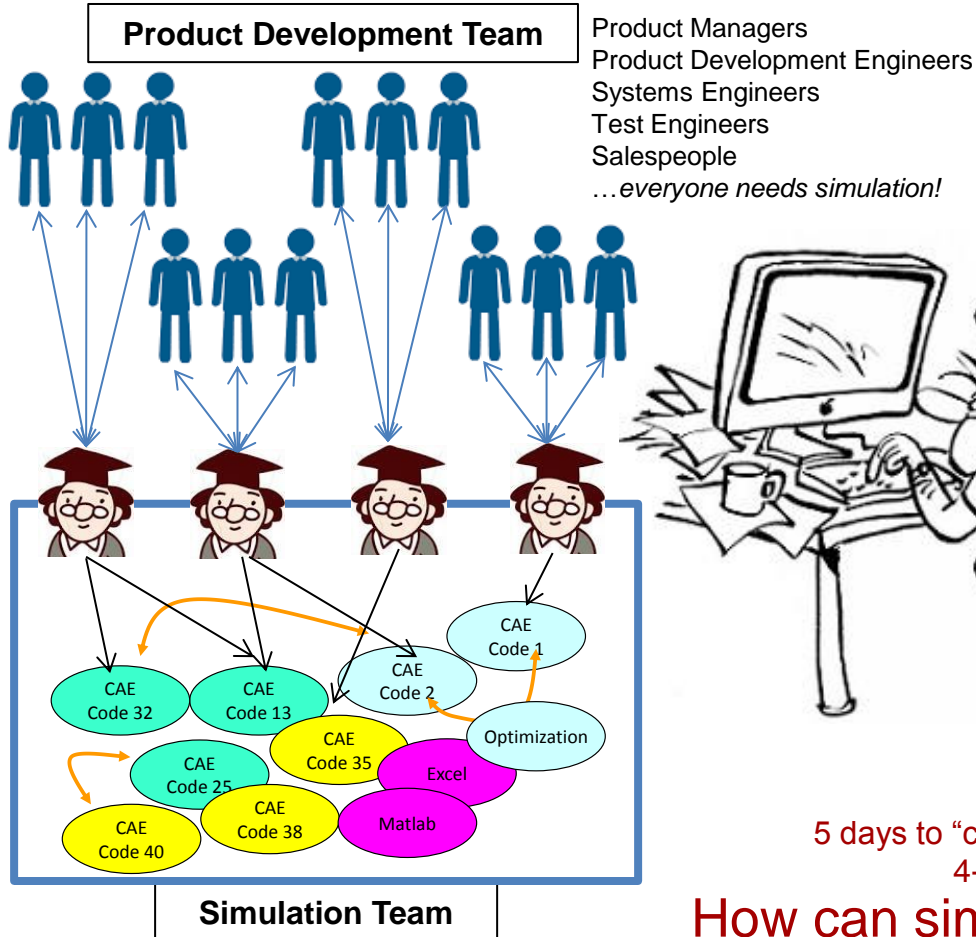
Sources of Information for Design Space Exploration:
*Experience, Current/Prior Designs, Physical Testing, **Simulation***

Simulation process automation templates should allow every product engineer to easily:

- Explore/compare various architectures and designs at any “appropriate”, mixed levels of model fidelity
- Swap out entire subsystems/components to rapidly find a better architecture and design
- ***Assess all Key Performance Indicators simultaneously, across all aspects of the product***

Lights-Out Automation!

Simulation status quo: *Silos Everywhere!*



Simulation Data:

**in silos, inconsistent,
non-integrated**

Simulation Processes:

**manual, error-prone,
highly inefficient**



Simulation Experts:

often the bottlenecks

5 days to "clean up" geometry and create a "perfect" mesh??
4-6 weeks to complete a single analysis?

How can simulation be a driving force in design?

Simulation processes are manual & highly inefficient

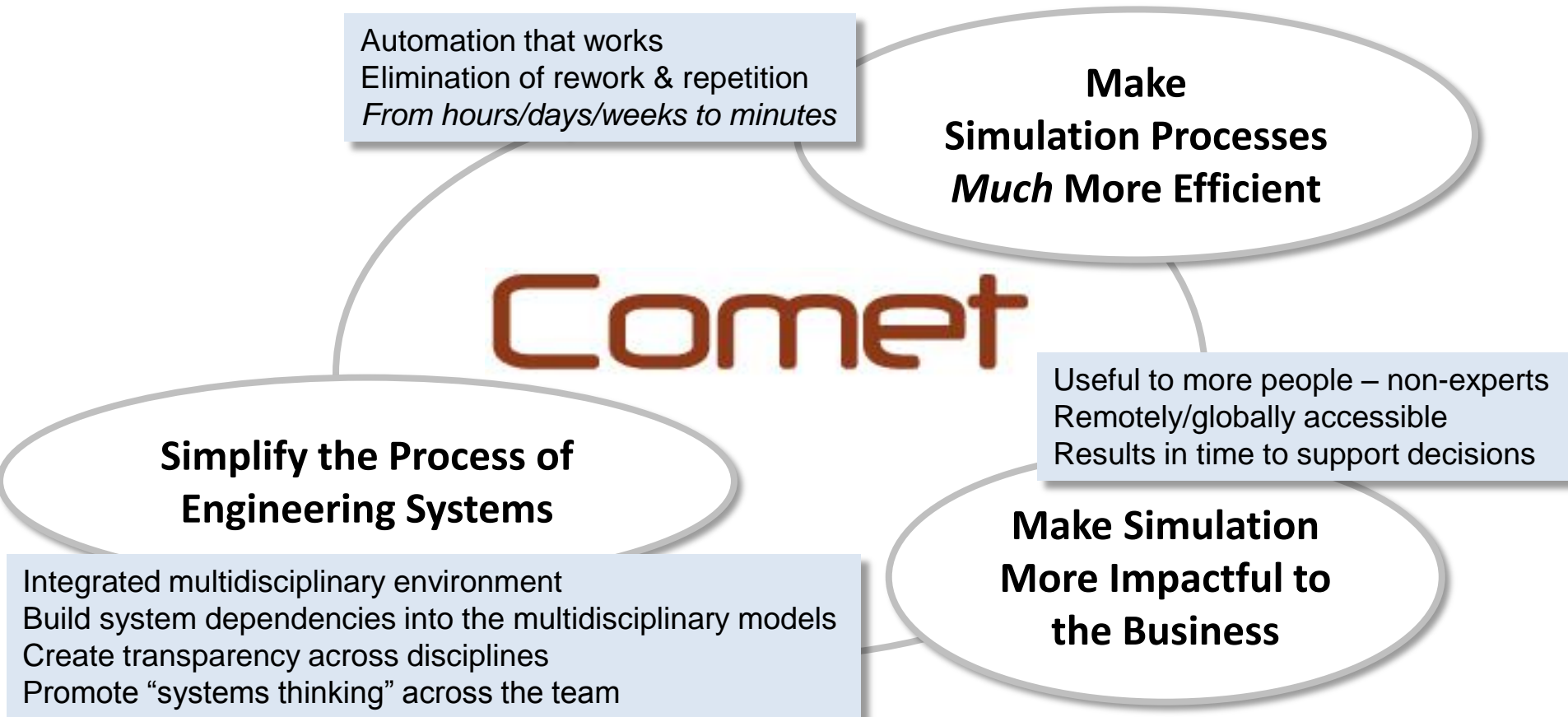
How can we capture simulation processes for automated Design Space Exploration?

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Intelligent Templates for automated Design Space Exploration

Our Mission

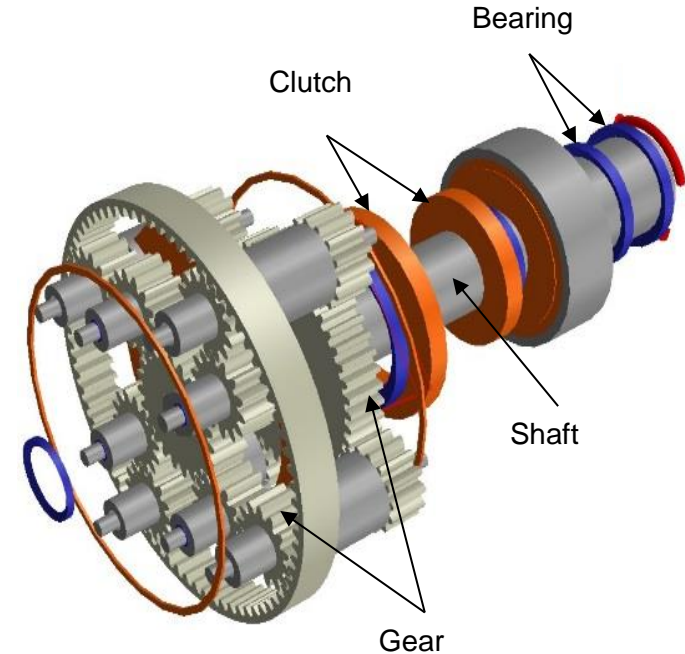
To simplify the complex process of engineering systems, expand the impact of Simulation on product development and increase customers' ROI from virtual and physical simulation investments.



Intelligent Templates for automated Design Space Exploration

The Problem With Engineering Models

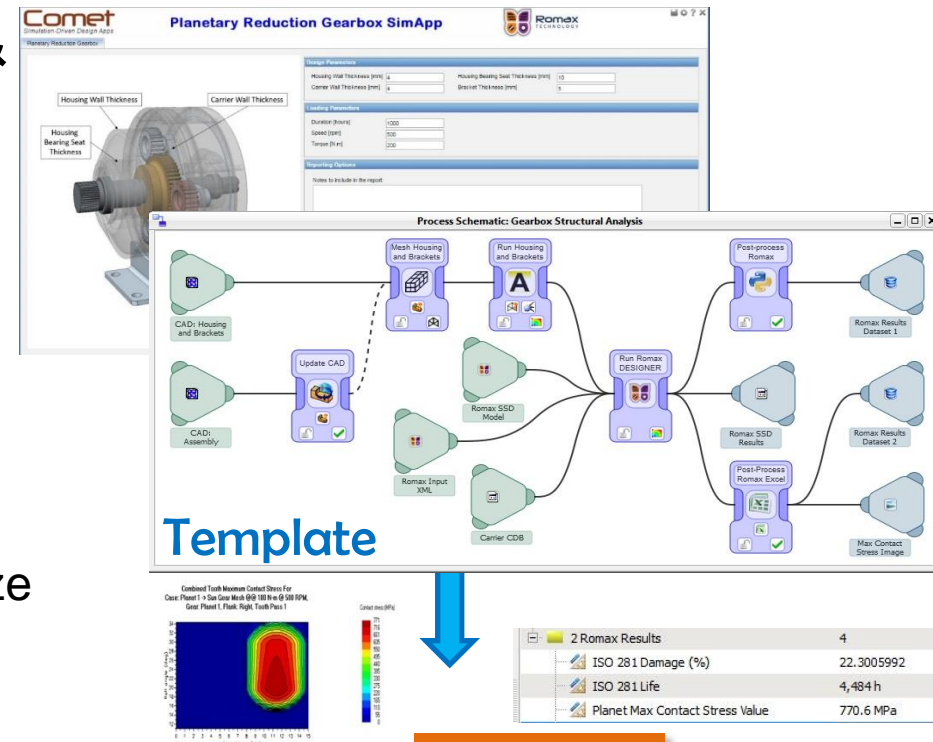
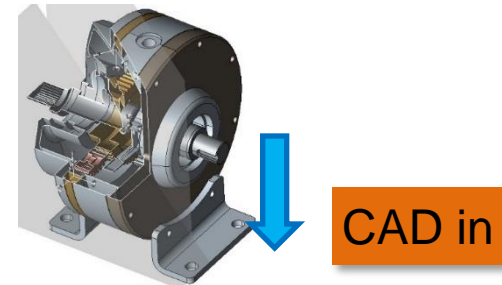
- Product Descriptions Are Functional and Descriptive
 - Common language understood by all your designers, engineers, customers, and suppliers
- But, Engineering Models Are Tool-Specific and Unique
 - C-Bush, P-Bush, Spider Joint, MNF, M-File, Modal Model, FRF, Beam with rotational DOF
 - Every tool has its own language
- Each Product Variation (*esp.*, *swapping entire components*) Drives Many Model Changes
 - FEA, CAD, MBD, Excel, In-House Tools, and more...
- Every Model Change introduces ***rework, translation errors, cost, and huge amounts of time for re-analysis***



Comet's Intelligent Templates

Product Evaluation Using Simple “Engineering Calculators” (SimApps)

- Embed expert knowledge
 - In robust, reliable, easy-to-create templates
 - With *minimal or no scripting*
 - Using the Experts' Tools – Your CAD, Your CAE
- Automate repetitive modeling & analysis work
 - Using Abstract Modeling, they work across the entire Family of Products that share a basic architecture
- Deploy *Anywhere!*
 - Web-based, cloud-enabled
- Run by *Anyone!*
 - Easily, Rapidly & Automatically analyze and optimize design variants
 - Within a discipline or across multiple disciplines

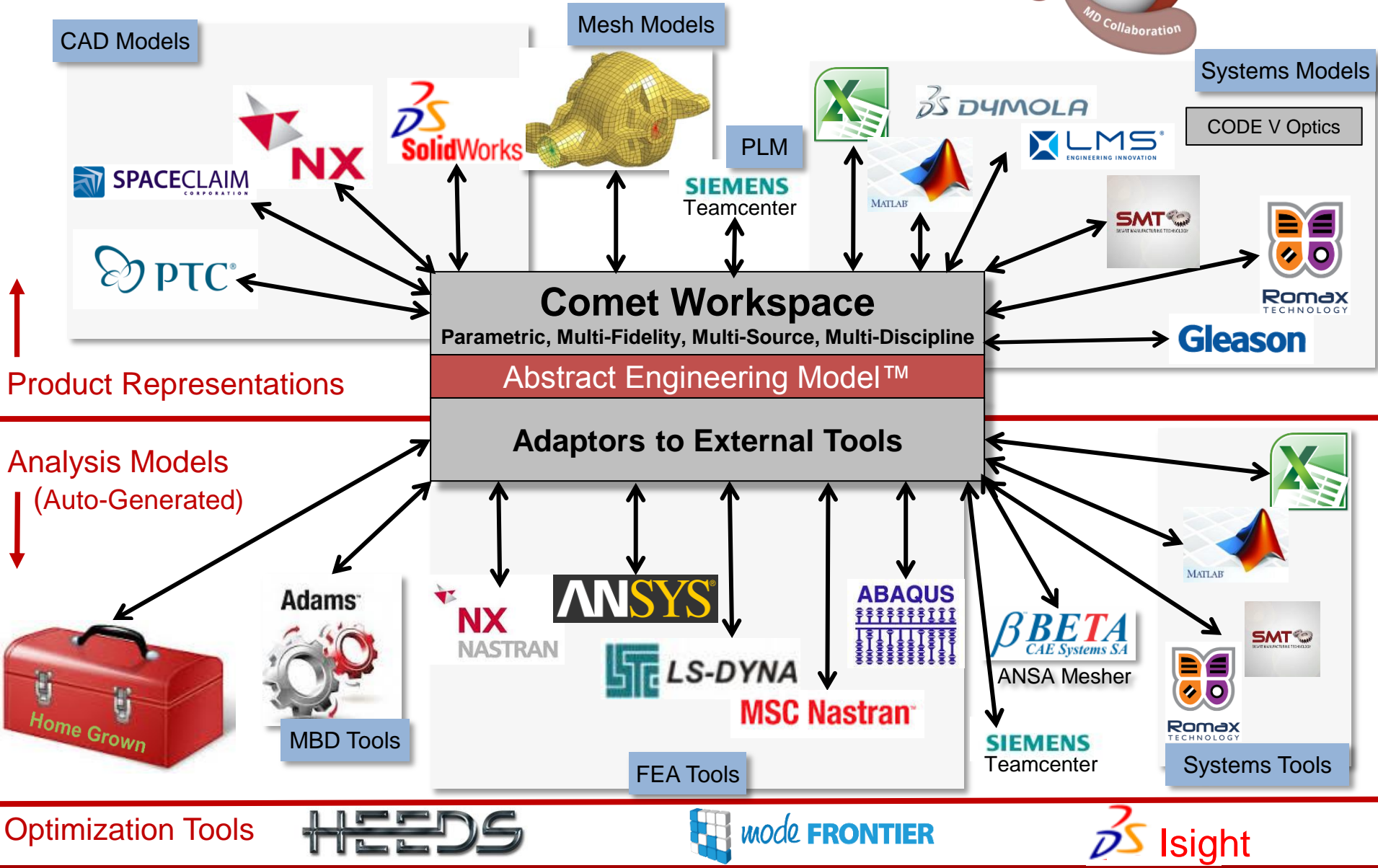
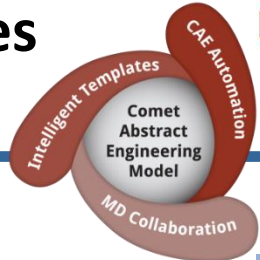


True Virtual Test Rigs

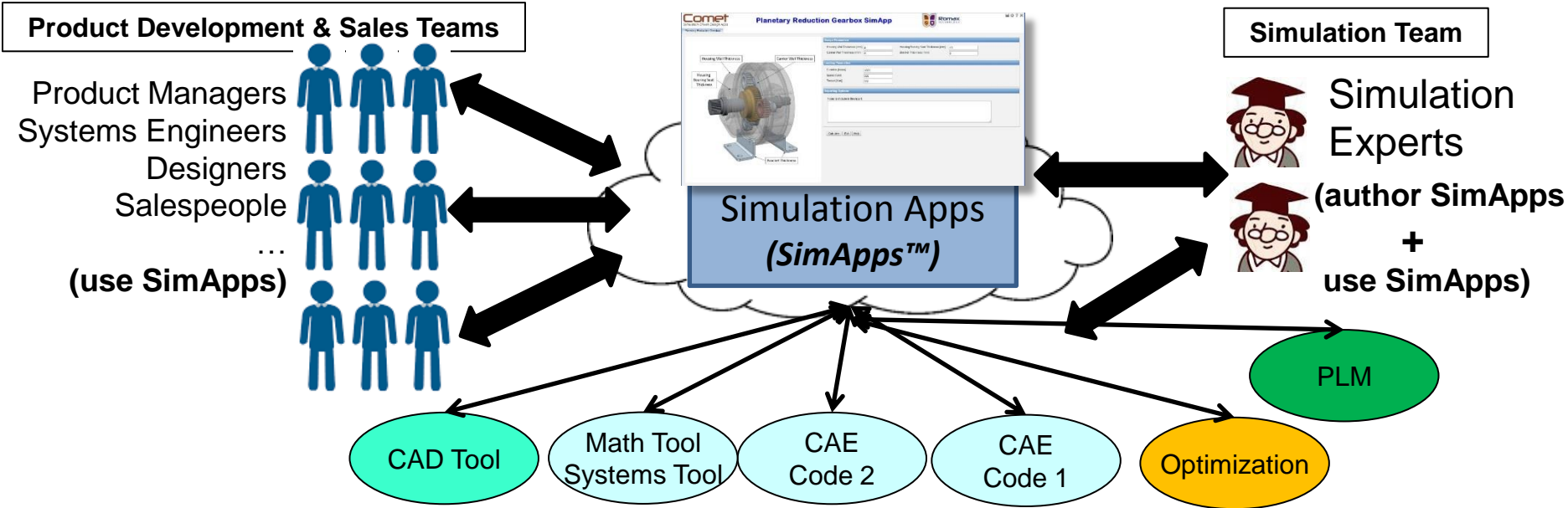
Report out

Comet – Automating Product Development Processes

Integrating Tools & Data Across All Design Phases



Simulation Apps: *Simulation for Everyone*



Targeted Applications: answer particular questions,
on a particular product family, at a particular level of fidelity

Expert Certified!
Safe and robust for all users

Robust across a Product Family

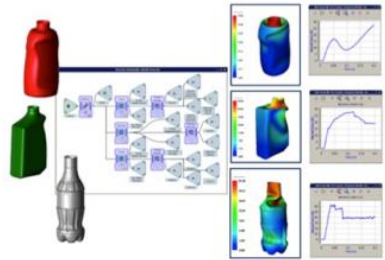
Simple GUI's that drive Templates that capture/enforce expertise
Must work across significant design changes and across a Product Family

Must speak the language of the user, not "Simulation"

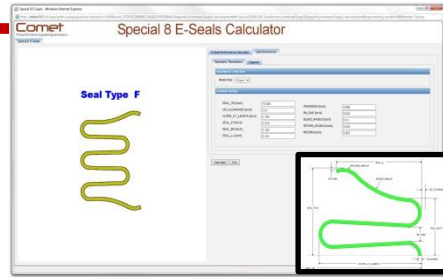
Web-deployed on Intranets & "The Cloud"
Provide all the computing required for rapid throughput

Intelligent Templates for automated Design Space Exploration

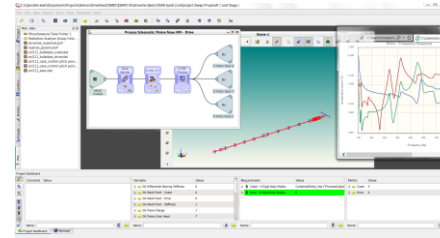
Scope of SimApps



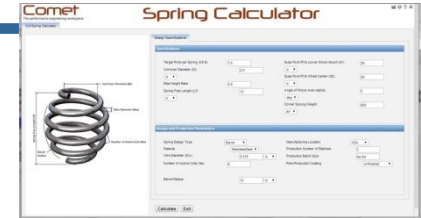
Plastic Bottle Design



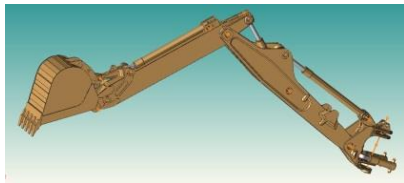
Aircraft Metallic Seal Design



Automotive Driveline Design

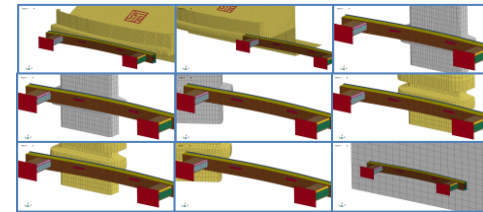


Automotive Spring Design



Heavy Equipment Design

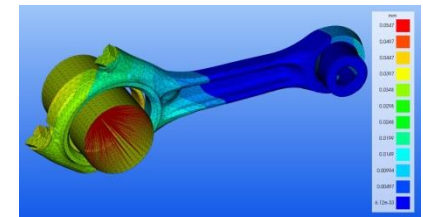
Automotive subsystems
Off-Road vehicles
Plastics & containers
Consumer appliances
Aerospace subsystems
Optical Imaging systems
Laser systems
Electronics PCBs



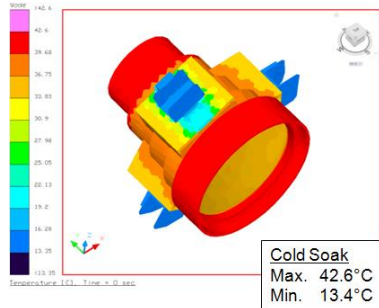
Automotive Bumper Design



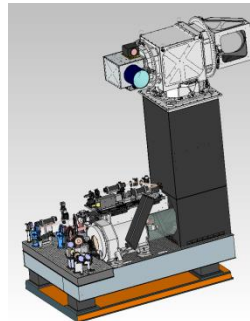
Vehicle Suspension Design



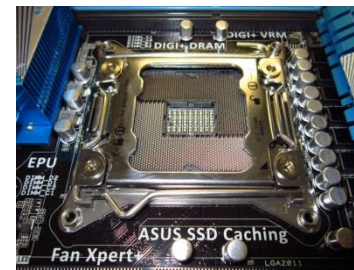
Engine Connecting Rod Design



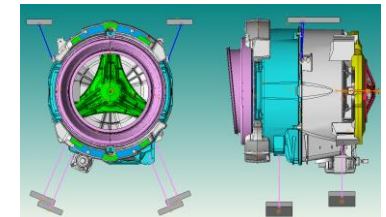
Space-Borne Optical Systems
with Thermal Controls



Laser Systems Design



Electronics Board Reliability



Washing Machine Design

Comet

Intelligent Templates for automated Design Space Exploration

Demo: Simulation Apps

Using EASA Web GUI's
&
Comet Automation Templates

Customer Successes & ROI (Comet+EASA)



ROI

Realize **80-95%** efficiency gains in setting up and postprocessing simulations
Perform **10-100x** the number of simulations you perform today
Allow experts in 1 domain/tool to run system simulations using tools of other domains
Enforce simulation best practices and simulation data consistency, *globally*
Perform automated Design Space Exploration, early in the process

***More robust product architecture & design, meeting all requirements,
earlier in the process***



JOHN DEERE



AEROSPACE

Comet



Intelligent Templates for automated Design Space Exploration

Business Benefits of Automation & SimApps

- Enable Engineers and Teams of Engineers to perform Rapid & Robust Design Space Exploration *early & often*
 - Significantly reduce the cycle time of each design iteration (**>80-90%**)
 - Explore the design space more accurately and automatically
 - Evaluate more concepts and designs
- Better utilize limited resources:
human experts, time/schedule, program cost
- Capture knowledge of scarce and dwindling number of experts in an *executable/reusable* form using Comet's Intelligent Templates
- Enforce process (best practices) and data consistency across simulation teams, globally

Significantly increase the ROI of your simulation investments over the entire product development lifecycle

Thank You!

Malcolm Panthaki
CTO & Founder

Comet Solutions, Inc.
www.cometsolutions.com



Sebastian Dewhurst
Director, Enterprise Solutions
Mike Nieburg
Business Development

EASA Software
www.easasoftware.com



What Engineers Really Need

- Functional representation of *product systems*
 - System & product Intent
 - Functional requirements
 - Design variables
 - System constraints
 - Operating conditions
 - Performance metrics
- Tool-agnostic engineering automation
 - CAD, FEA, MBD, Gearbox, math tools
- Automation that is *robust across design changes and Product Families*
- Automated mixed-fidelity modeling and swapping of components

