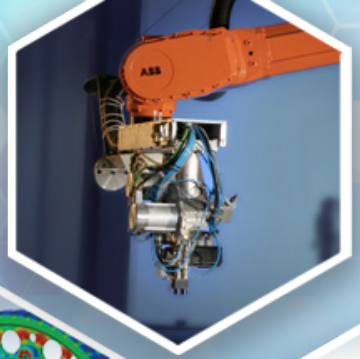
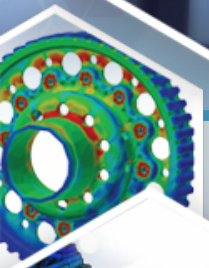
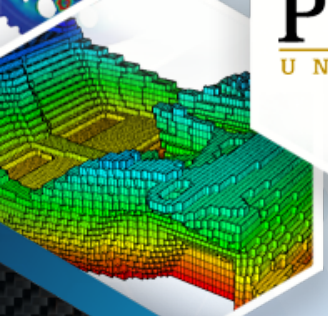
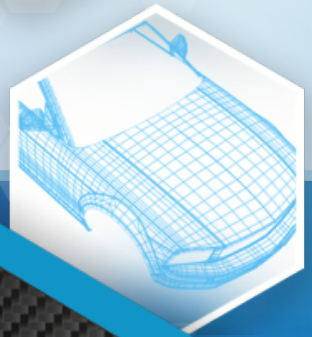








PURDUE
UNIVERSITY

# Composites Virtual Factory HUB

R. Byron Pipes

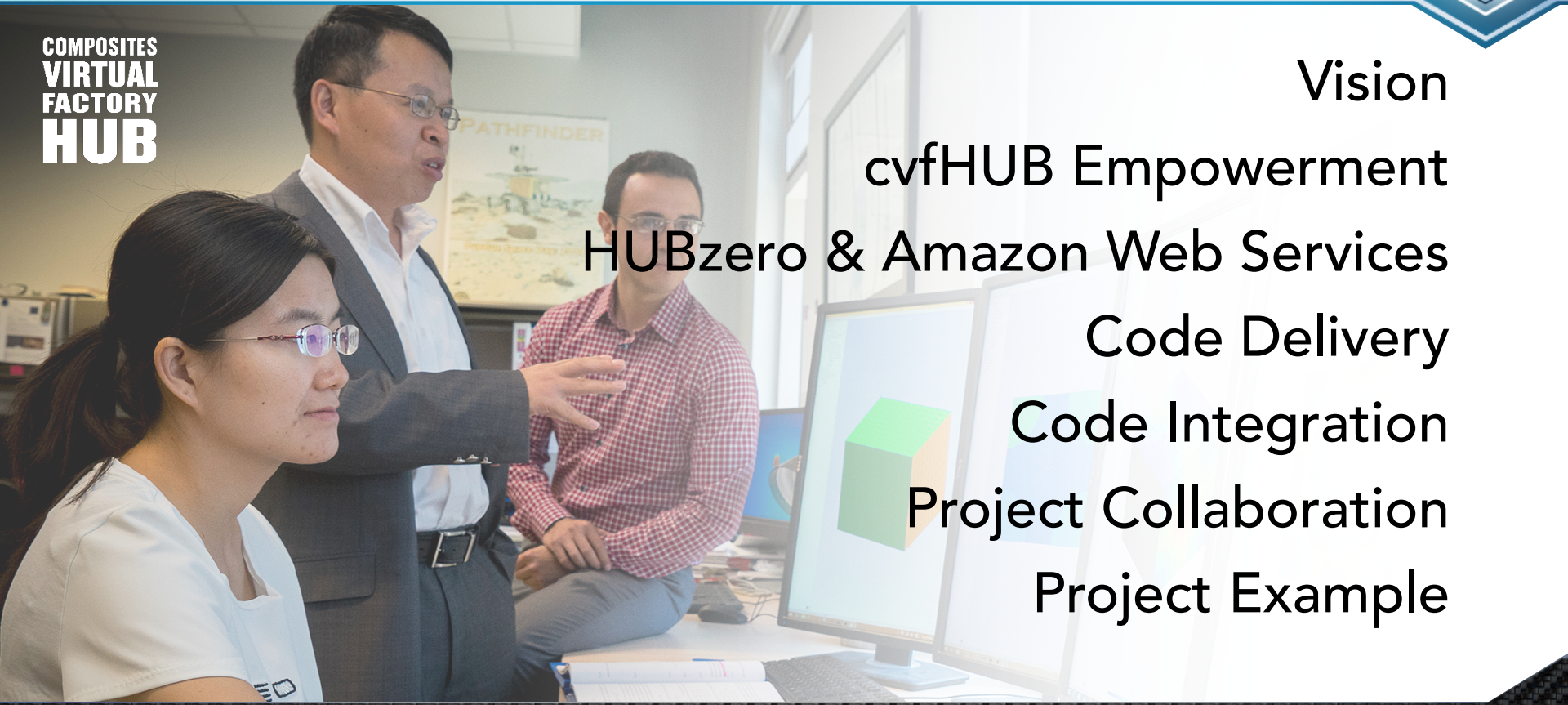
Johnathan Goodsell & Michael Bogdanor

COMPOSITES
VIRTUAL
FACTORY
HUB

# DESIGN MODELING AND SIMULATION

cvfHUB.org

# Outline




Vision

cvfHUB Empowerment

HUBzero & Amazon Web Services

Code Delivery

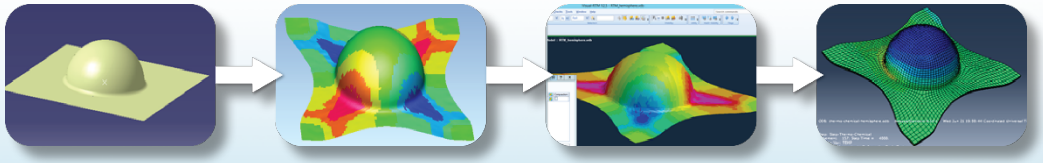
Code Integration

Project Collaboration

Project Example

# cvfHUB Vision

**End-to-end**
composites simulation.

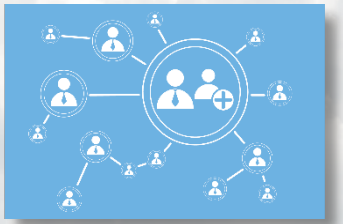


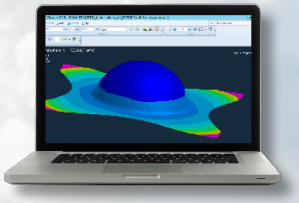
Powered by
**integrated** and **validated**
commercial software.

Design | Manufacturing | Performance

CATIA | Composites PAM-FORM 2G | SIMULIA

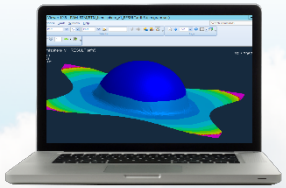
In a **secure**, **collaborative**,
**cloud-based** environment.



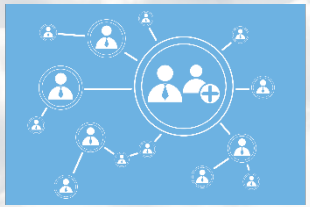


# cvfHUB Empowerment

Composites Innovation via Simulation in the Cloud



Cloud-based Simulation



Project Collaboration

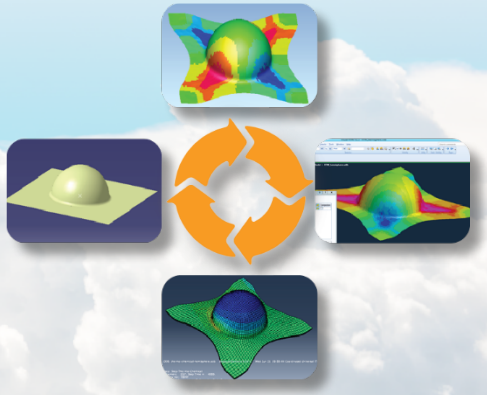
COMPOSITES
VIRTUAL
FACTORY
HUB

Hub Technology

AWS

Citrix

Manufacturing
Process Simulation



Process Integration

# Delivering Simulation Tools in the Cloud

amazon web services

A secure cloud services platform, offering compute power, file storage, content delivery, and other functionality to help businesses scale and grow.

# Delivering Composites Simulation Tools

COMPRO | RAVEN

CATIA | SIMULIA | BIOVIA | ENOVIA | DELMIA
3D EXPERIENCE

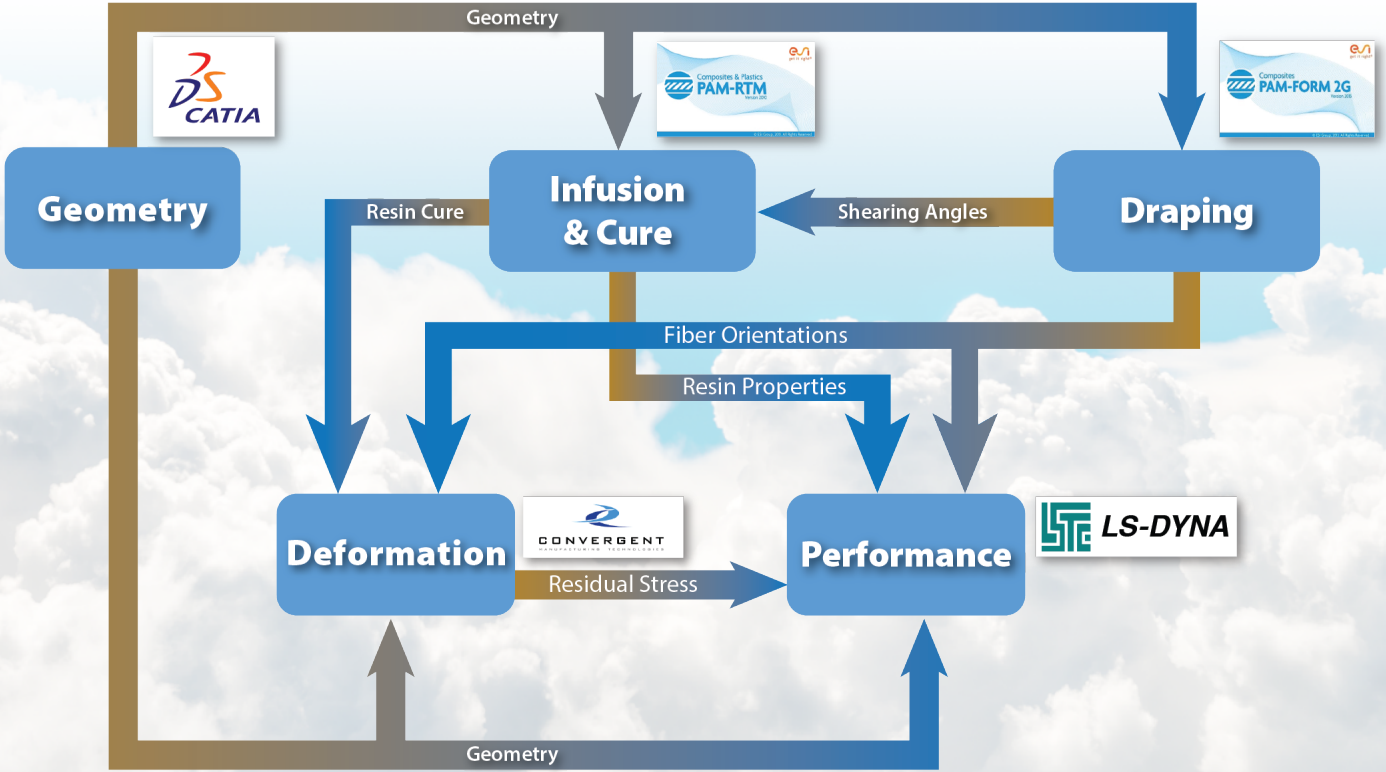
SWIFTCOMP | VABS

DIGIMAT | NASTRAN

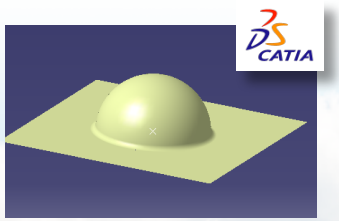
PAM-FORM | PAM-RTM | PAM-DISTORT | PAM-CRASH

**A single platform - with major composites software.**

# Code Integration HPRTM Process Modeling

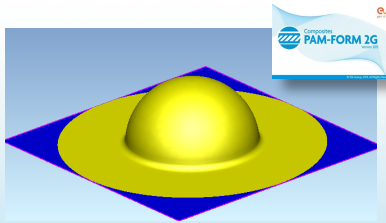


# Code Integration HPRTM Process Modeling

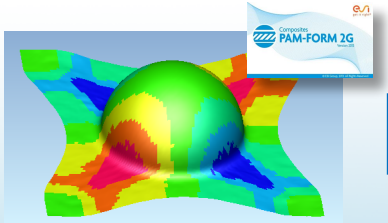



Build Geometry

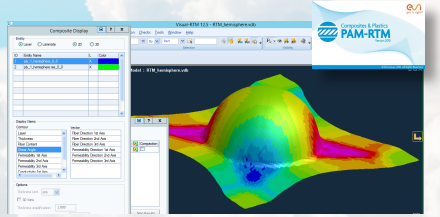
Import geometry



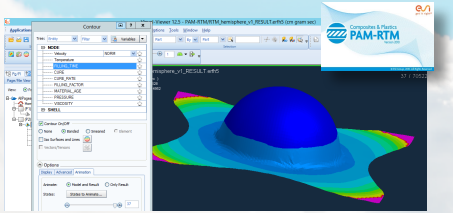

Run draping model



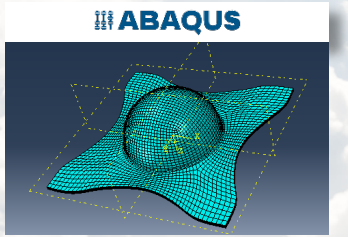

Import draping



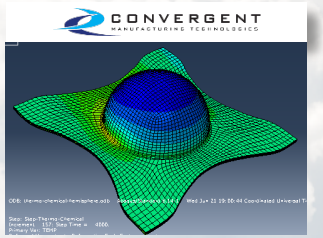

Run RTM model




Map results onto deformation model




Run deformation model



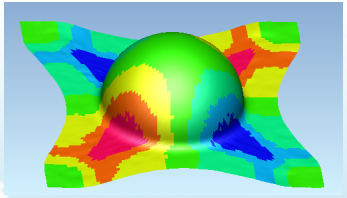

Manufacturing Informed Performance

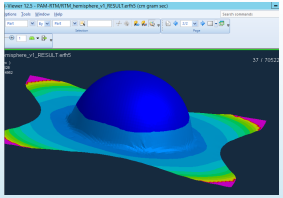
## Manual Method

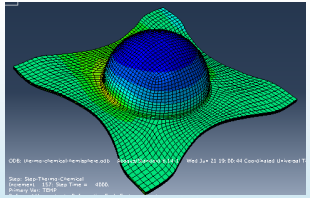
- 5 complex tools
- 1 hour active working time

# Code Integration HPRTM Process Integration

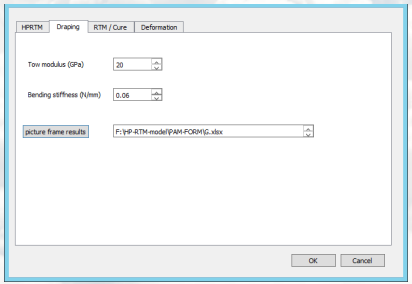
Build and save FORM, RTM, COMPRO models.







Program will automatically update models with new material properties / process conditions and run the models.




Open HPRTM process integration program.

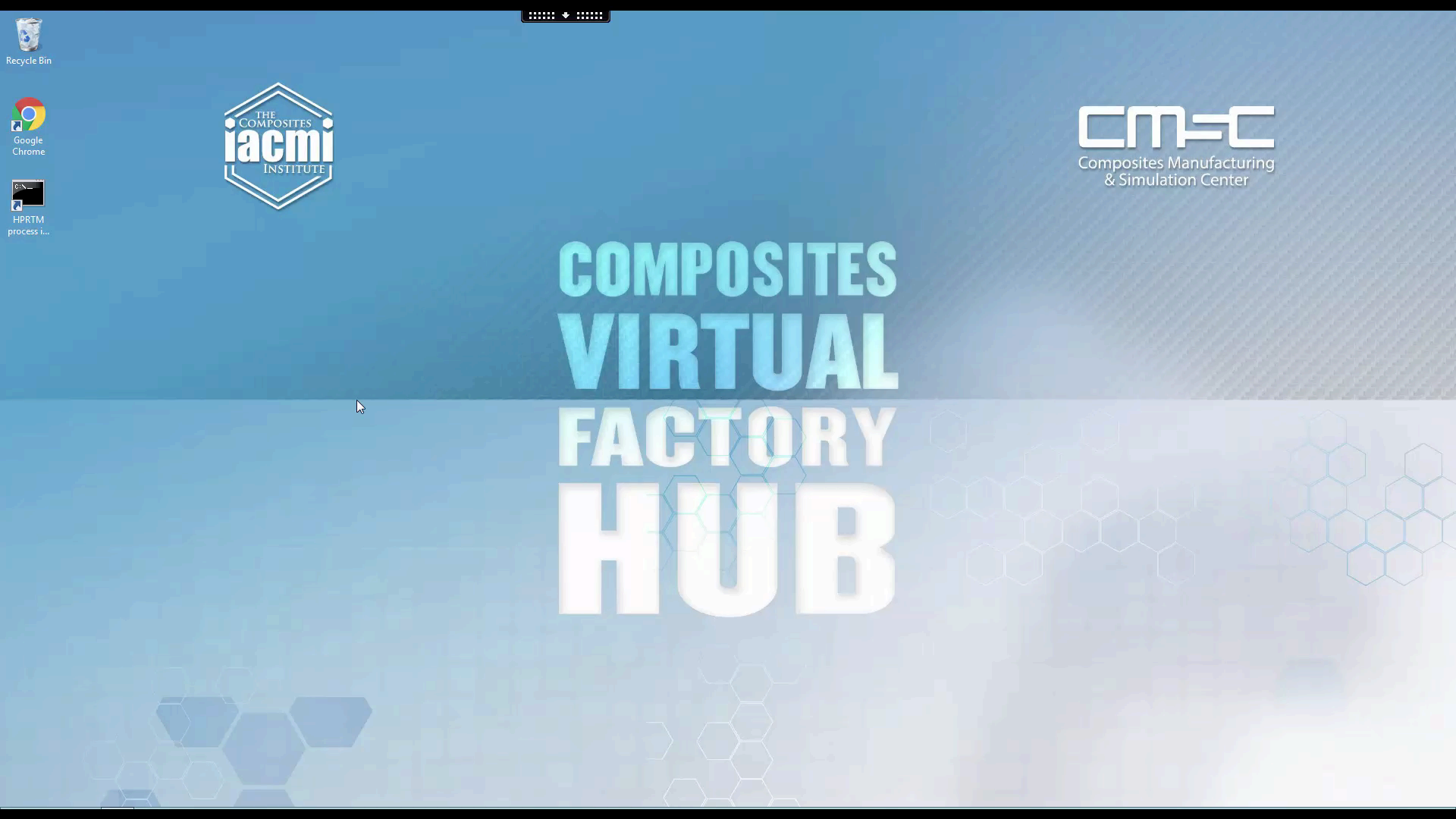
Enter material properties and process conditions

HPRTM Process Integration

Manufacturing Informed Performance

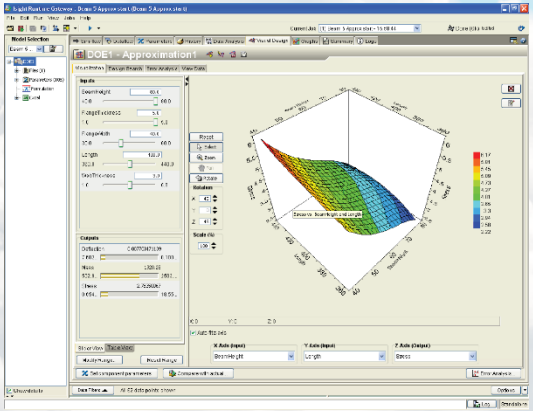
## Integrated Method

- 1 simple interface
- < 5 min. active working time

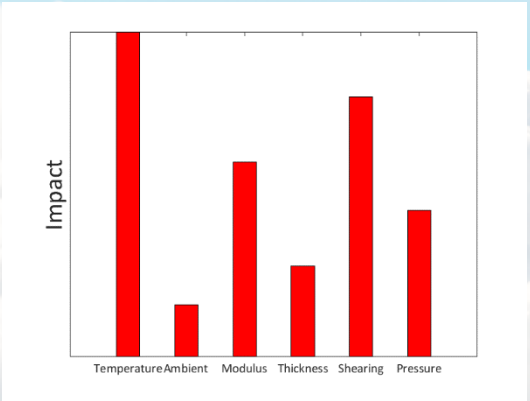

Recycle Bin
Google Chrome
HPRTM process i...
THE COMPOSITES
iacmi
INSTITUTE
Composites Manufacturing & Simulation Center
COMPOSITES
VIRTUAL
FACTORY
HUB

# Code Integration Makes Possible

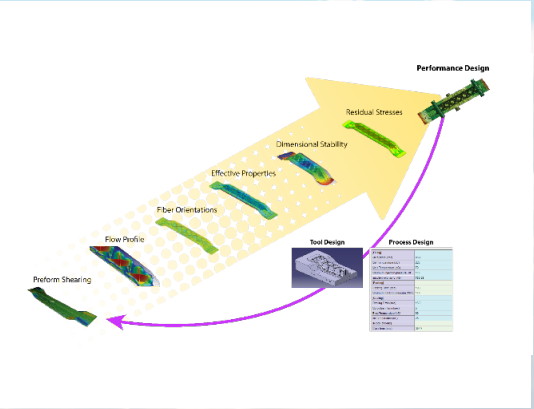
## Optimization



## Sensitivity Studies




## Manufacturing Informed Design

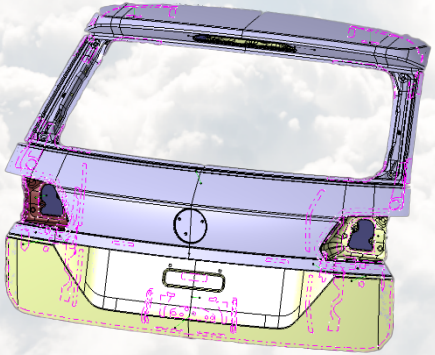


# Project Collaboration

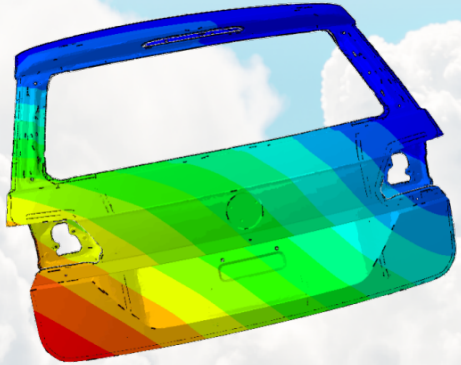
- Access to project files wherever partners are located.
- Co-located simulation files and software.
- Eliminate the need for sharing files over e-mail or insecure file-sharing services.

# Common Access to Project Files

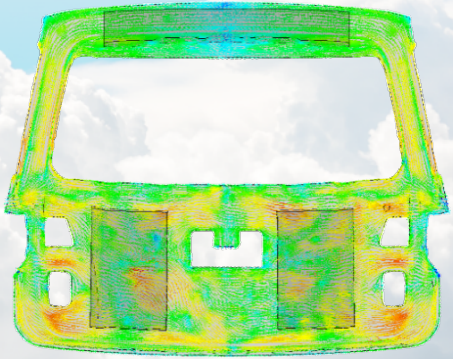
Geometry Files **>1GB**



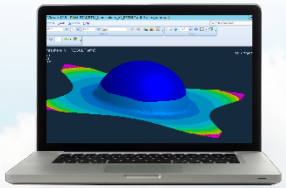
Performance Analysis **>400MB**



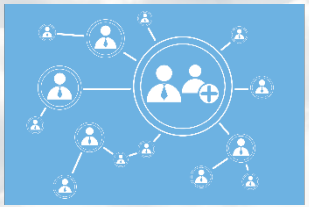
Molding Simulations **>2GB**



# cvfHUB Allows Composites Innovation via Simulation in the Cloud



Cloud Delivery of Simulation Codes



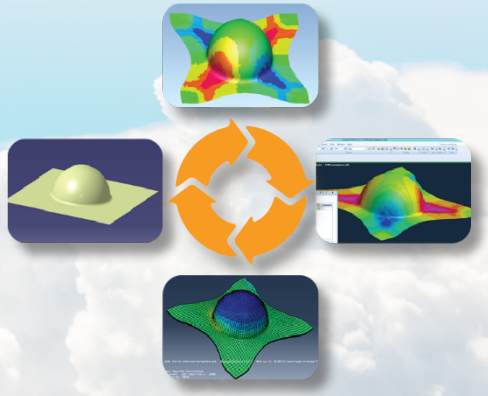
Collaboration

**COMPOSITES VIRTUAL FACTORY HUB**

Hub Technology

AWS

Citrix



Code Integration

# cvfHUB Access & Workshop

## cvfHUB Workshop tomorrow from 9–10am

*Simulation tools available **ONLY** to members of approved **IACMI** project teams*

How to become a **cvfHUB** member

How to organize project groups

What manufacturing processes can be simulated

Available simulation tools