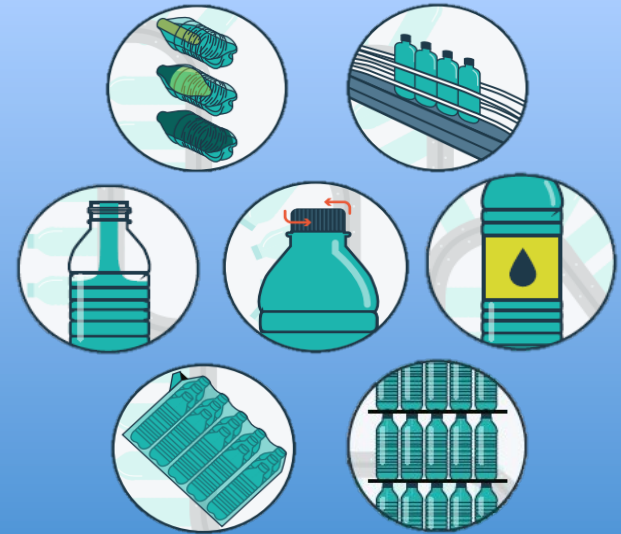
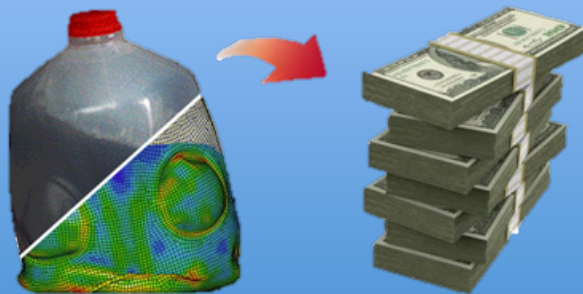


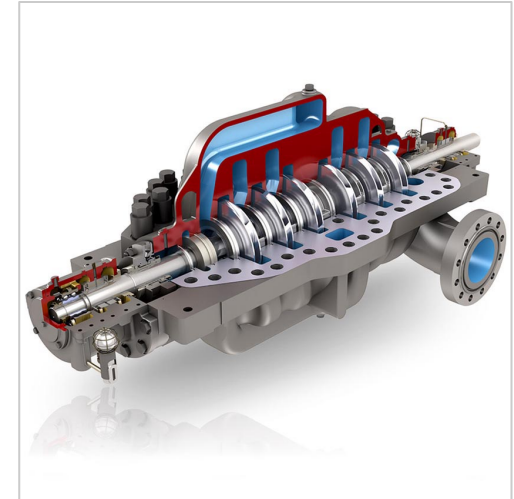
Yes! Product Engineers with limited CAE Expertise can safely run complex simulation using simulation Apps.



Jeremy Jarrett, Vice President of Engineering, Kinetic Vision
Malcolm Panthaki, Founder & CTO, Comet Solutions, Inc.

Background

- Who is Kinetic Vision?
- What kind of customers and simulation work do we support?
- Why would a consulting company be interested in enabling product engineers to run their own simulations?



Applications for Packaging Simulation

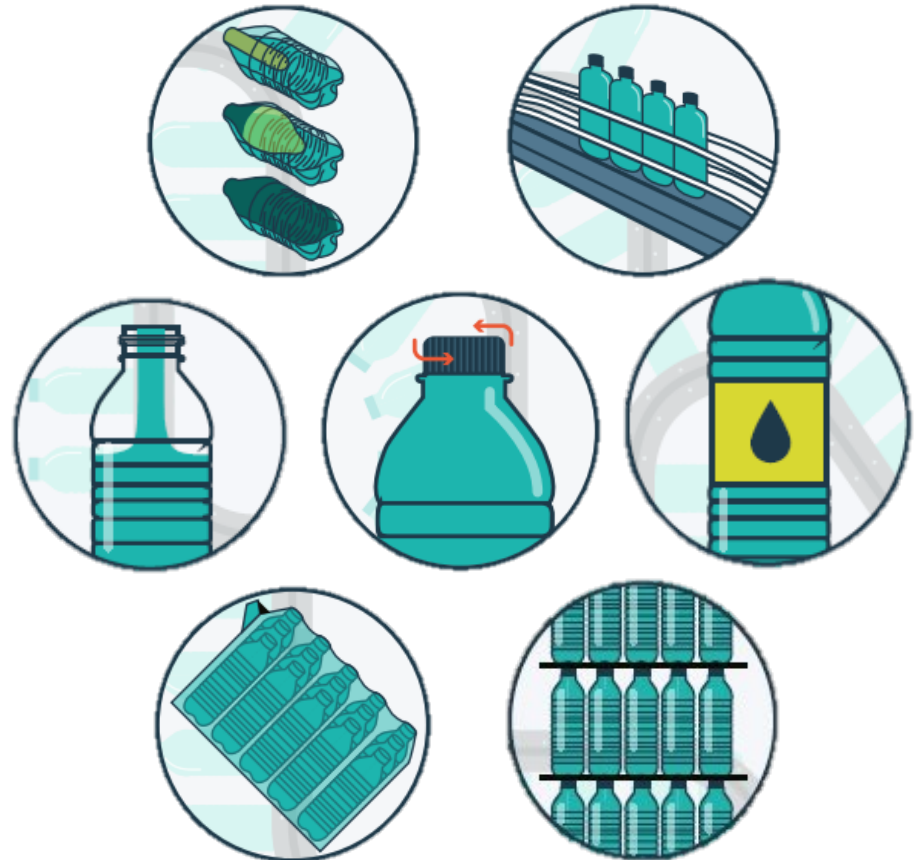
You can simulate many simple and complex operations

Manufacturing processes

- Blow molding
- ISBM
- Injection molding

Performance metrics

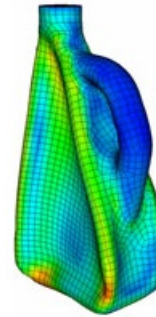
- Top load (ASTM D642)
- Squeeze (ASTM D4003)
- Drop (ASTM D2463)
- Pressure / Vacuum
- Conveying
- Filling
- Capping (On-torque, Off-torque, Snap)
- Labeling
- Case Packing
- Shipping Vibration
- Pallet stability
- ... and many more



SimApp Components

The background of automated virtual prototyping

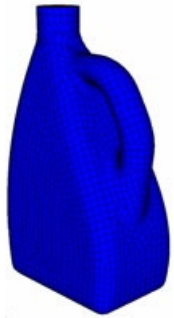
Solver
Pre/Post



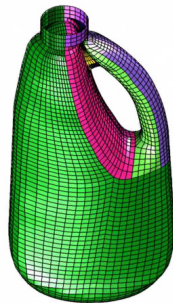
SimApp Components

The background of automated virtual prototyping

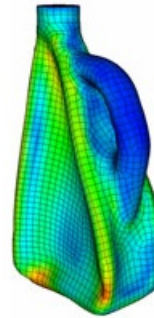
Parametric CAD
Modeler



Meshing Tool



Solver
Pre/Post



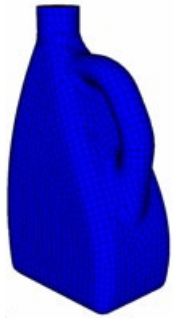
High-Performance
Computing



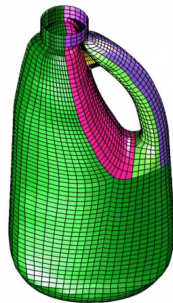
SimApp Components

The background of automated virtual prototyping

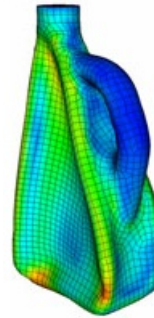
Parametric CAD
Modeler



Meshing Tool



Solver
Pre/Post



High-Performance
Computing

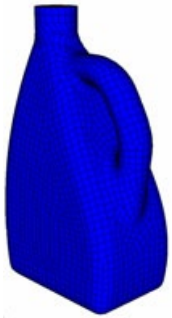


Automation
Platform

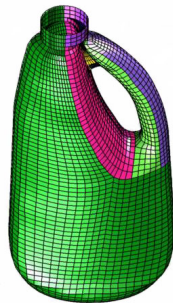
SimApp Components

The background of automated virtual prototyping

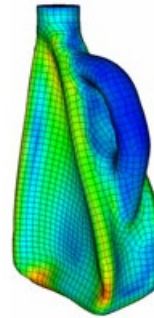
Parametric CAD
Modeler



Meshing Tool



Solver
Pre/Post



High-Performance
Computing



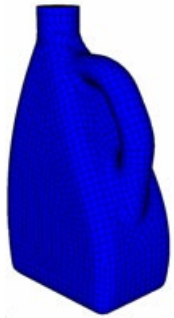
Automation
Platform

GUI and
Deployment
Platform

SimApp Components

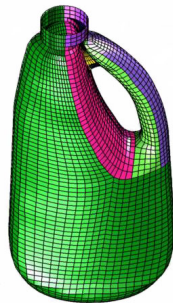
The background of automated virtual prototyping

Parametric CAD
Modeler



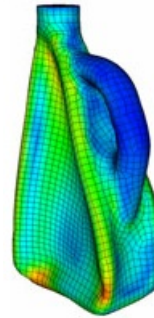
3D SOLIDWORKS

Meshing Tool



ANSA

Solver
Pre/Post



ABAQUS

High-Performance
Computing



Ohio Supercomputer Center
An OH·TECH Consortium Member

Automation
Platform

Comet

GUI and
Deployment
Platform

EASA

Top Load SimApp

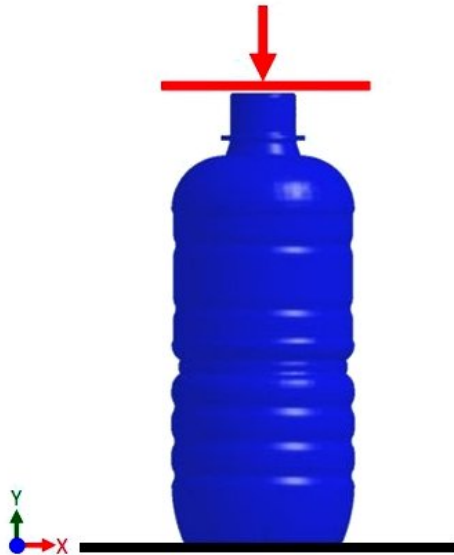
Simple to use, feature-rich

Comet
Simulation-Driven Design Apps

Top Load Analysis SimApp

kineticvision
AWE SIM

Top Load Analysis SimApp



Input Parameters

CAD Model File

Choose File

No file chosen



<< Choose a file, then press "Upload"

Upload

Simulation Name

MY SIMULATION

Mesh Size (mm)

1.5

Compression Distance (mm)

5

Duration (ms)

150

Container Material

PP_4740WZ

Estimated Minimum Thickness (mm)

0.5

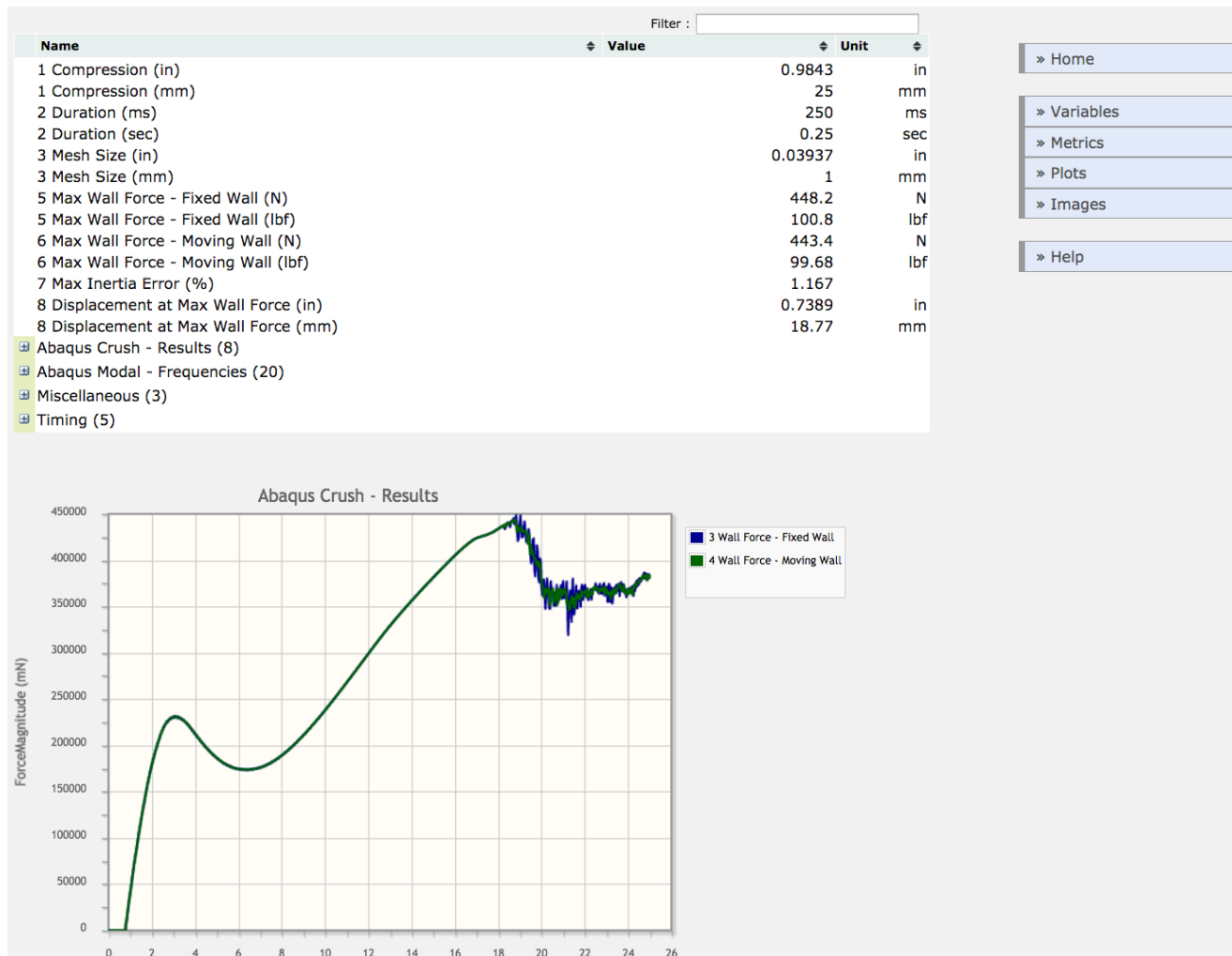
Calculate

Exit

Help

Top Load SimApp

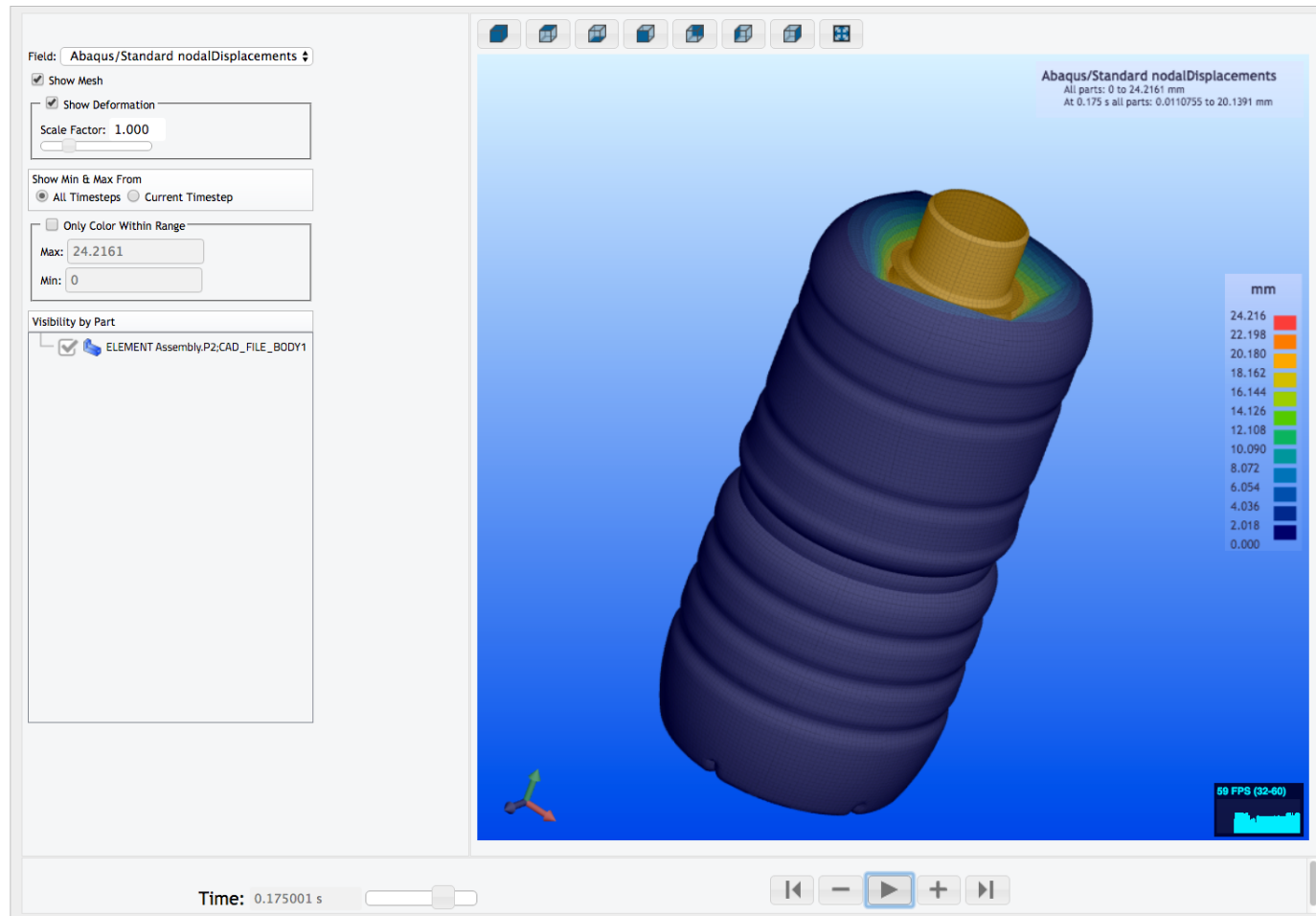
Simple to use, feature-rich



Top Load SimApp

Simple to use, feature-rich

Simulation: Bottle Demo - 1s 25d 250ms 0.5mtk



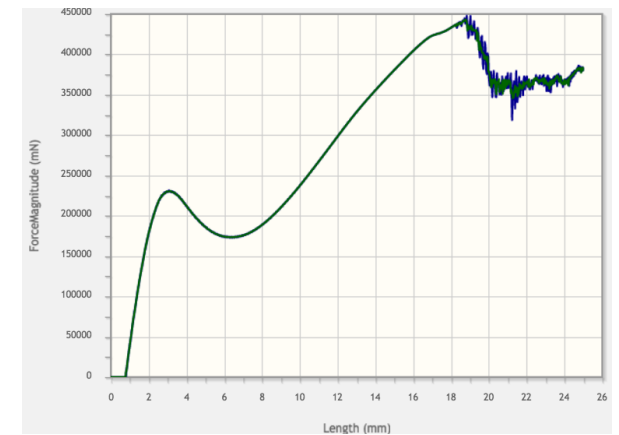
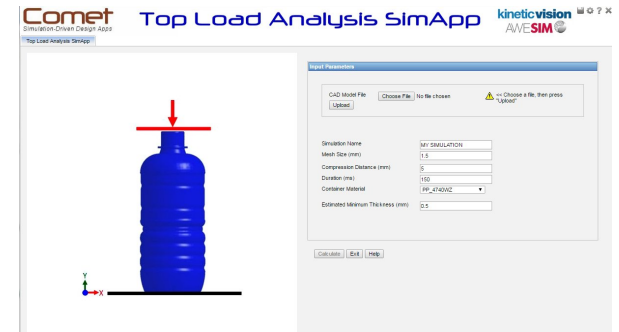
Top Load SimApp

Simple to use, feature-rich

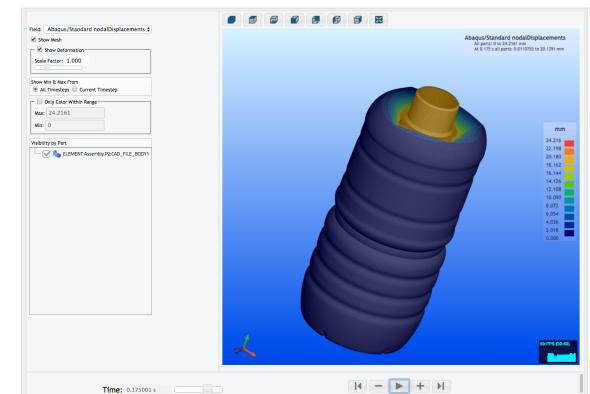
- Upload “As-is” DFM injection molded or blow molded part.
- Creates automatic shell mesh w/ thickness
- Automatically locate/orient simulation components like rigid surfaces.
- Solve in the Cloud (Ohio Supercomputer Center)
- Automated post processing and web reports
- Simulation Error/Warning Detection and Results QA

Additional Features:

- Ability to adjust CAD geometry from the SimApp
- Experiment with the thickness and part weight easily
- New Load Cases



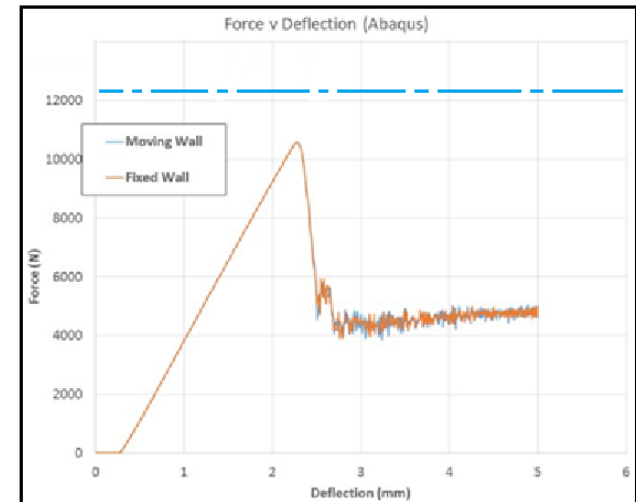
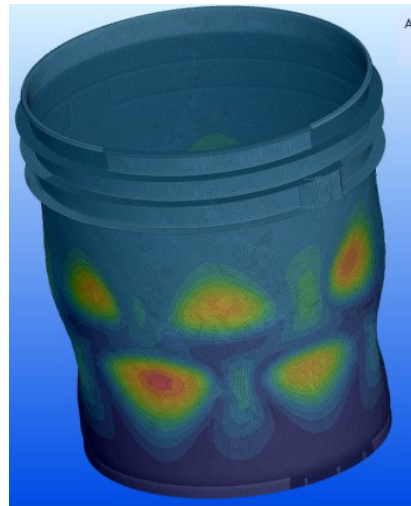
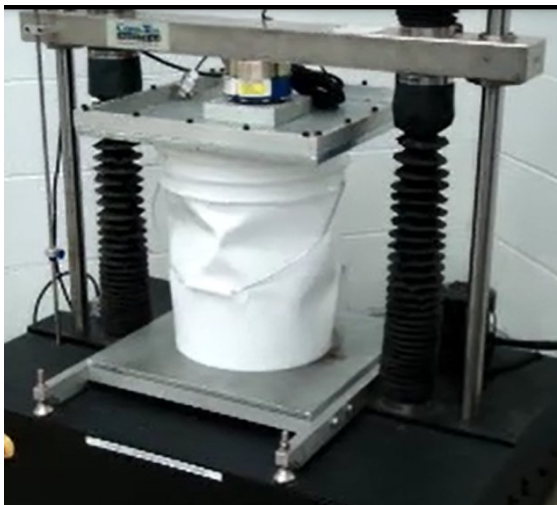
Simulation: Bottle Demo - 1s 25d 250ms 0.5mtk



Top Load Simulation App: Real Results

- SimApp initially validated to within 15% of physical test results.
- With improved meshing quality and material properties SimApp produces results within 10%.
- Validation of SimApp results is critical.

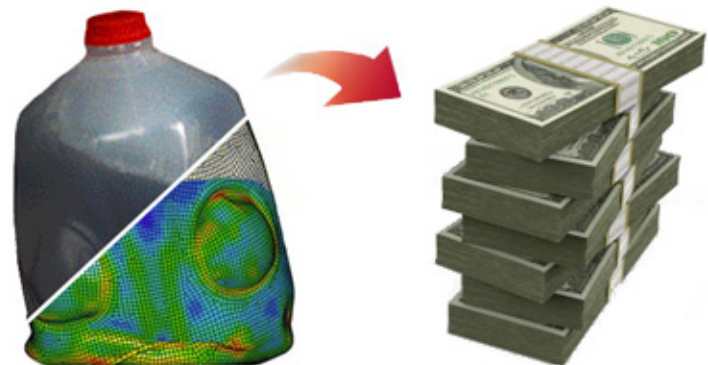
Max Reaction Force Results	lbf	N
Physical Test	2875.1	12,789
Simulation App	2379.6	10,585



Benefits to Product Engineers

P&G discloses that every \$1 invested in simulation returns at least \$7 in business impact.

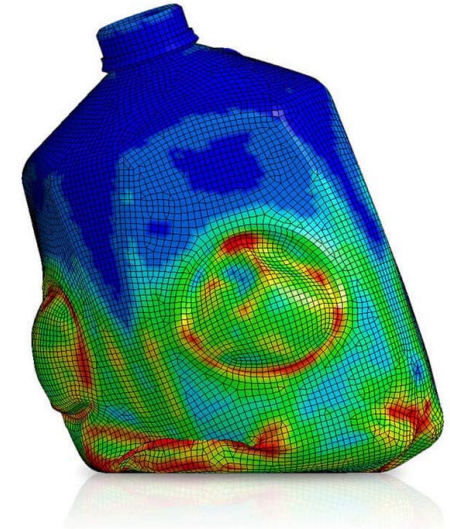
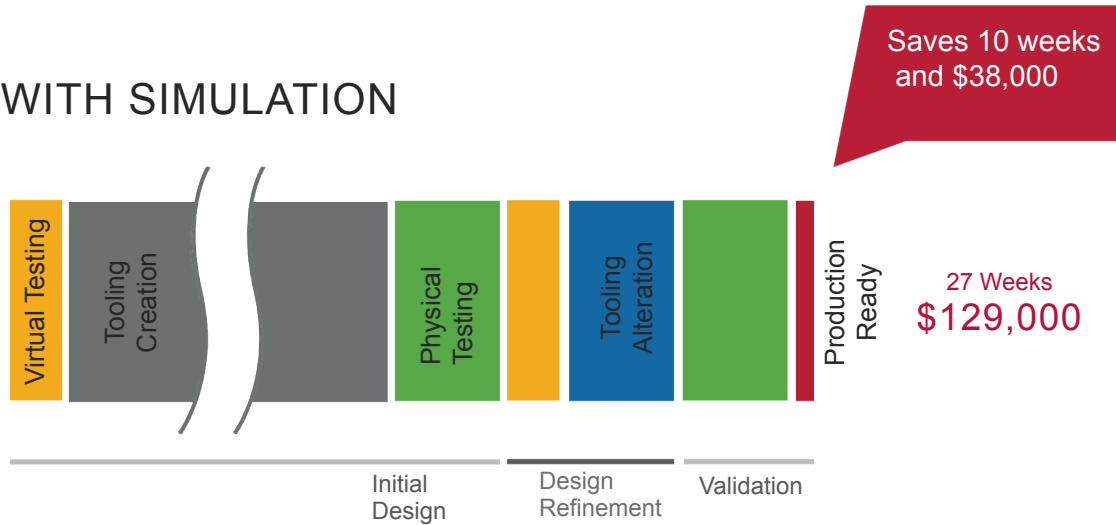
- Reduce manufacturing iterations
- Improve simulation QA
- Provide additional insights
- Provides an archive for storing and finding results
- Builds proprietary advantage



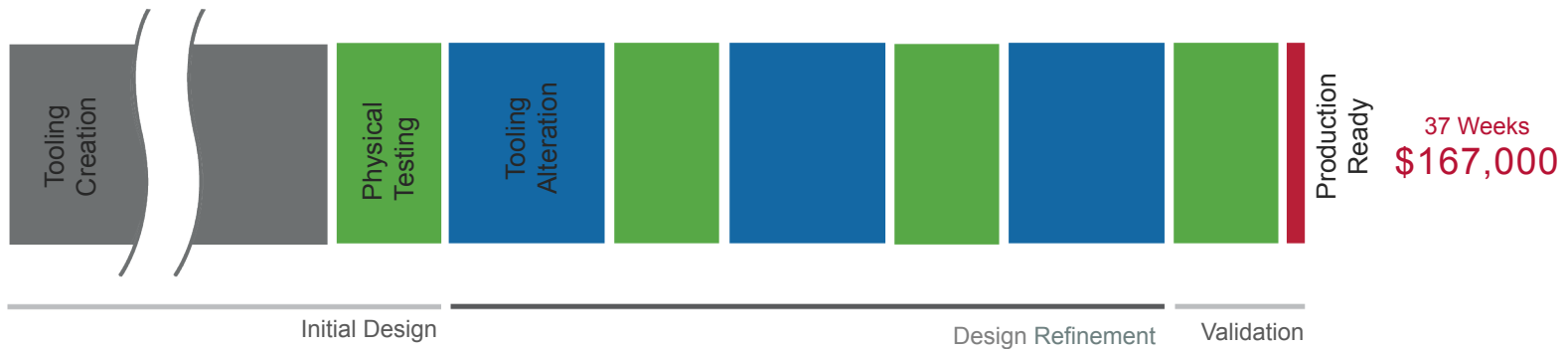
Real Example: Cost & Time Impact

Manufacturing Time Savings

WITH SIMULATION



WITHOUT SIMULATION

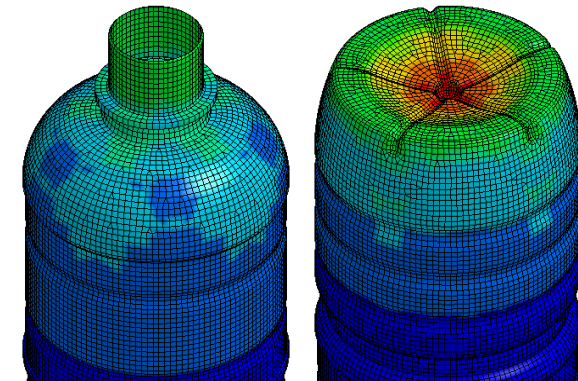
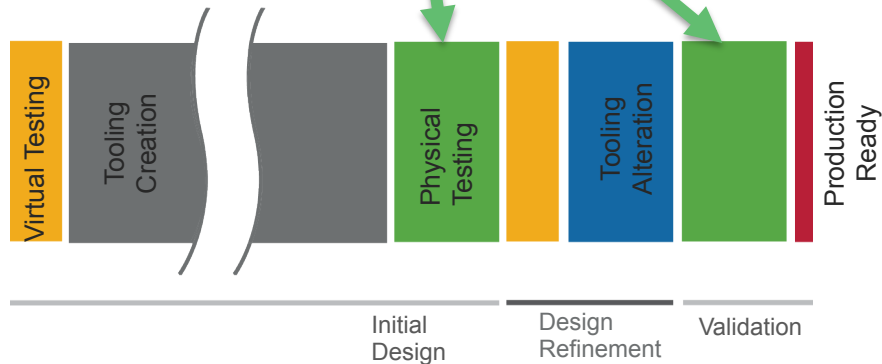


Integration of Simulation with Physical Testing

“Simulate your first test, not your last one” – Tom Lange (P&G – Retired)

Even with a high fidelity simulation, there are still many assumptions made that don't fully capture the **physical test**.

WITH SIMULATION



Throughput: Consulting vs. SimApp Analysis

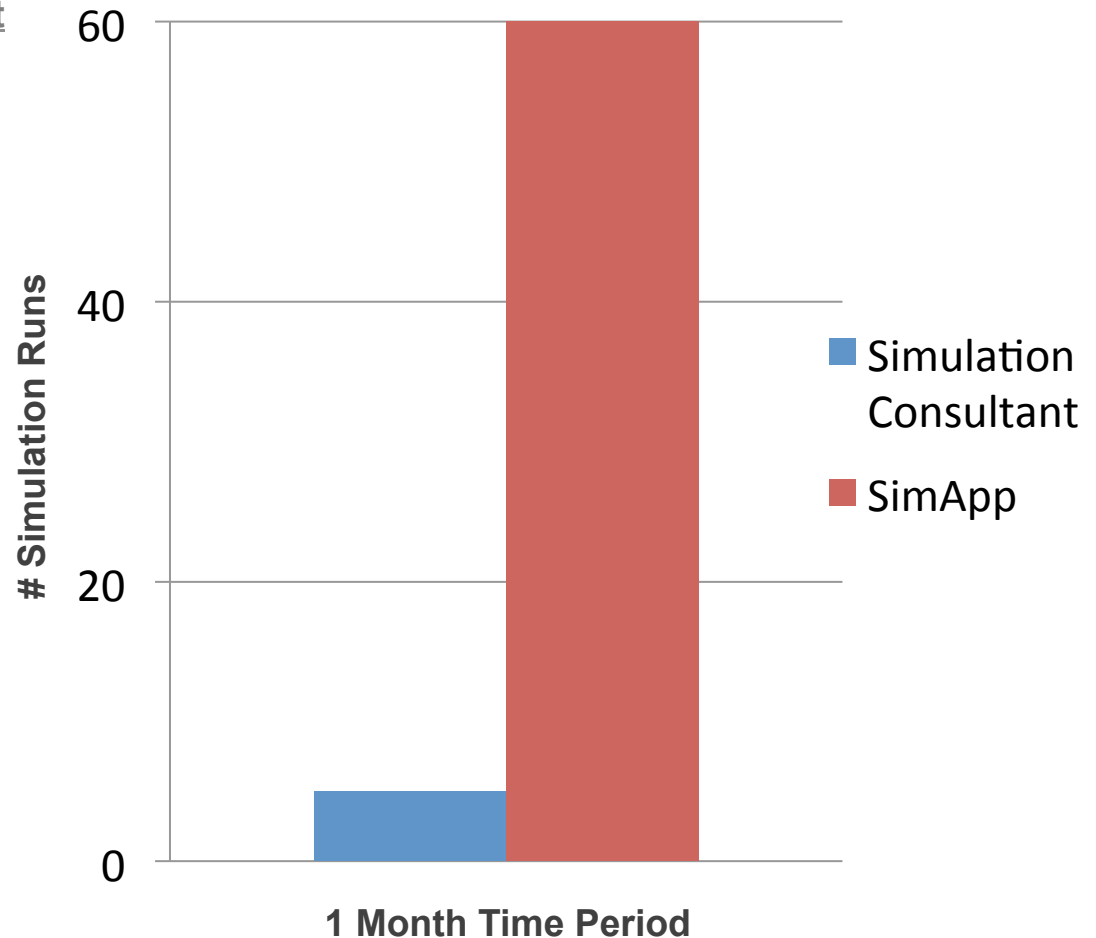
The difference in possibility when you are in control

Using a Simulation Consultant

- # of simulations limited to ~5
- Understanding the product
- Communication

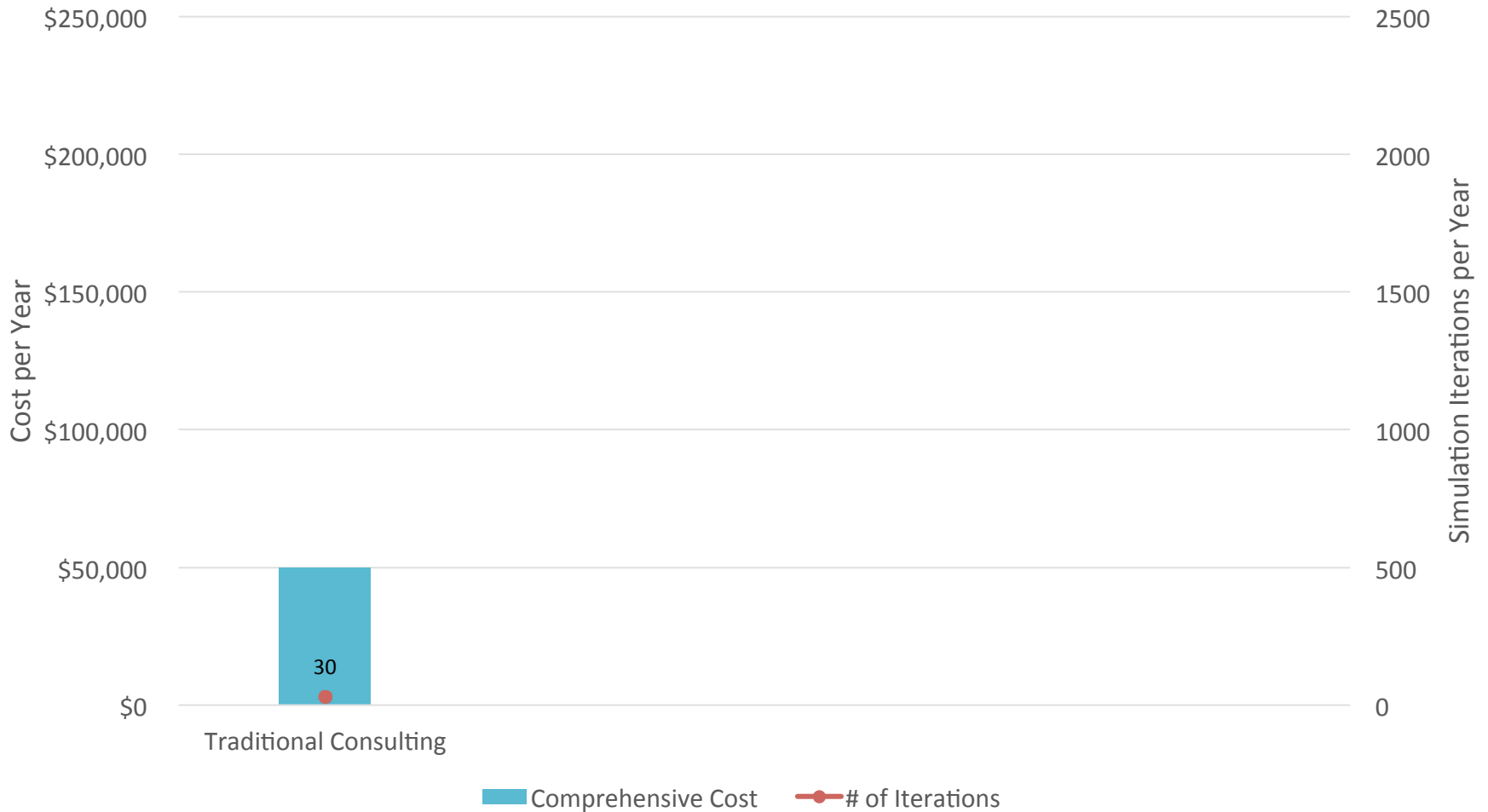
Using a SimApp

- ~60 simulations / month
- Best in class tools
- User friendly
- Expand the user base
- Built in expertise



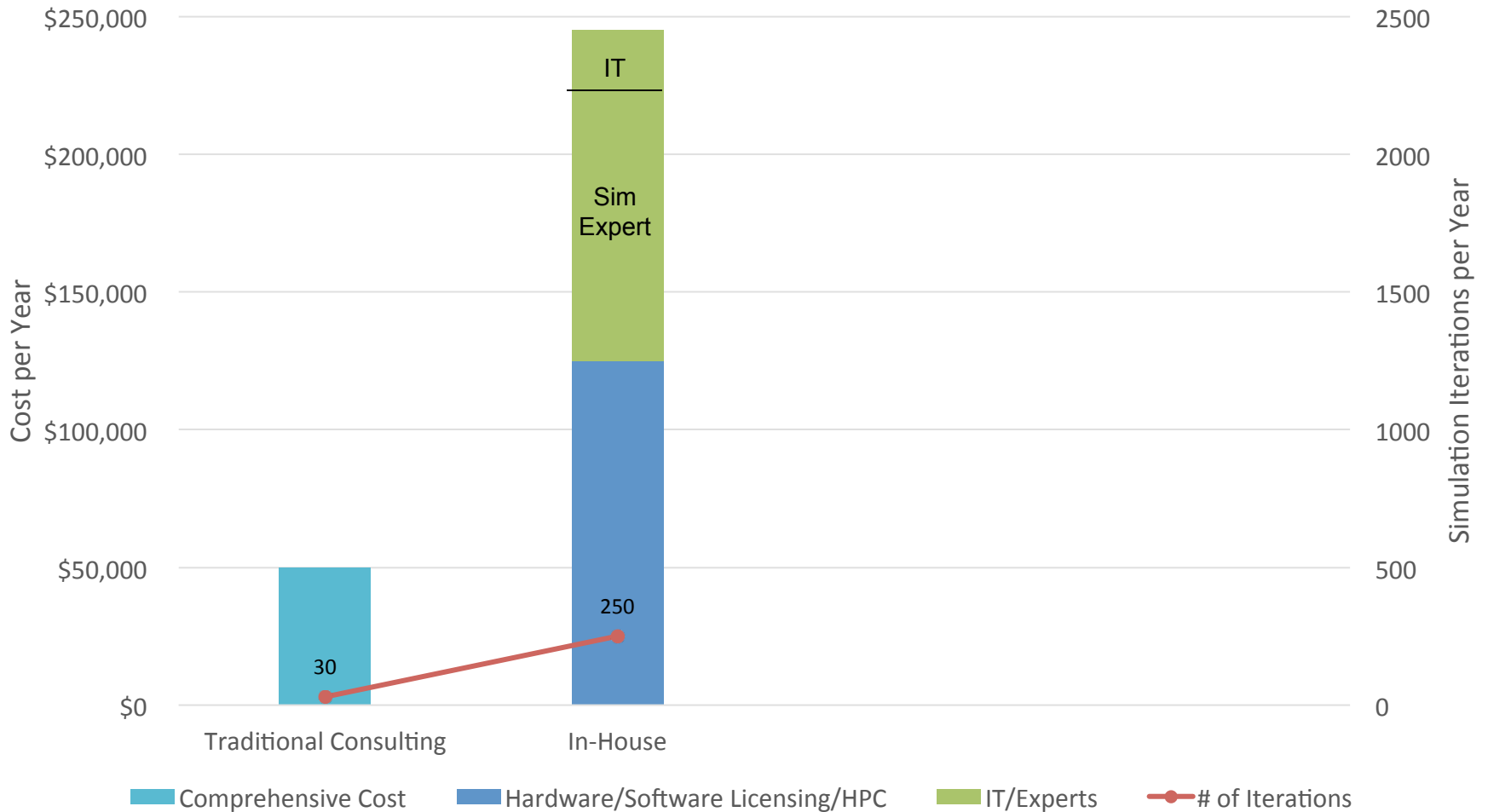
Cost of Automated Virtual Prototyping

Comparing cost and the number of simulation iterations



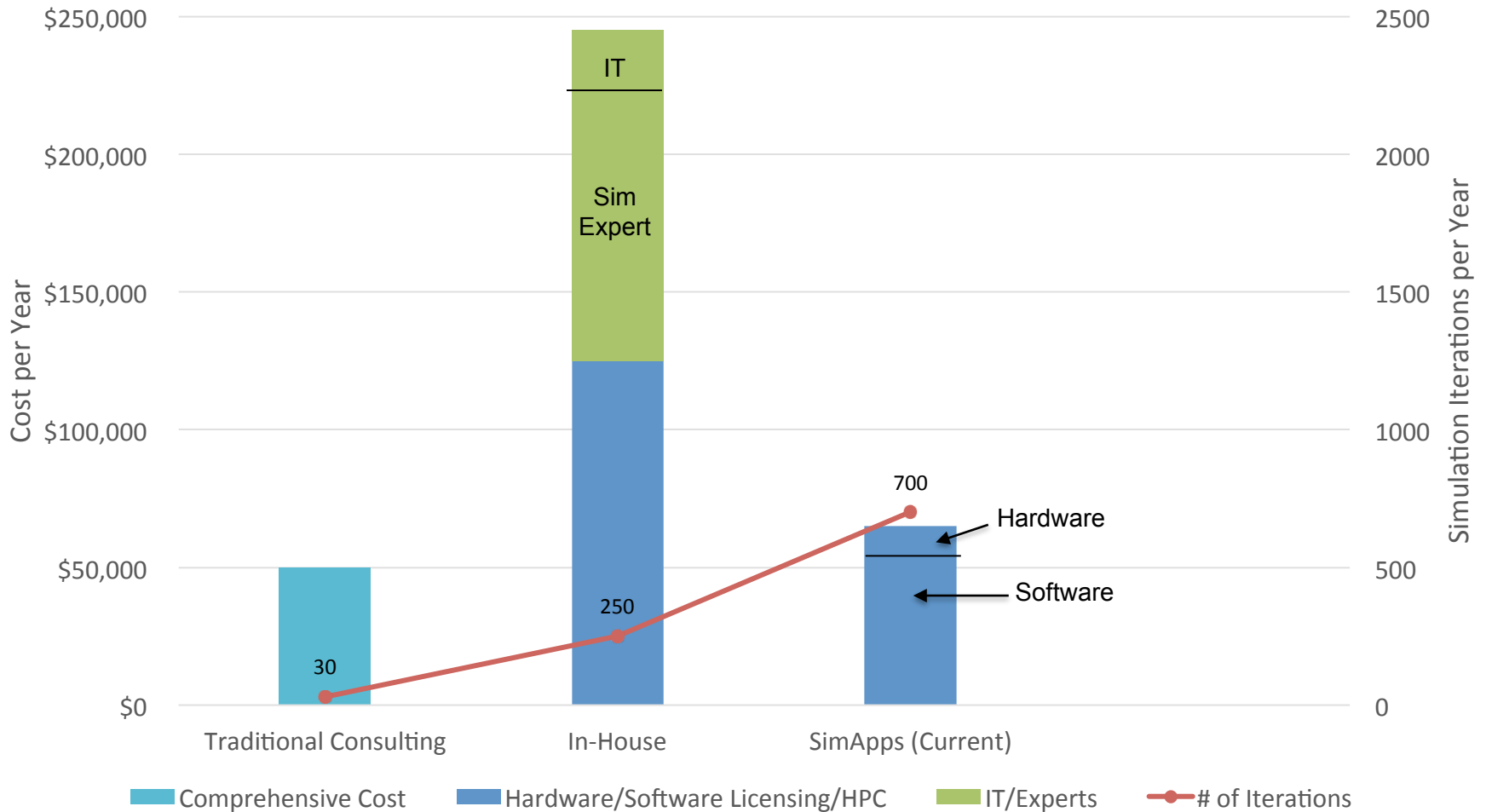
Cost of Automated Virtual Prototyping

Comparing cost and the number of simulation iterations



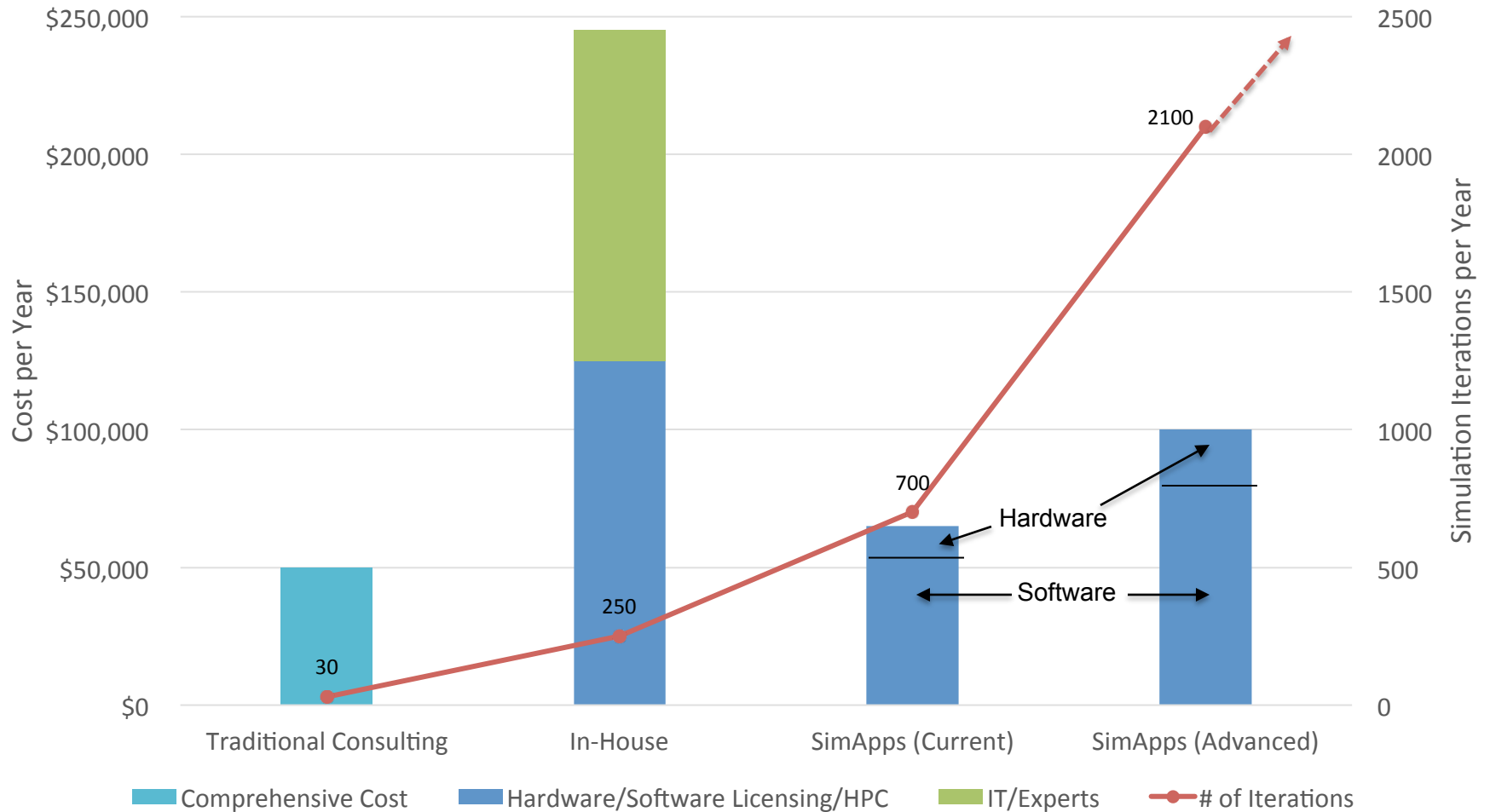
Cost of Automated Virtual Prototyping

Comparing cost and the number of simulation iterations



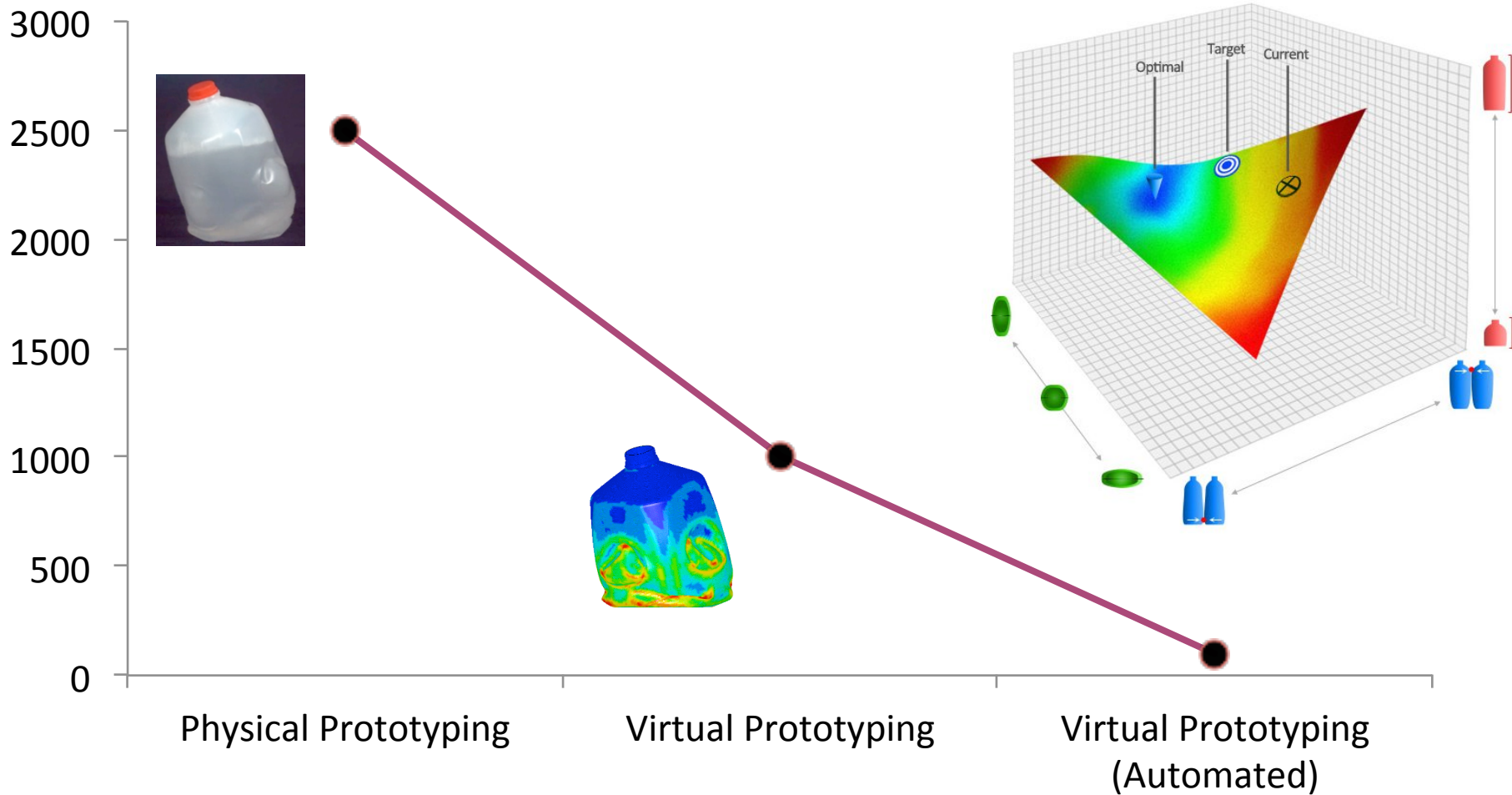
Cost of Automated Virtual Prototyping

Comparing cost and the number of simulation iterations



Virtual testing becomes more inexpensive

Testing Cost Per Iteration (\$)



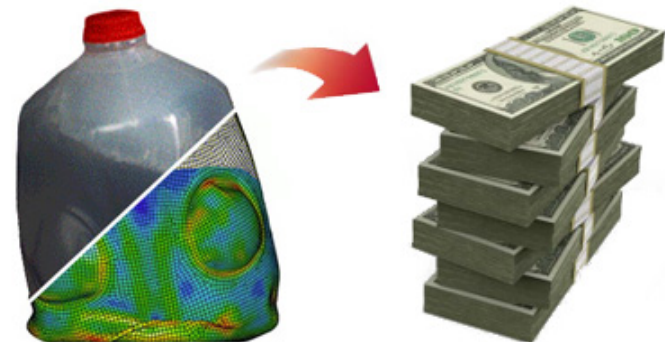
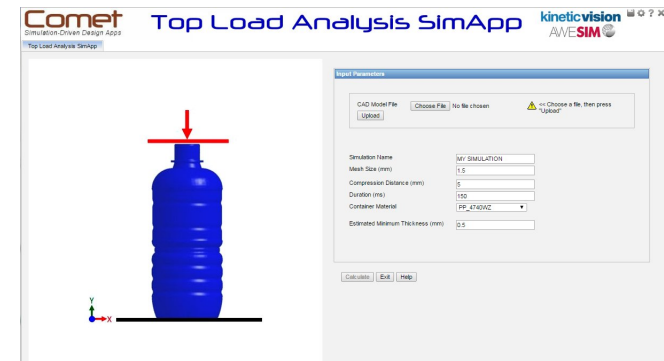
Conclusions

SimApps enable Product Engineers to quickly get direction from commonly used and validated simulations.

Cloud computing, flexible licensing and faster development tools make integrated simulation more accessible than ever before.

Benefits to Simulation Experts:

- Enables Product Engineers to be more self-sufficient within your simulation culture.
- Promotes consistent work-processes
- Provides an archive for storing and finding results
- Frees up Simulation Experts to develop new models.



Ingredients of a Successful App:

SimApp Developer Perspective

- Expertise
- Validation of results
- Implementing “Lights-Out” Automation
- Authoring Environment for *rapid* template creation
- Authoring Environment for *rapid* Web GUI creation

Ingredients of a Successful App:

Expertise & Validation

- Understanding the design and manufacturing of plastic consumer packaging
- Understanding the CAD and CAE tools
- Validating the results against test data
 - Testing the App extensively against many different container designs
 - Validating material libraries – can be a proprietary advantage for each manufacturer

Ingredients of a Successful App:

“Lights-Out” Automation

- Minimal input from the user
 - CAD (Product Rep.) in → Report out
- For consumer packaging, must accept the original CAD without feature simplification
- Meshing has to be *fully* automated
 - Non-experts know nothing about meshing
 - Design Space Exploration
 - Adaptive meshing to achieve mesh quality
- Report performance, *but also analysis quality metrics*

Ingredients of a Successful App:

Template Authoring Environment

- Rapid template development
 - Days, not months
 - **Minimize scripting & programming**
- Create maintainable & enhancable templates
 - Graphical environment to capture the process & best-practice rules
- Vendor-neutral – often, multi-vendor toolset
- Single, tool-independent product engineering data model – *support for multiple reps. for each component*
- Capture rules based on the Functional Architecture. Apps need to be robust across:
 - Significant geometry & topology design changes
 - An entire Product Family

Ingredients of a Successful App:

Web GUI Authoring Environment

- Rapid Web GUI development
 - Hours or Days, not weeks or months
 - ***Minimize Web scripting & programming***
- Create maintainable & enhancable GUIs
 - Graphical environment to capture the GUI and the constraint checking rules
- Built-In support for:
 - 3-D data
 - Results management and sharing
 - Database & PLM access
 - Load balancing

Ingredients of a Successful App:

Business Perspective

- Software Licensing (*the not-so-good news!*)
- Hardware in the Cloud (*the good news!*)
- What do you charge?
 - Controlled by the software licensing models
 - What can they afford and what value do they perceive?
 - Business model for App Developers?
- Working with the customer
 - Accommodating erratic usage patterns
 - ***Making DSE affordable***

Thank You!

Jeremy Jarrett, Vice President of Engineering, Kinetic Vision

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