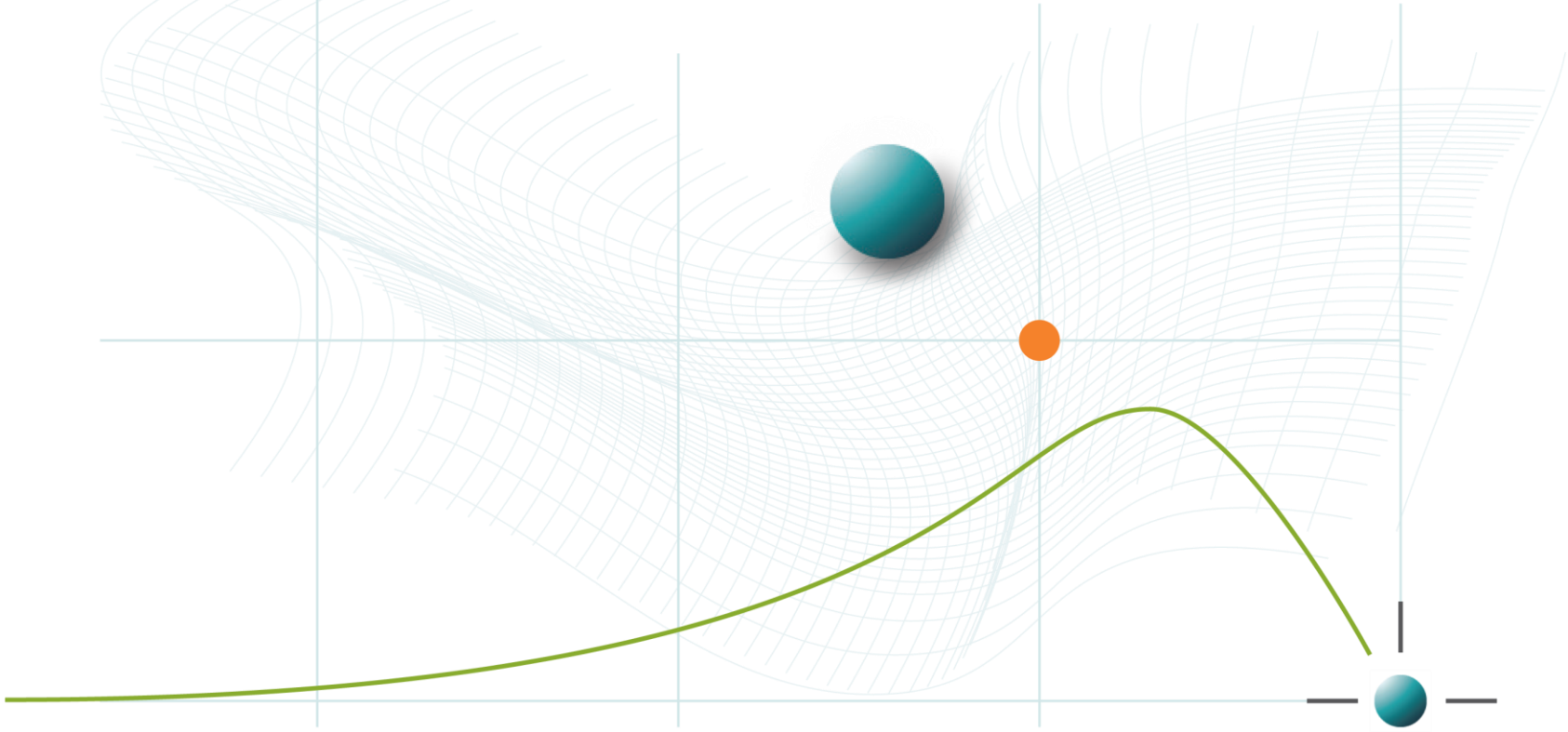
Role of Materials in Simulation

reducing materials risk through testing, modeling, validation, management and knowledge capture

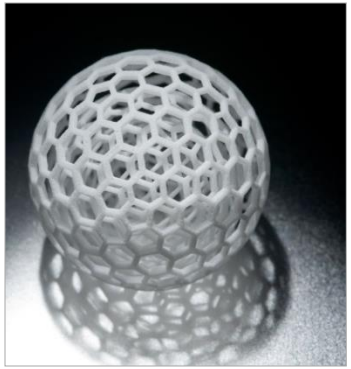
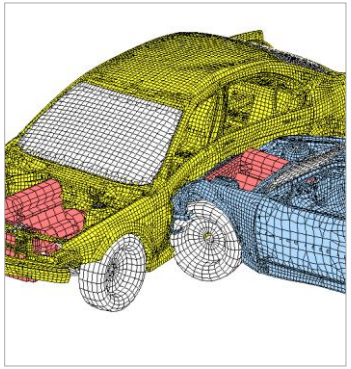
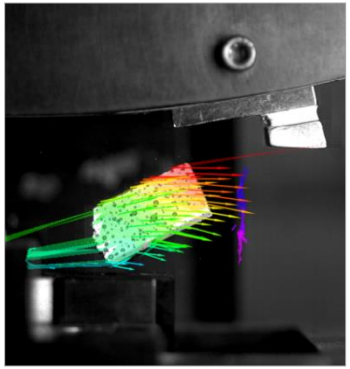


DatapointLabs TestPaks matereality knowmats picsci

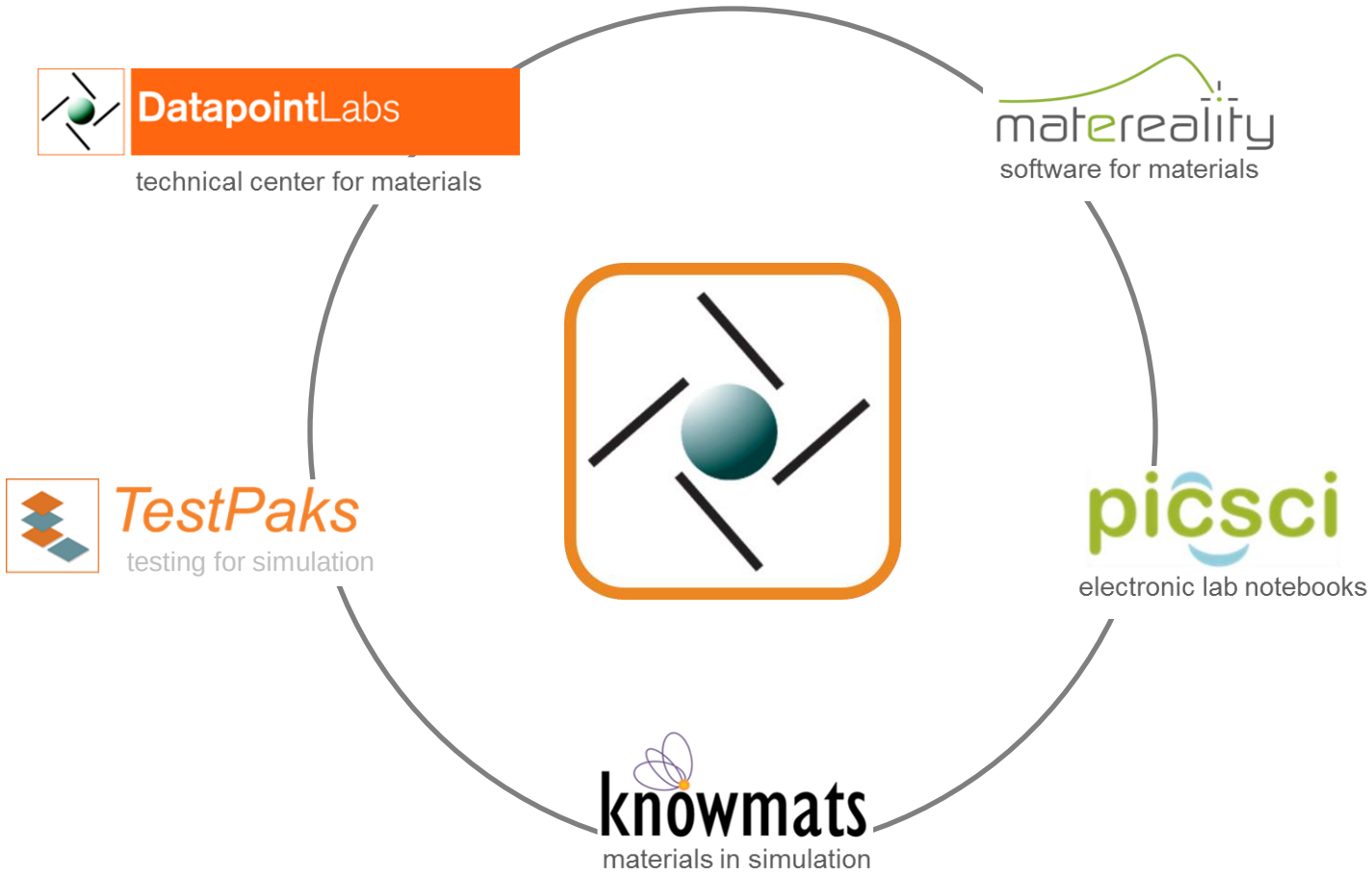
expert material testing | CAE material parameters | CAE Validation | software & infrastructure for materials | materials knowledge | electronic lab notebooks

Mission

We strengthen the materials core of manufacturing enterprises to facilitate their use of new materials, novel manufacturing processes, and simulation-based product development.

Brands


DatapointLabs
technical center for materials
matereality
software for materials
TestPaks
testing for simulation
picsci
electronic lab notebooks
knowmats
materials in simulation

20+ years of **Datapoint**Labs

- Focused on “materials in simulation” since 1995
- Deep domain expertise
  - physics of materials, CAE parameter conversion, software for materials
- Market dominant and world renowned

Yesterday's product development

- Conventional, well understood materials
  - Handbook material data was adequate
  - Material testing in a few cases, in an R&D mode
- Large factors of safety
- Simulation used on the sideline, as "trendy"

Today's landscape

- New materials
  - Behavior not completely understood
- New production processes
  - Can affect product performance
- Light-weighting
  - Shape optimization
  - Critical designs with optimal factor of safety
- Trend to simulation driven product development
  - Design decisions being based on simulation results
  - Reduced or eliminate late-stage prototyping

Failure can be expensive

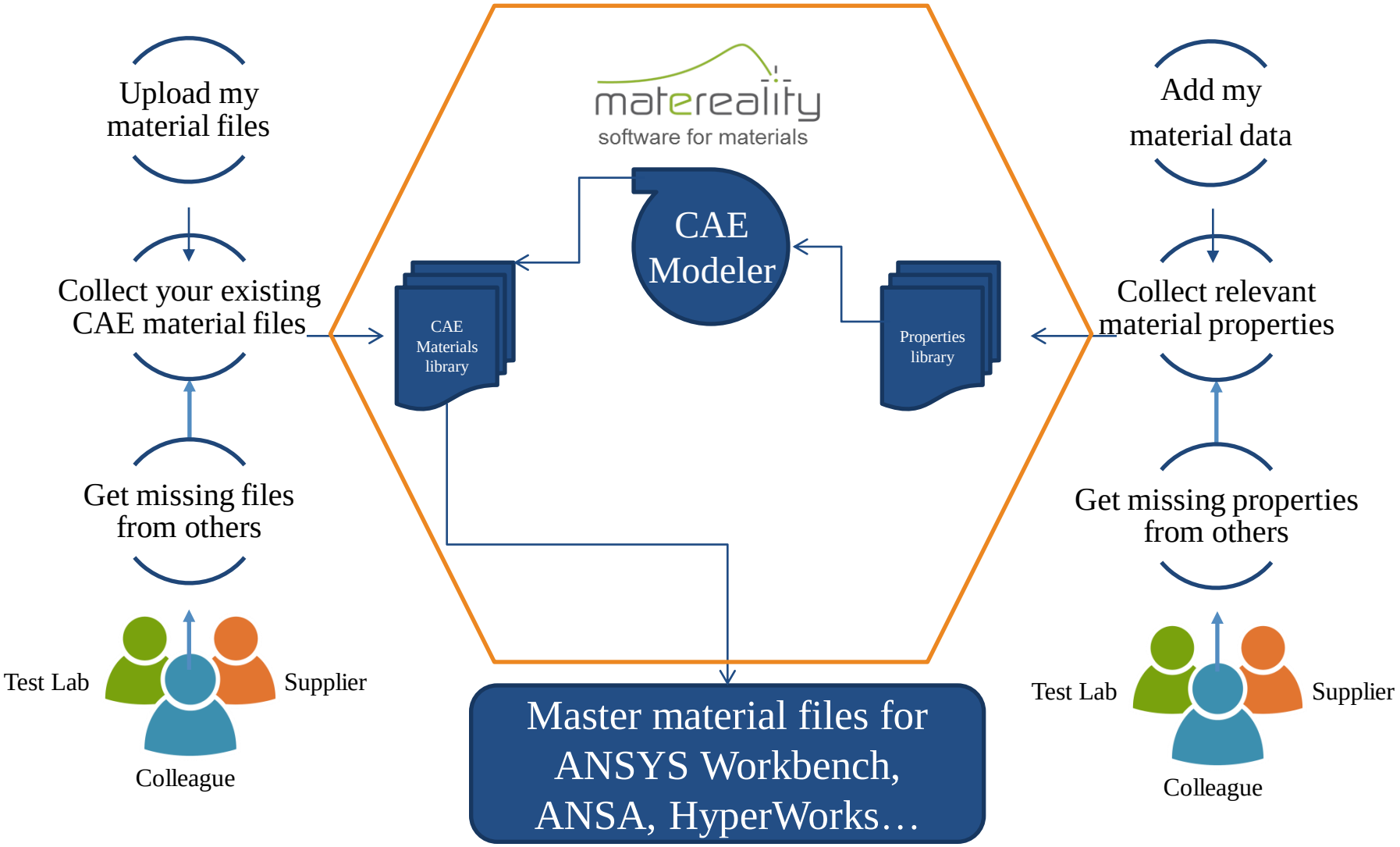
Contribution of materials

- Need for accuracy & traceability
  - Data from internet presents unmanaged risk
- Modern material data can be complex
  - Not easily understood by design/CAE engineers
- Conversion to material parameters for CAE
  - Need for correct data processing

What is needed – a process approach

- The right material data
  - Actual material, correct manufacturing process
  - Accurately measured properties
- Fitted to correct model
  - Right material model
  - Correct parameter conversion
  - Correct material file
- Mid-stage validation of simulation
  - Check if simulation produces correct result
- Error-free export to simulation
  - Master material files
  - Correct material name (same as on the BOM / print)
- Consistency: All users must use the same master material files

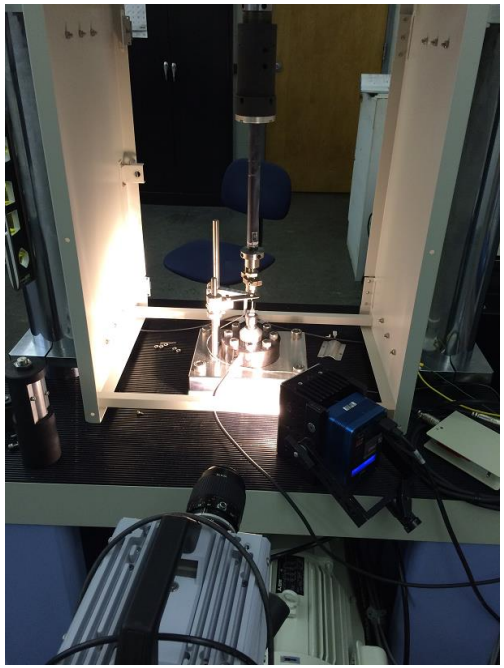
Materials Workflow for Simulation



Obtaining physical properties of your materials

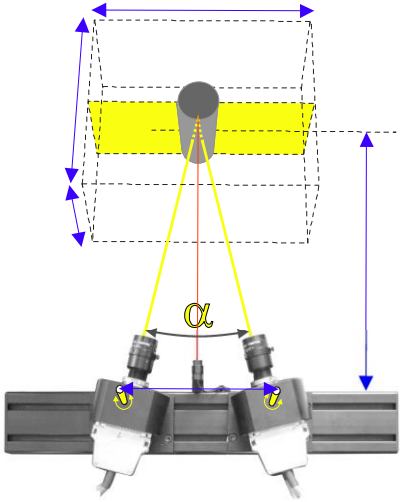
- Mechanical Properties
  - Tensile
  - Compressive
  - Shear
  - Hyperelastic
  - High strain-rate
  - Fatigue
  - Creep
- Thermal Properties
  - Expansion
  - Conductivity
  - Specific Heat
- Flow Properties
  - Rheology
  - Viscoelasticity

crash and drop simulation data



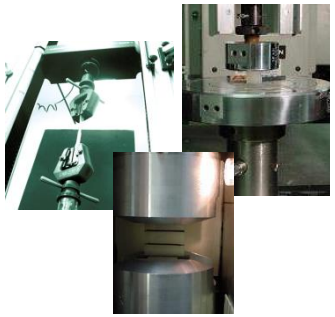
Advanced measurements

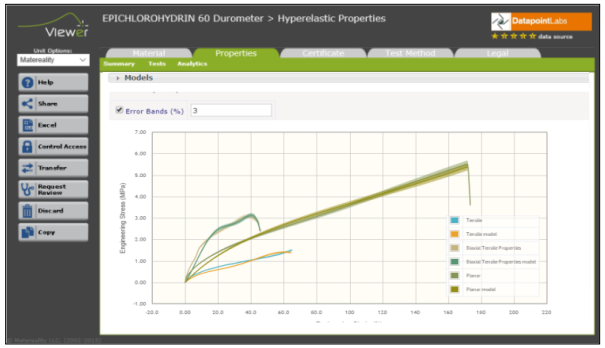
- **DIC**
- **High speed data**
- **Composite shear**
- **Validation**



Simulation properties

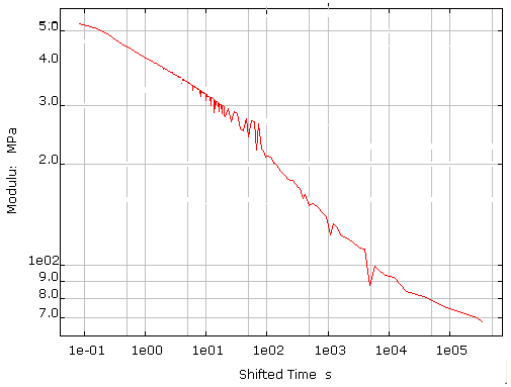
hyperelastic modeling of rubber





testing of foams

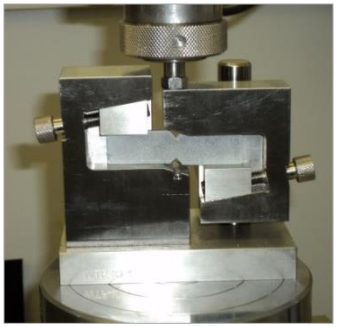
creep, fatigue, long term behavior



Material parameter conversion process

- Need accurate consistent data on your material
- All required properties must be measured
- Material parameter generation must be correct
- Validation can be beneficial

composite



ORTHO Option

MID	RO	EA	EB	EC	PRBA	PRCA	PRBC
1		62117	81531	55480	0.035	0.43675	0.361
GAB	GBC	AOPT	G	SIGF			
4458	3371	0	125000	500			

ANISO

MID	RO	C11	C12	C22	C13	C23	C33
1		1.23E-05	-6.8E-07	1.61E-05	-4.43E-06	-6.26E-06	8.62E-06
C14	C24	C34	C44	C15	C25	C35	C45
0	0	0	2.24E-04	0	0	0	0
C55	C16	C26	C36	C46	C56	C66	AOPT
1187	0	0	0	0	0	4458	0

testing + conversion

your design

Obtaining material parameters for CAE
TestPaks

testing | material parameters | CAE material file | validation

Your data, material cards and test reports are deposited directly into your Matereality database

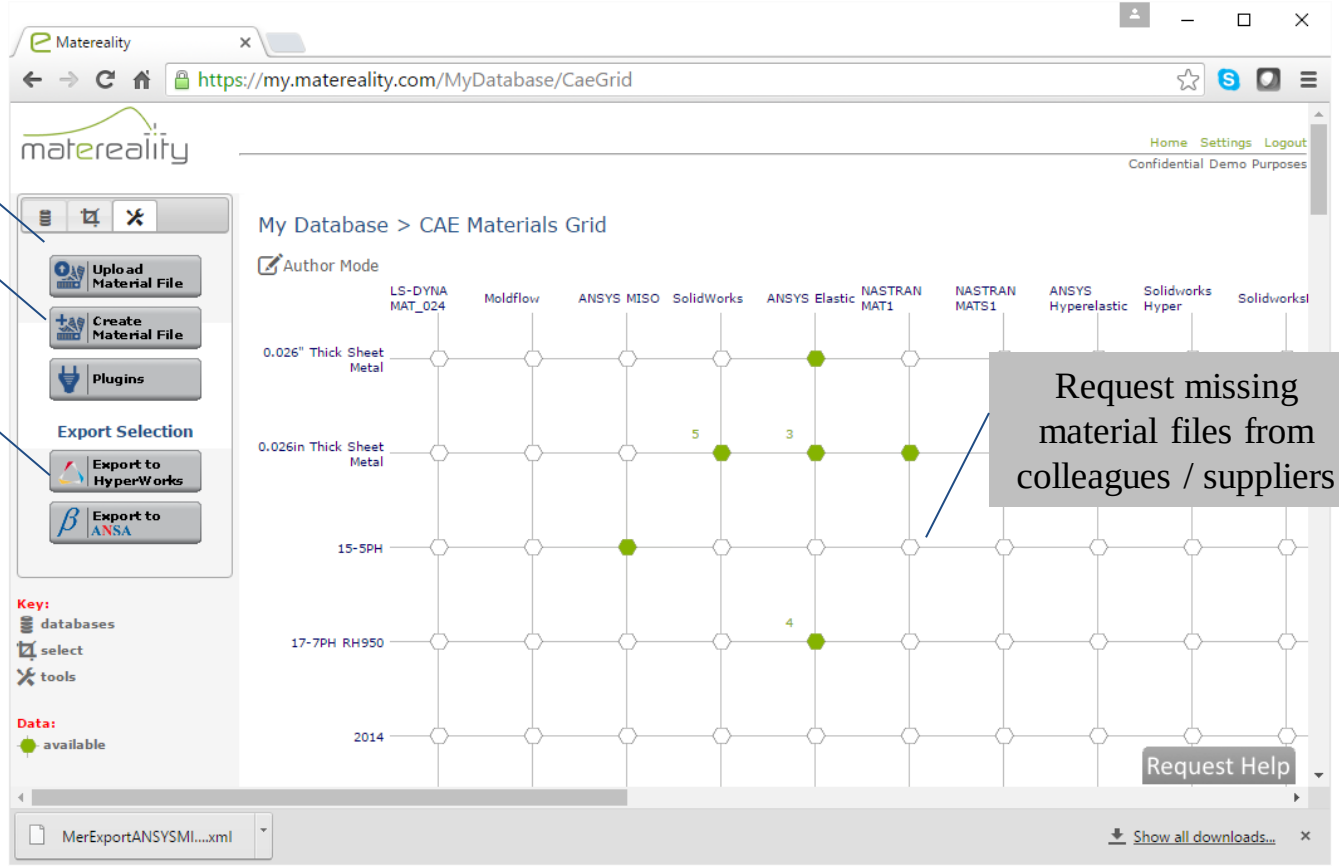
Matereality's framework

assemble: convert: deploy

upload existing material files

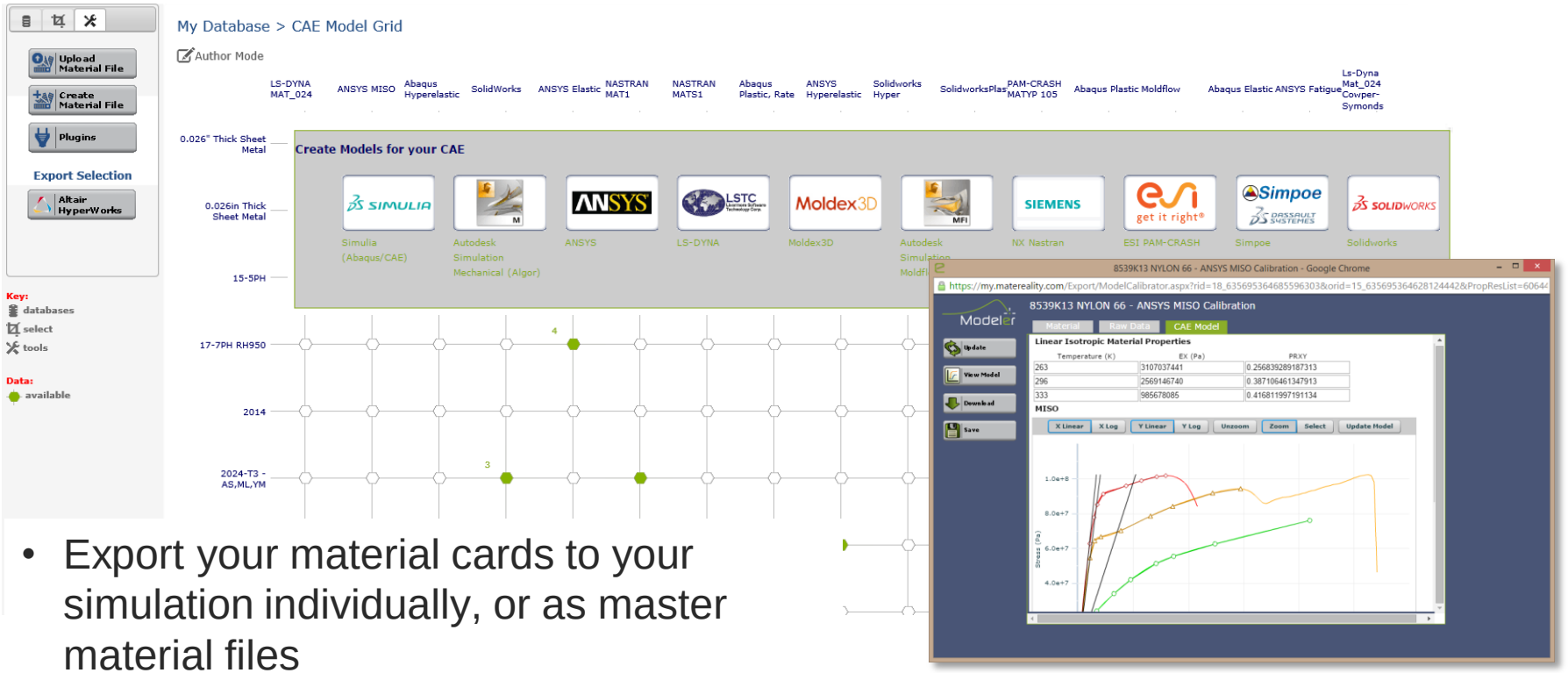
Create material files from property data

Export master material files to simulation



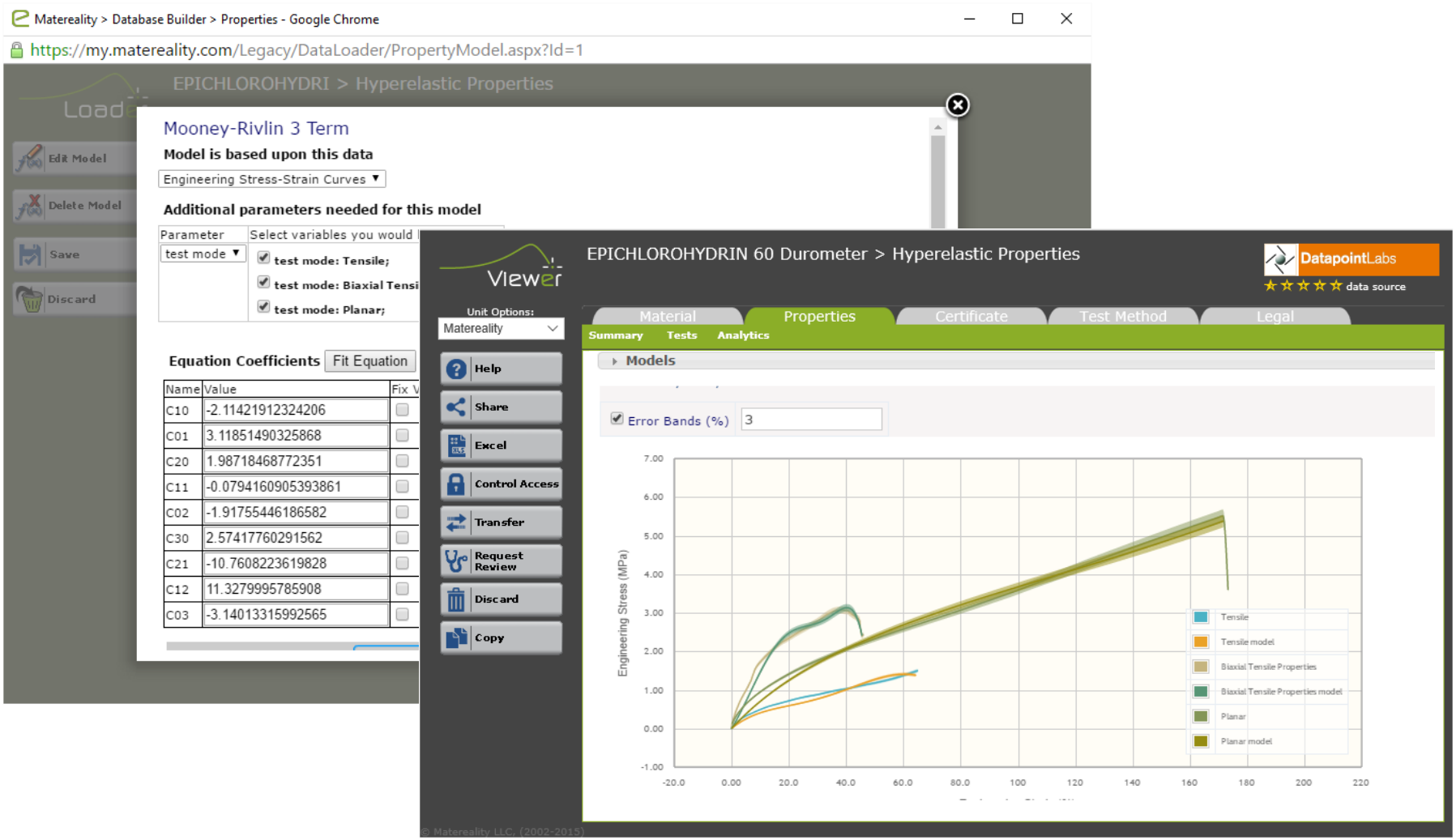
Request missing material files from colleagues / suppliers

Software for material parameter conversion



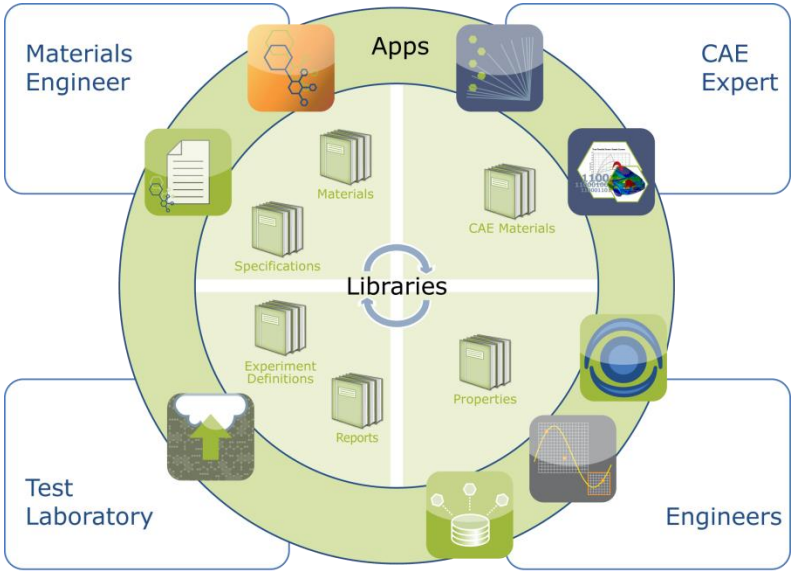
- Export your material cards to your simulation individually, or as master material files

DIY: fitting material parameters with Matereality

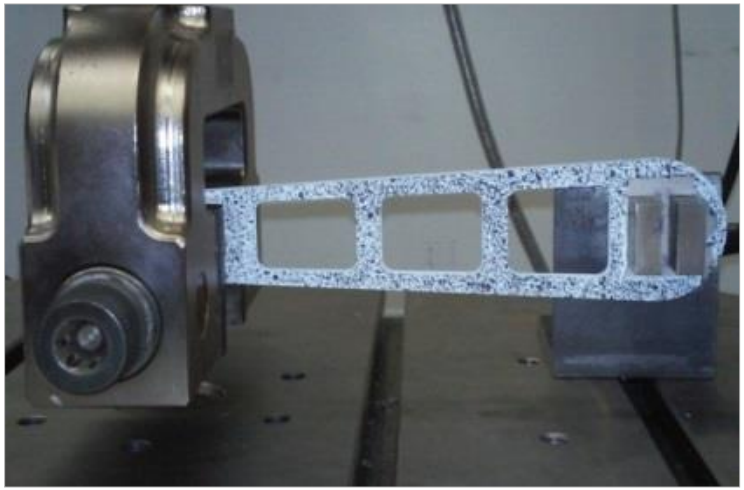


Integration with the enterprise materials landscape
the big picture

- Material Data Server for Enterprises
  - Libraries
    - Material information
    - Properties
    - Material specifications
    - CAE material files
    - Test reports
  - Software modules
    - Load, view, compare materials
    - Create CAE material cards
    - Create master material files
    - Create/manage specifications

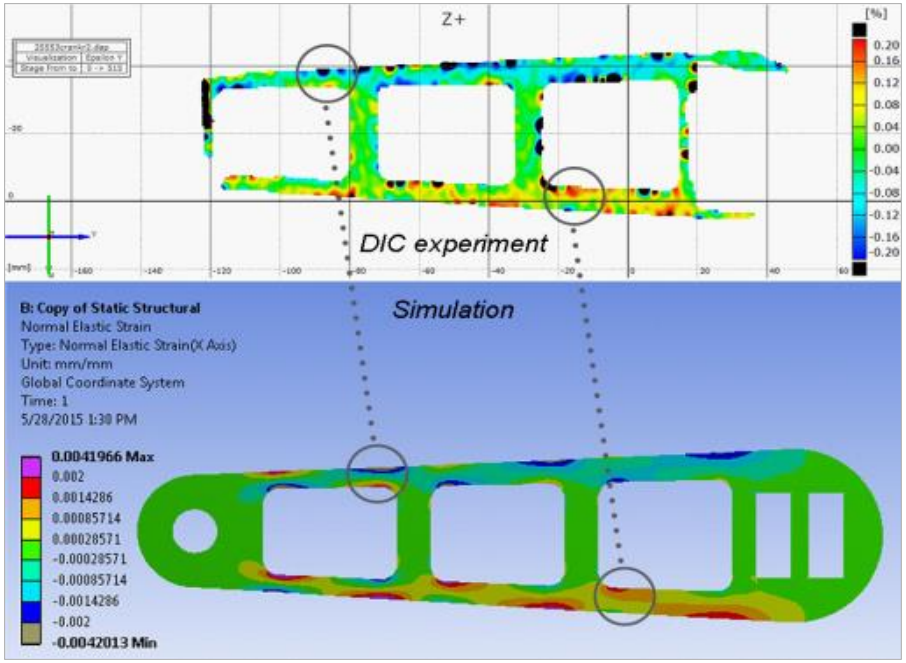


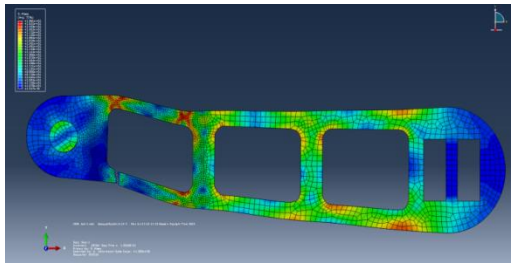
3D printing validation by *CAETestBench*



Validation of ANSYS® simulation for a 3D printed aluminum component, using a standardized bike crank (from Cornell's Swanson Laboratory for Advanced Engineering Simulation) and DIC.

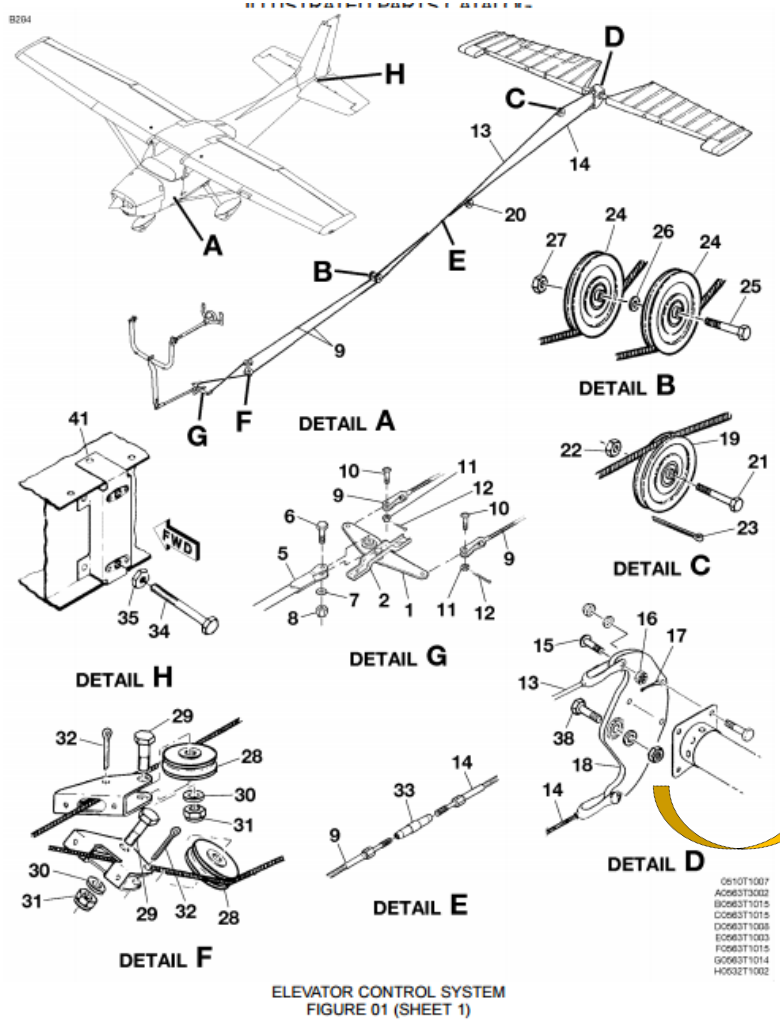
DIC validation

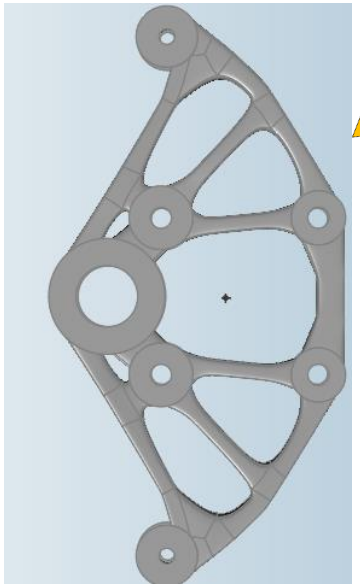




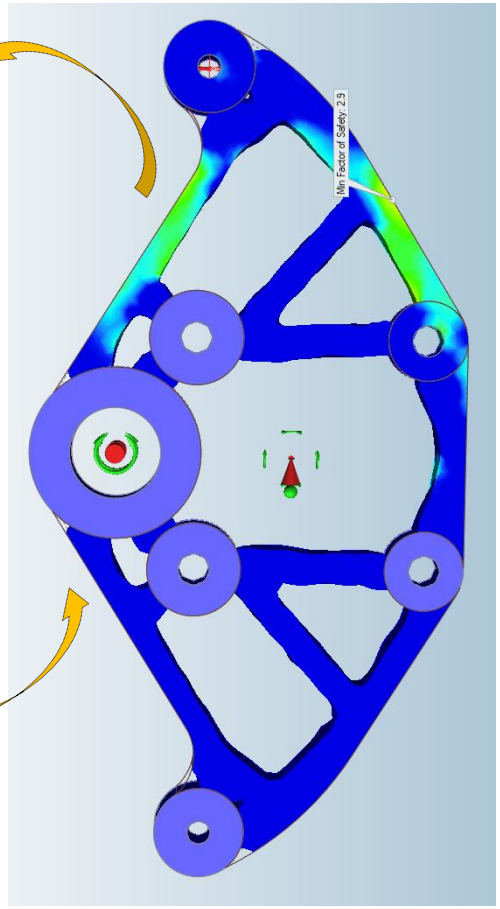
Failure validation

SDPD process applied to 3D printing



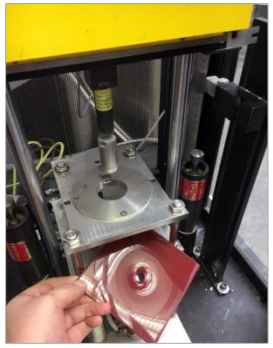


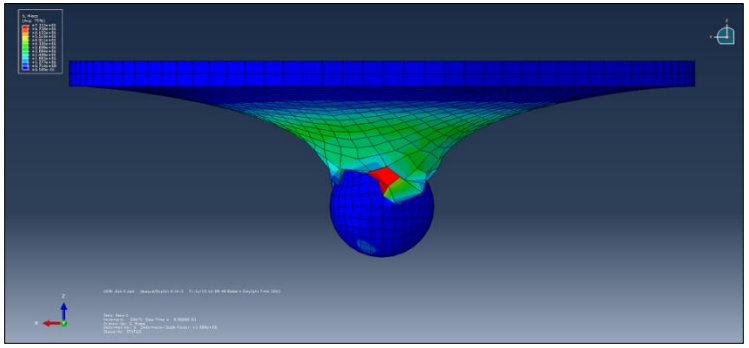
Shape optimized part



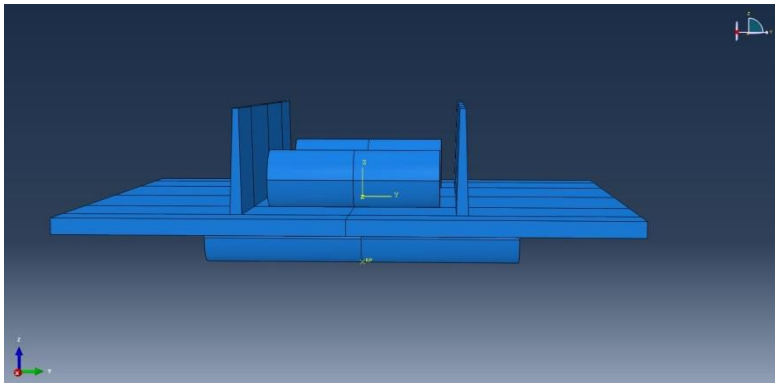
Original part

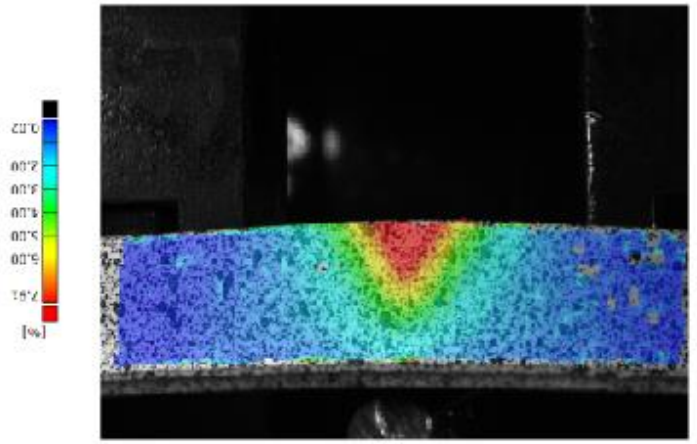
Crash validation by *CAETestBench*

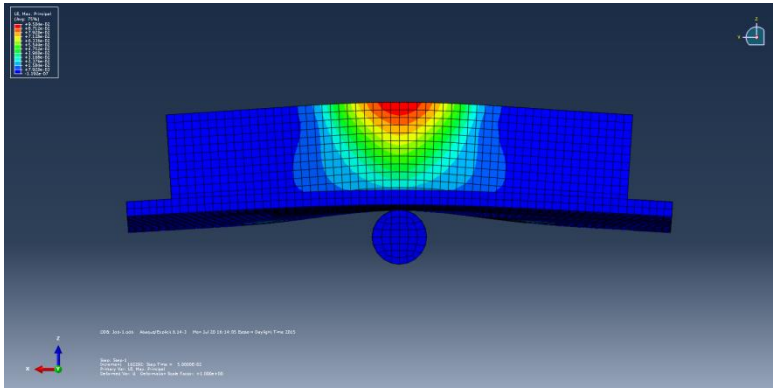




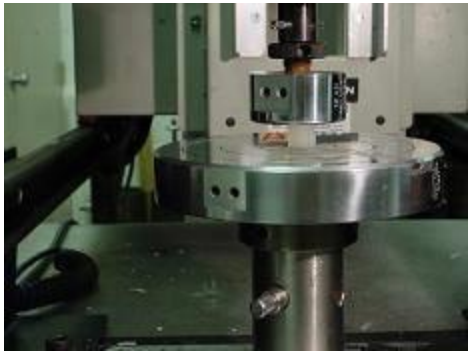
Plastics validation by *CAETestBench*

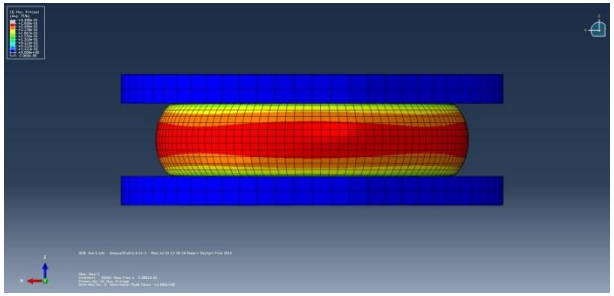




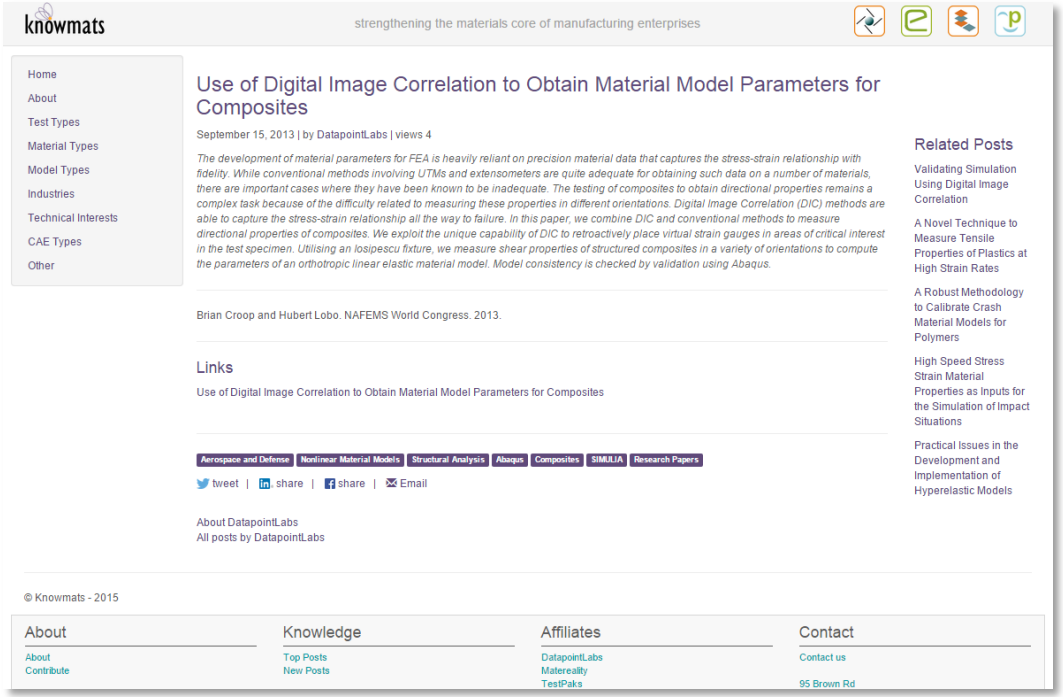


Rubber hyperelasticity validation
CAETestBench





Use Knowmats™ to learn more about *materials in simulation*



Knowledge accumulated by DatapointLabs, partners, industry experts

Datapoint
Reporting on advancements in material testing and data management

Share your findings and get peer review related to materials in simulation

Topics for today's presentations

- Plastics: testing, modeling and model validation
- Hyperelastic: testing, modeling and model validation
- Creep/Stress Relaxation/Viscoelastic/Fiber-filled: testing, modeling
- Rate Dependent: testing, modeling and model validation

Some interesting 10-year testing trends

- Metals 5%
- Plastics 76%
- Rubber 5%
- Foam } 7%
- Composite
- Adhesives 1.5%
- Paper

–Aerospace
–Automotive
–Appliance
–Biomedical
–Consumer products
–Electronics
–Industrial Goods
–Materials
–Petroleum
–Packaging