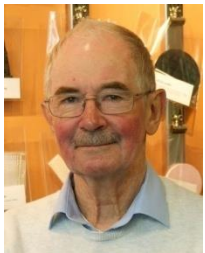


Herausforderungen und Vorteile einer Material Daten Management Strategie

Thomas Weninger

4a Technologietag, Schladming, Feb. 2014

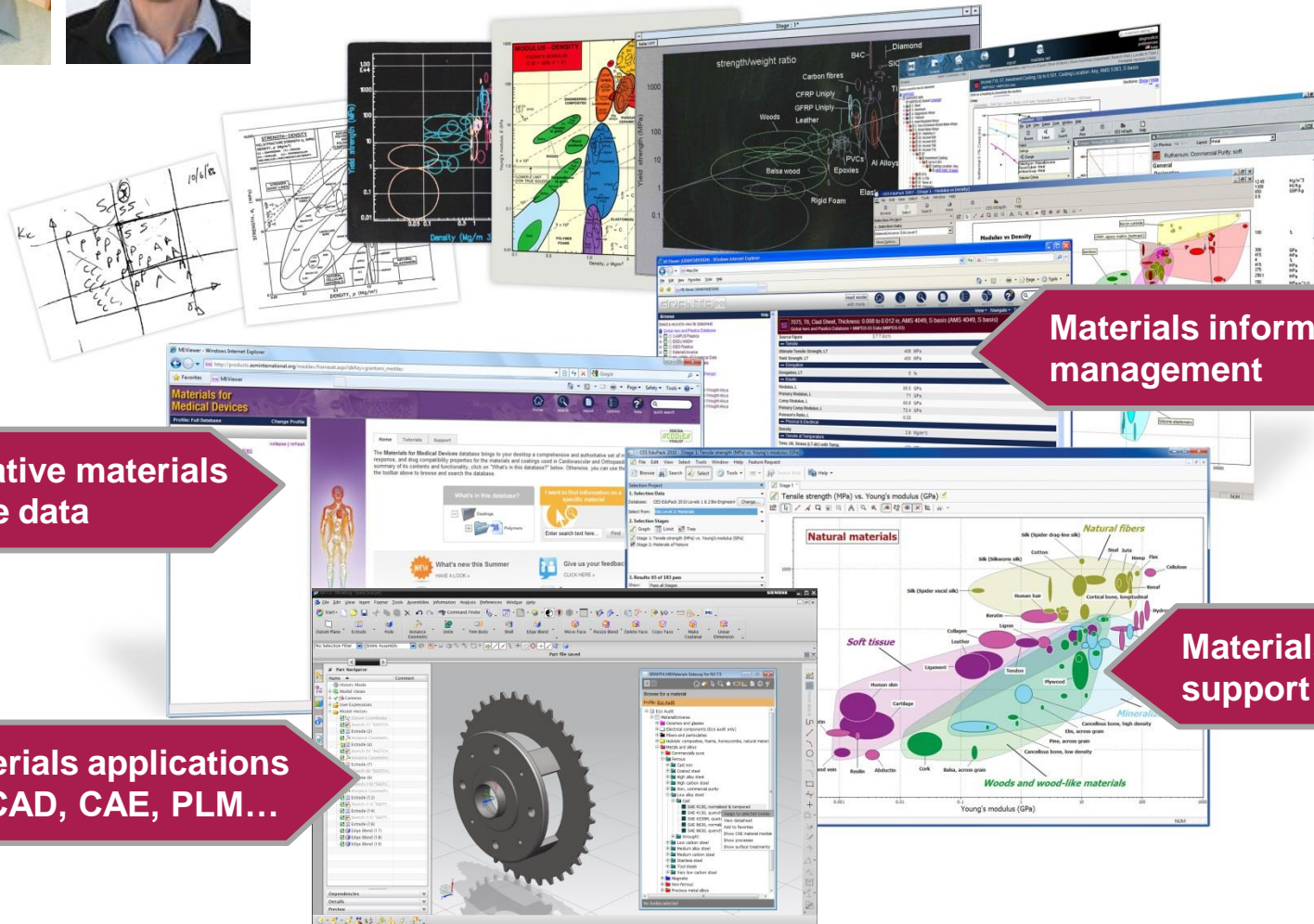
Granta Design—innovating since 1994



UNIVERSITY OF
CAMBRIDGE



The Materials
Information Society



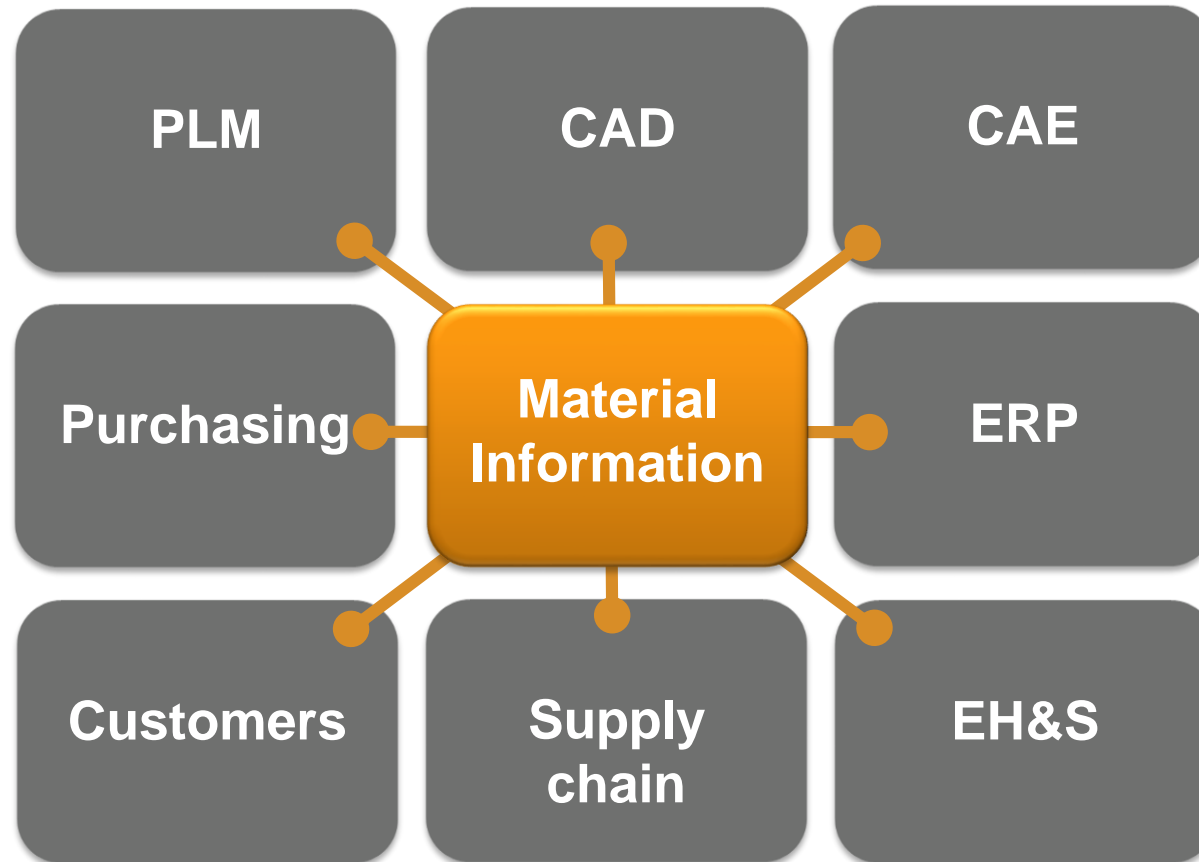
Authoritative materials
reference data

Materials information
management

Materials decision
support tools

Materials applications
for CAD, CAE, PLM...

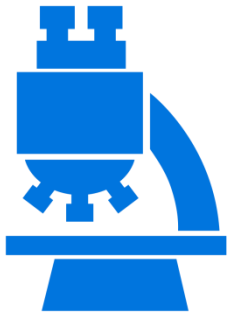
Materials data in your business context



- Needed everywhere in the corporate PLM environment
- Used in many different applications
- Expensive to generate and maintain

Materials information enterprise-wide

RESEARCH



Materials R&D

- Testing
- Characterization
- Statistical analysis
- Reports
- Certification

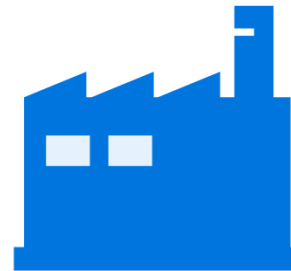
DESIGN



Decision support data

- Certified design data
- Reference data (Properties, cost, eco)
- Purchasing specs
- Preferred materials
- Restricted substances

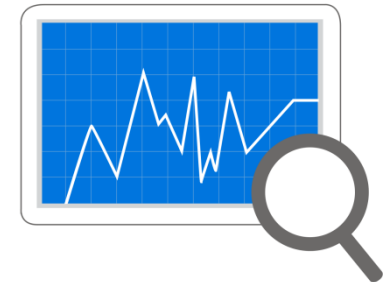
PRODUCTION



Materials QA

- Batch testing
- SPC data
- Comparison with specs
- Process improvement

IN-SERVICE & END-OF-LIFE



Materials performance

- Failure reports
- In-service testing
- Empirical knowledge
- Materials substitution
- Cost reduction
- Materials aging
- Recycling and disposal

Typical materials information environment



- Data scattered in spreadsheets, databases, hard copy, file systems...
- Islands of information
- No systematic access control, security, versioning

Where is this a problem?

Materials engineering productivity

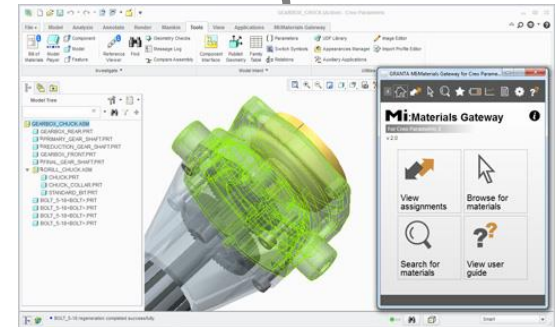
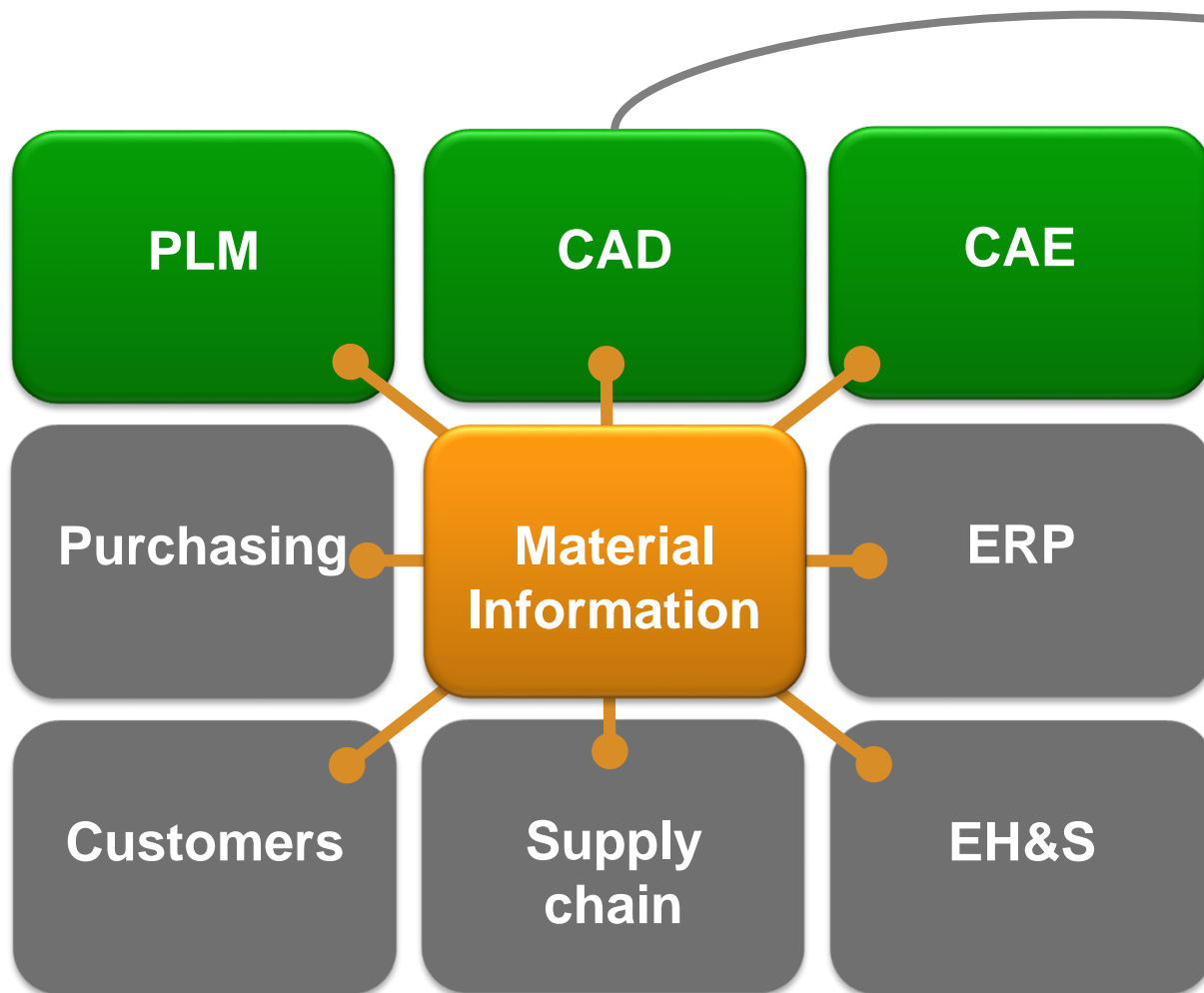
Design and simulation

Purchasing, supply chain, manufacturing

Regulation, legal, reputation

Enterprise-wide – cost, delay, risk, missed opportunity

Materials data in your business context



Single, reliable, controlled source for corporate materials data

Materials data and applications, when and where you need them

Generating material information for CAE



#1: Measure raw material data i.e. tension, bending etc.



#2: Model fitting i.e. statistical backed design data



#3: Model calibration / validation with CAE code



#4: Material consolidation / comparison



#5: Generate / Export solver specific material cards



#6: Manage life cycle of material information

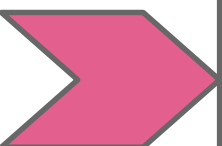

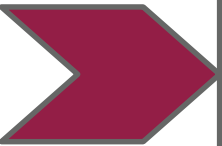
Generating material information for CAE



#1: Measure raw test data i.e. tension, bending



#2: Model fitting i.e. statistical backed design data



Generate CAE Material Cards based on raw material data
i.e. using Impetus



#6: Manage life cycle of material information

Generating material information for CAE



#1: Measure raw test data i.e. tension, bending

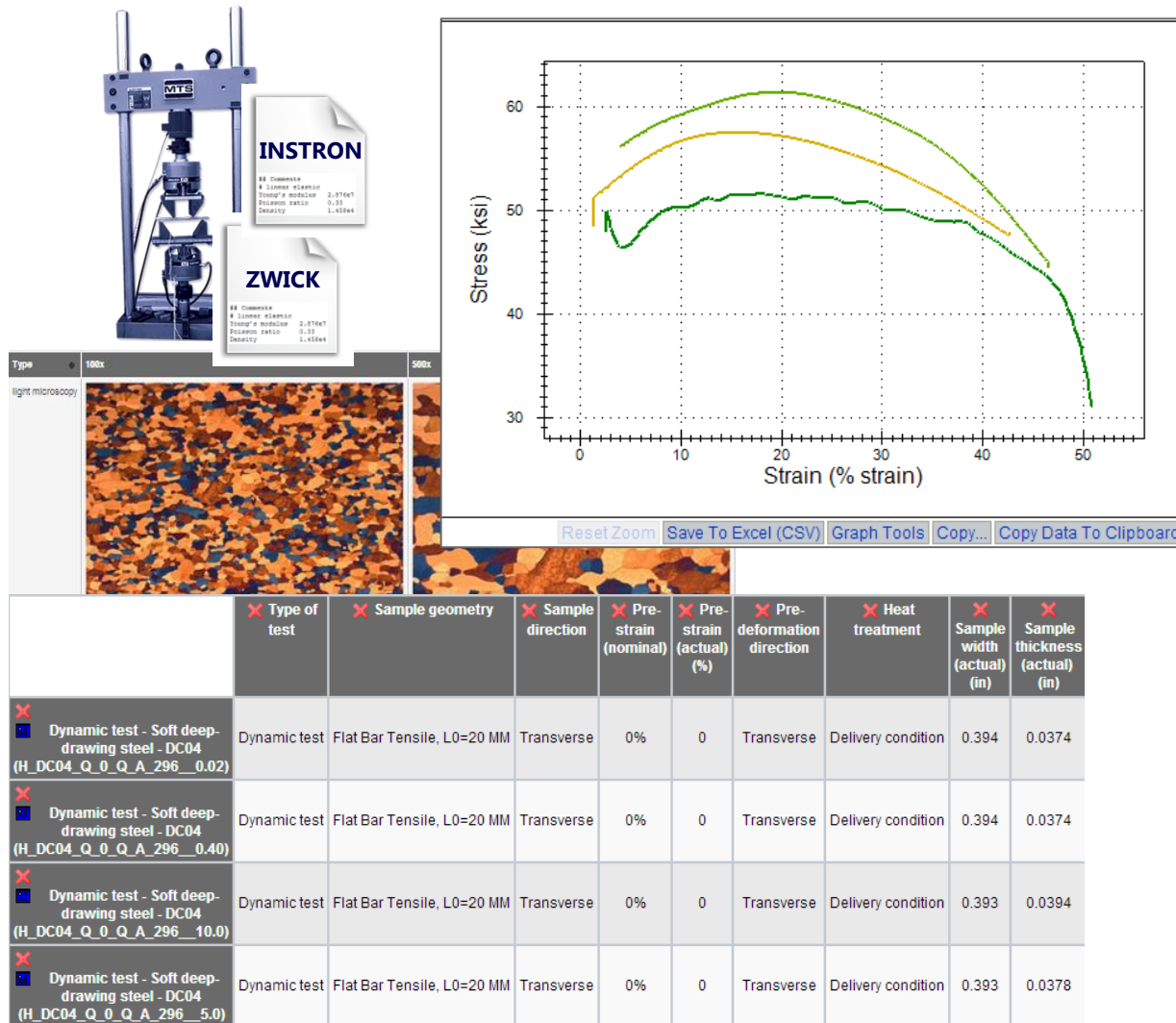


#2: Model fitting i.e. statistical backed design data



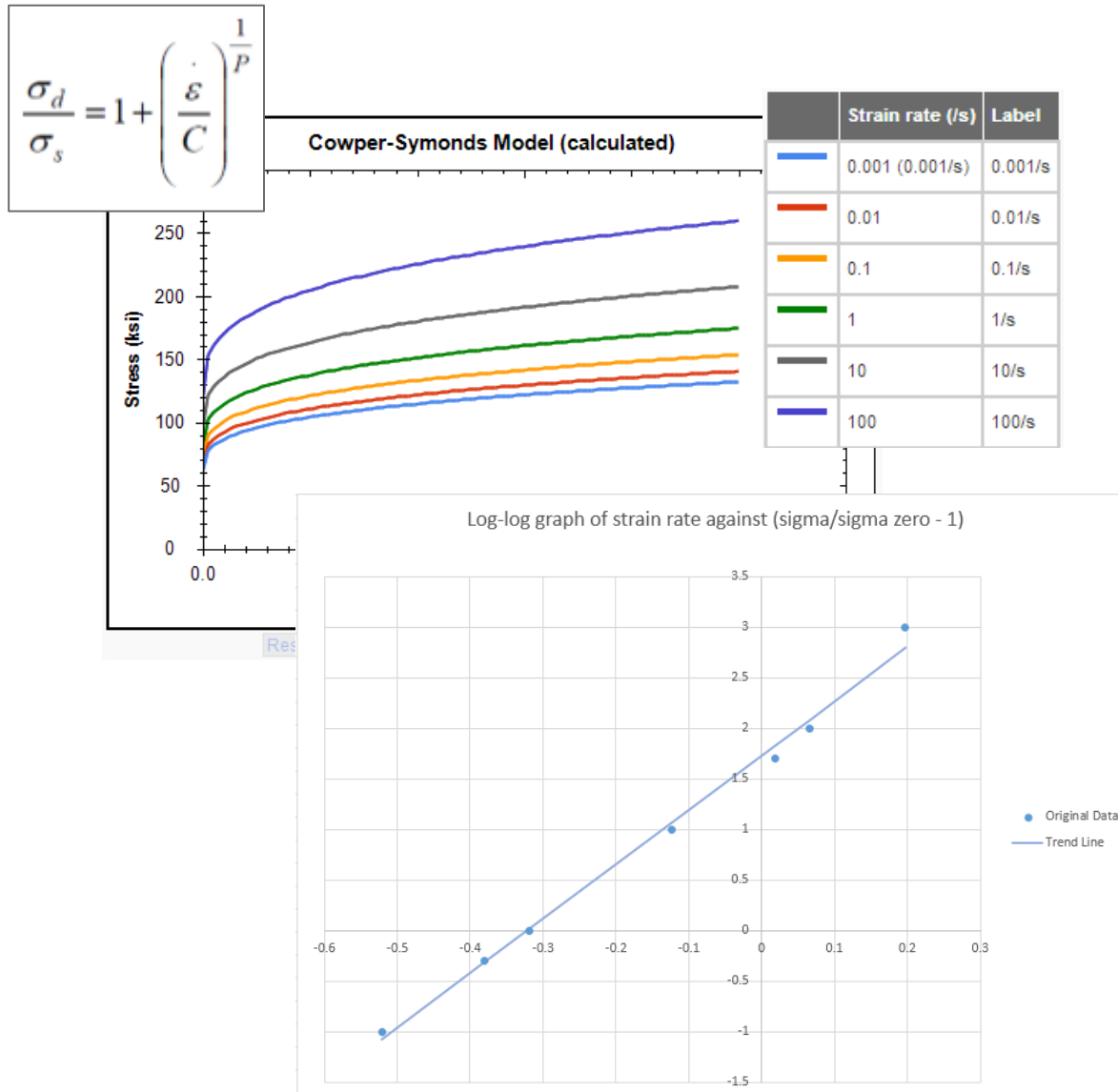
#6: Manage life cycle of material information

1. Raw test data



- Capture test data from test machines
- Capture pedigree, e.g. microstructure, composition, etc.
- Manage with complete traceability
- Use, e.g. Granta's Sheet Steels for Automotive database as a template

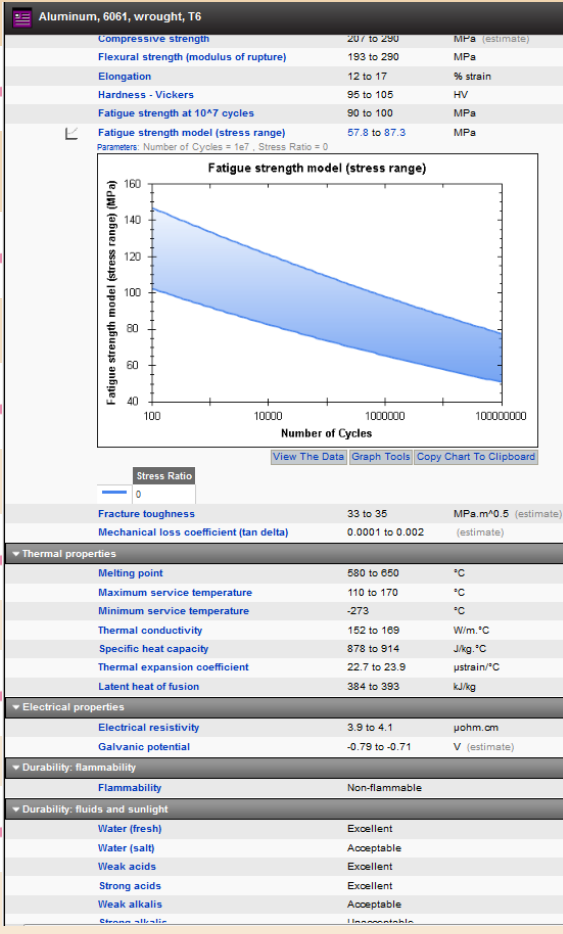
2. Model fitting



- Implement standard workflows for curve smoothing, averaging, model fitting, etc.
- Integrate with Excel, MATLAB, in-house tools, Impetus
- Store analysis in system with full traceability
- Store model parameters and visualize stress-strain curves on the fly

6. Manage materials lifecycle

Corporate “Gold Source” materials database



Name	Aluminum 6061	
Density	2.71	kg/m^3
Youngs Modulus	68.9	Gpa
Poissons Ratio	0.33	
Yield Strength	241	Mpa
Ultimate Tensile Strength	290	MPa
Thermal Conductivity	167	W/m °C
Thermal Expansion	23.6	µstrain/°C

Relevant, correctly-versioned material models made available when requested

Get accurate, up-to-date properties

Select and assign

Name	Aluminum 6061	
Density	2.71	kg/m^3

CAE

CAD

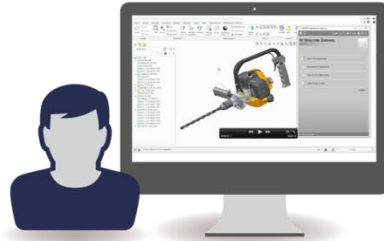
PDM

Product Lifecycle



The material gold source: GRANTA MI

SUPPORT CAD, CAE, PLM



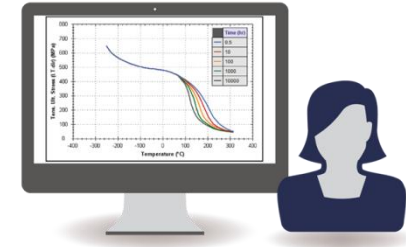
MAKE DECISIONS



BROWSE, SEARCH & REPORT

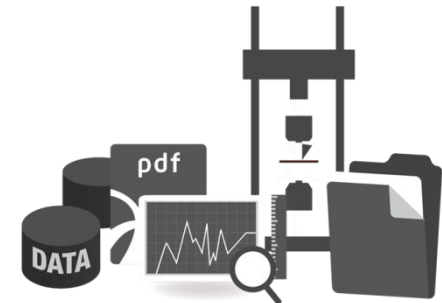
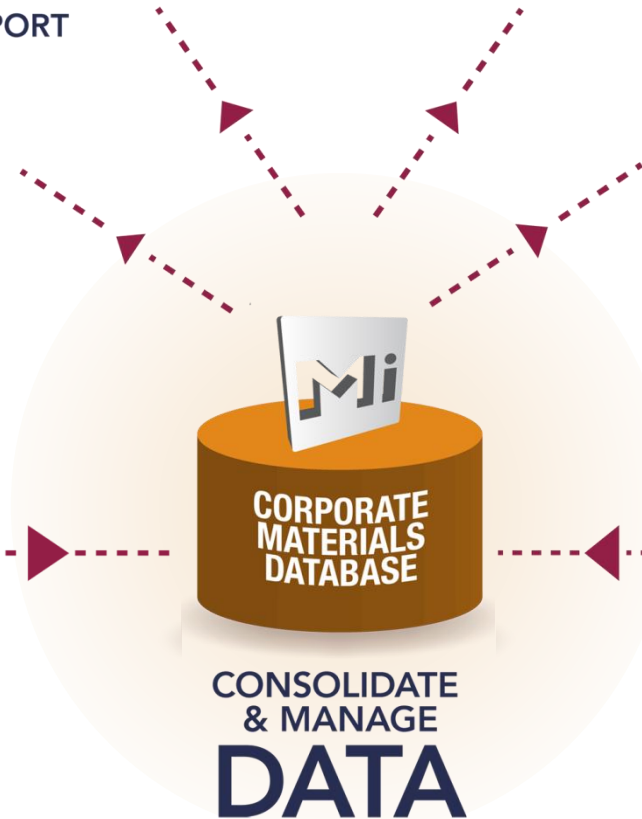


VISUALIZE & ANALYZE



**EXTERNAL MATERIALS
REFERENCE DATA**

Metals, plastics, composites,
ceramics, coatings...

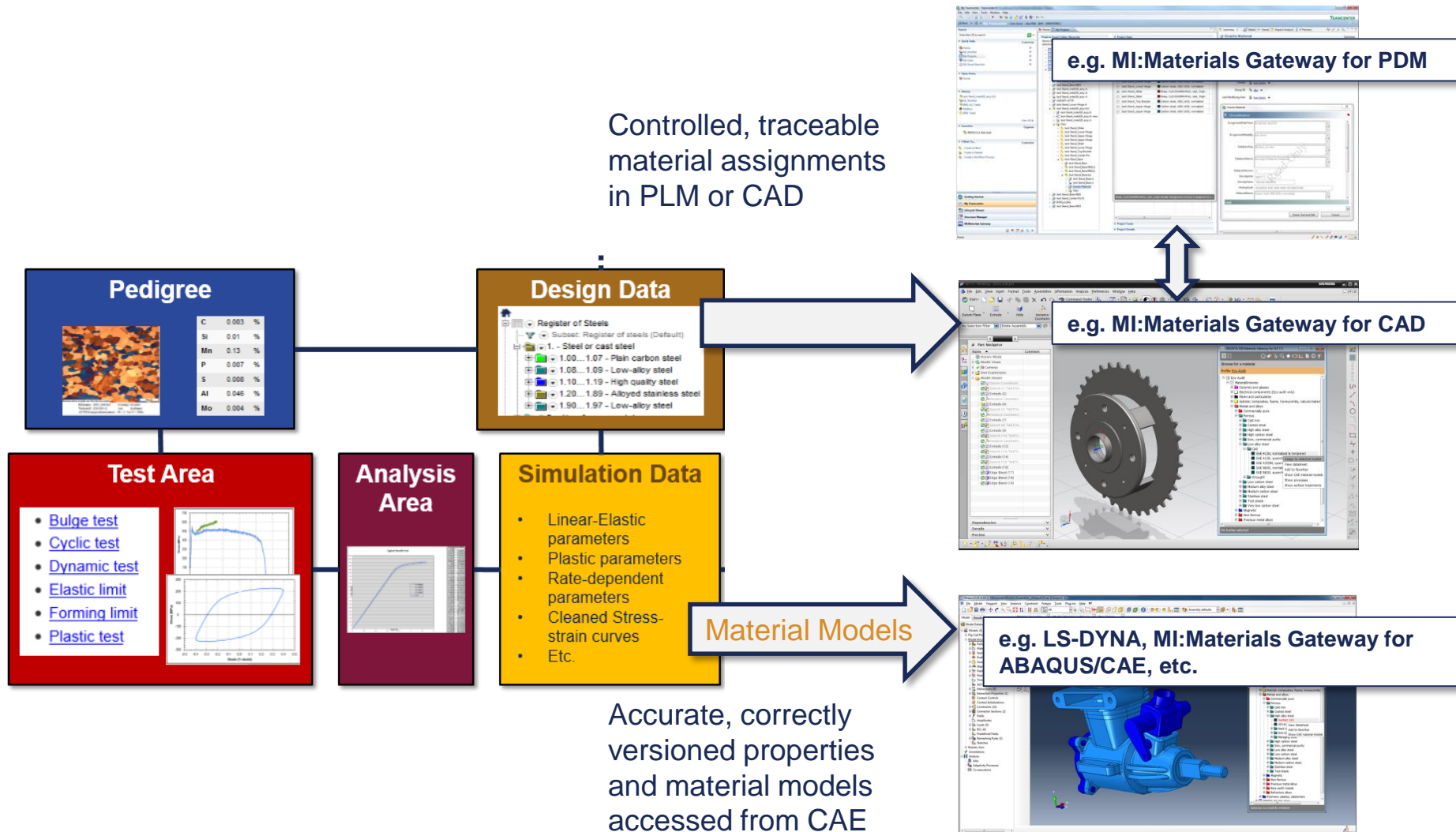


PROPRIETARY MATERIALS DATA

Testing, research, QA,
design, suppliers...

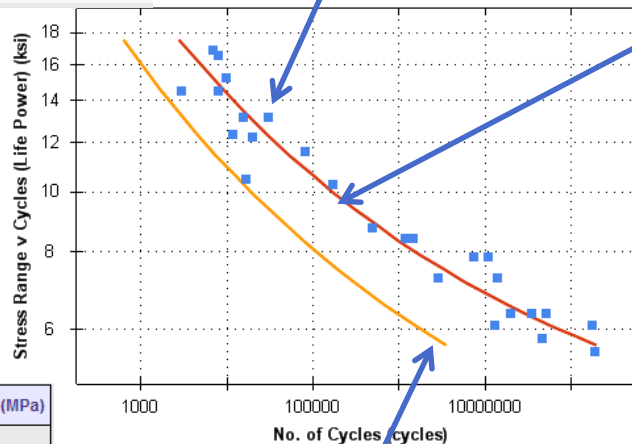
Example configuration for Automotive

Controlled, traceable
material assignments
in PLM or CAD



Representing Material Models

Life Power Coefficient, A0	-0.836
Life Power Coefficient, A1	0.618
Life Exponent, c	-0.1
Model Fit R ² (Life Power)	0.94
Half Life Data Used (Life Power)?	No
X or Y Std. Err. Used (Life Power)	x-axis
No. of Std. Err. (Life Power)	3
Standard Error (Life Power)	0.0243



No. of Cycles (cycles)	Stress Range v Cycles (Life Power) (MPa)
All	
1.2e6	451
1.5e6	400
2.9e6	372
7.5e6	400
3000	689
1.1e7	372
1.3e7	290
7000	800
1.4e7	345
8000	786
2e7	303
8000	689

As equations which are evaluated 'live'

Expression

$$\frac{[A:\text{Tensile strength}] / ((1 + [P:\text{Stress Ratio}] / (1 - [P:\text{Stress Ratio}])) + [A:\text{Tensile strength}] / ((([A:\text{Tensile strength}] * (1 + [A:\text{Elongation}] / 100) - [A:\text{Yield strength (elastic limit)])) / (\log(1 + \text{mean}([A:\text{Elongation}] / 100)) - [A:\text{Yield strength (elastic limit)] / (1000 * [A:\text{Young's modulus}])) * \log(1 + \text{mean}([A:\text{Elongation}] / 100)) * (2 * [P:\text{Number of Cycles}]^{-0.6} + [A:\text{Tensile strength}] * ((1 + [A:\text{Elongation}] / 100) * (2 * [P:\text{Number of Cycles}]^{\log_{10}(\text{mean}([A:\text{Fatigue strength at } 10^7 \text{ cycles}) / ([A:\text{Tensile strength}] * (1 + [A:\text{Elongation}] / 100)))) / \log_{10}(20000000)))))}{}$$

+

-

/

*

(

)

Validate

Not

And

Or

<=

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? :

If Else

Attributes

Constants

Parameters

Functions

cos

tan

csc

sec

cot

arcsin

arccos

Function: arcsin

point arcsin(point x)

Summary

Insert

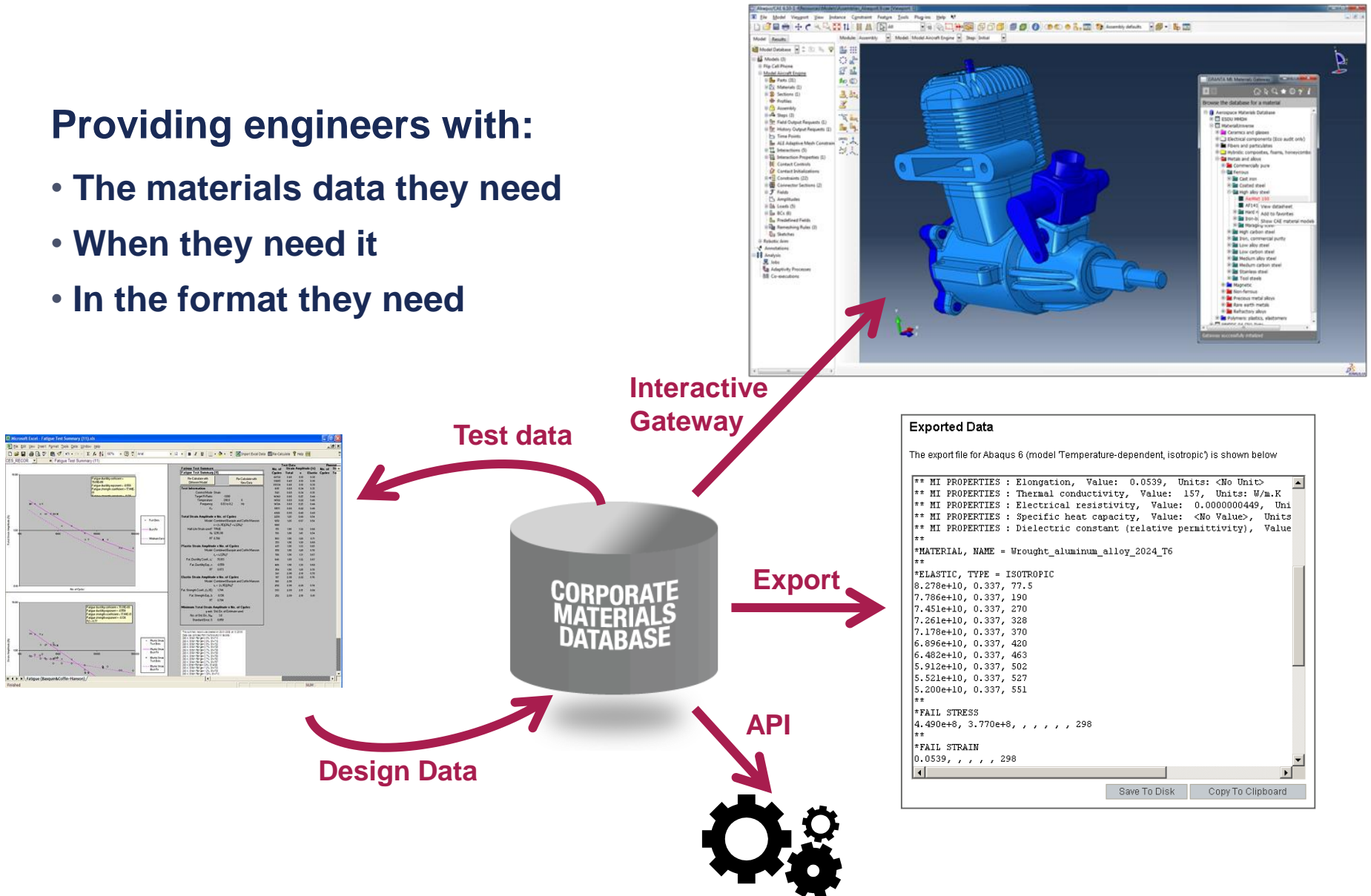
OK

Cancel

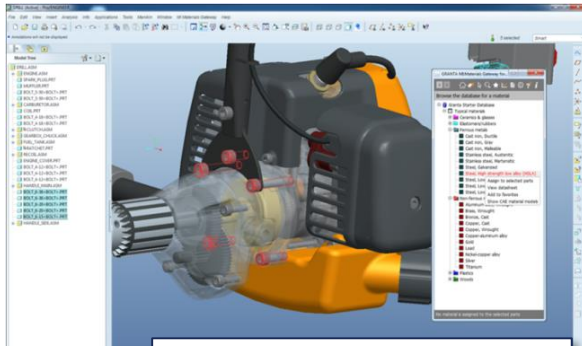
Integration options

Providing engineers with:

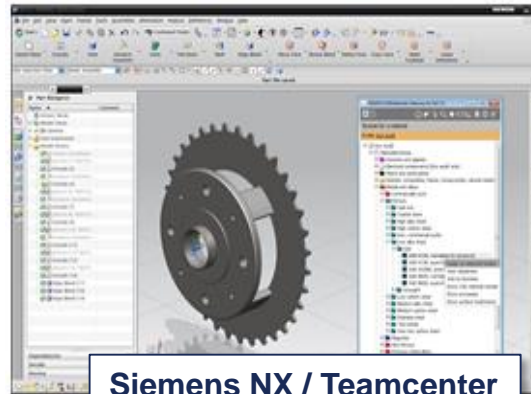
- The materials data they need
- When they need it
- In the format they need



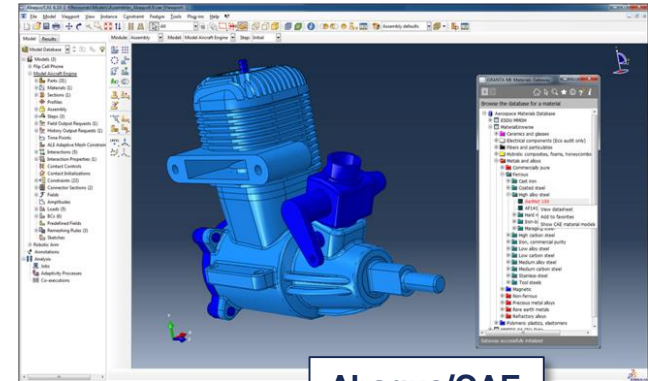
Direct Integration with CAD and CAE pre-processors



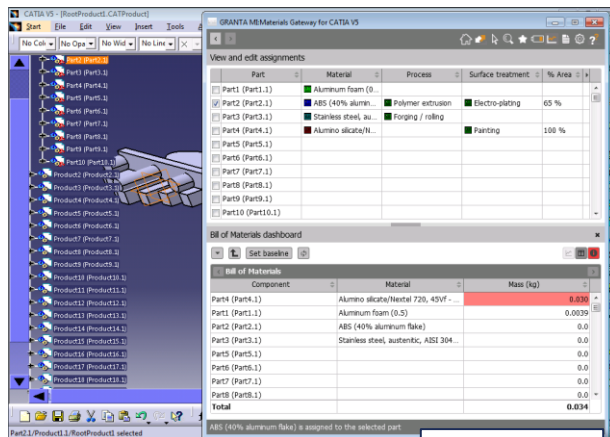
Pro/ENGINEER and Creo



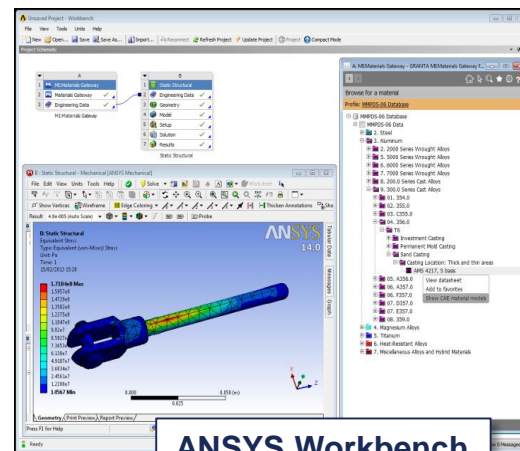
Siemens NX / Teamcenter



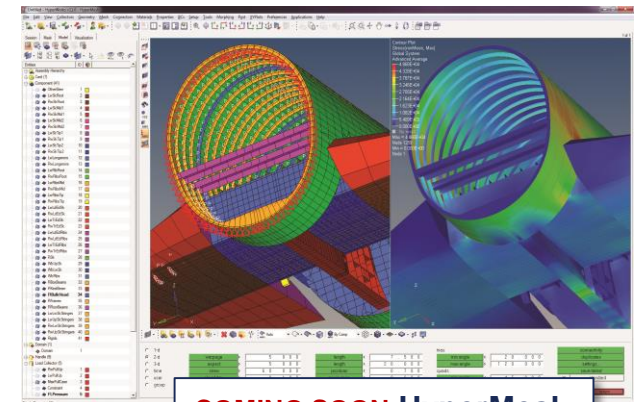
Abaqus/CAE



CATIA V5

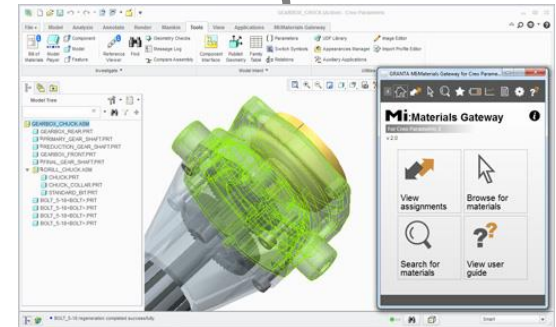
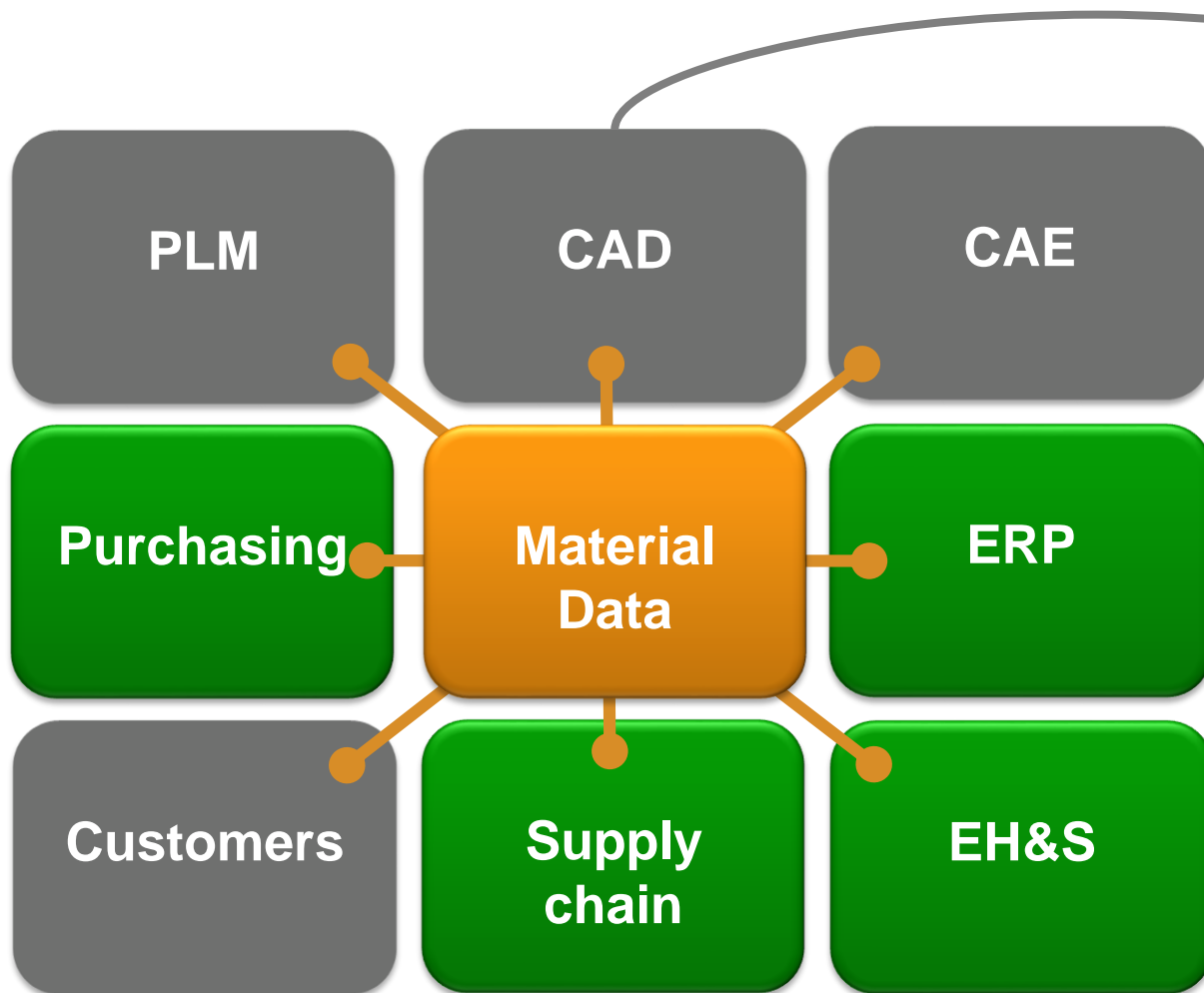


ANSYS Workbench



COMING SOON HyperMesh

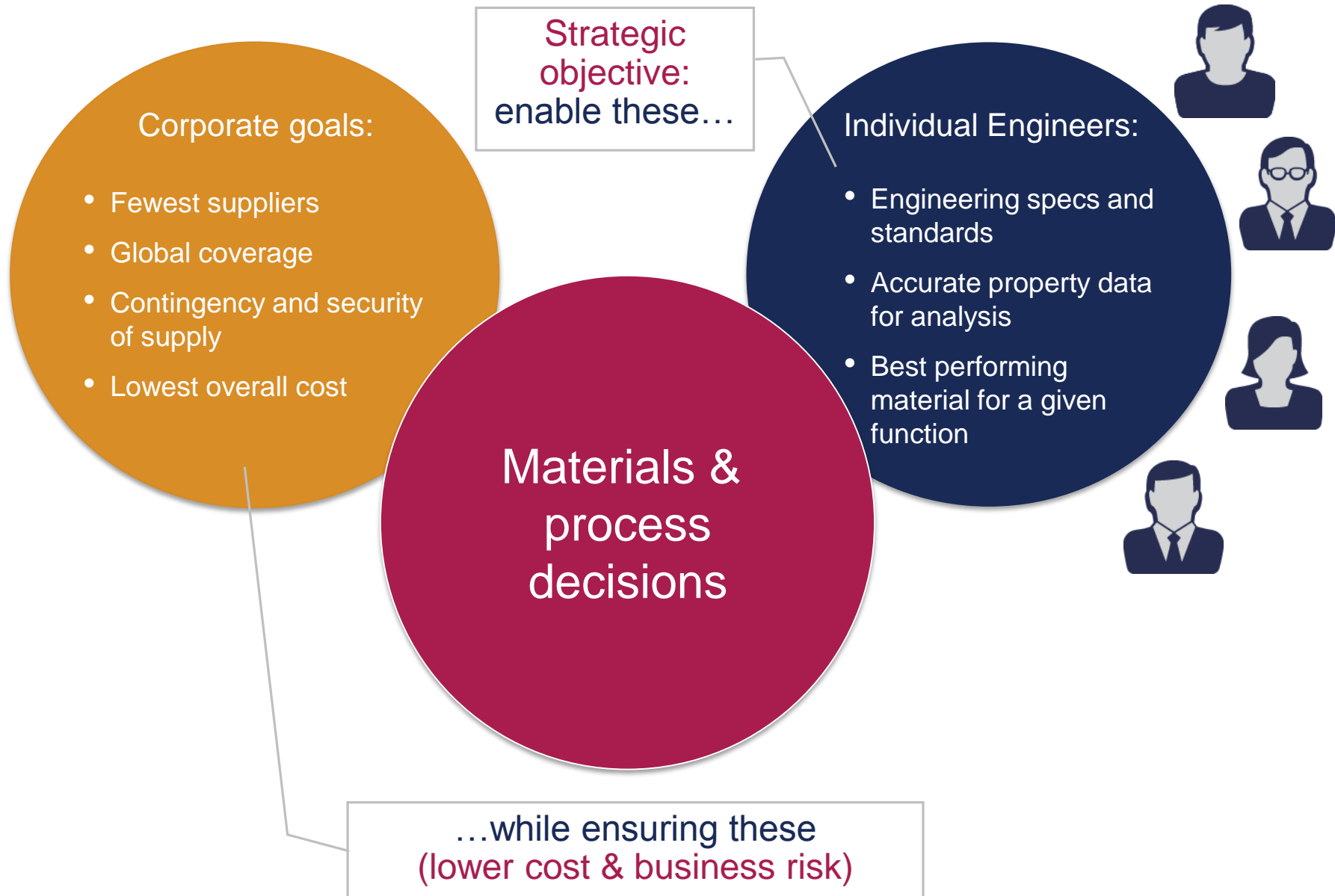
Materials data in your business context



**Single, reliable,
controlled source for
corporate materials
data**

**Materials data and
applications, when and
where you need them**

Purchasing, supply chain, manufacturing



Examples

- **Sourcing / Selection**
 - “preferred materials lists” and “preferred supplier lists”
 - Reduces costs and improve quality
- **Alternative / equivalent materials**
 - Design here – manufacture there
 - Cover obsolescence risks
- **Total cost of design**
 - Integrate materials & processes
 - Investigate alternative selections

Regulation, legal risk, reputation

Business risks

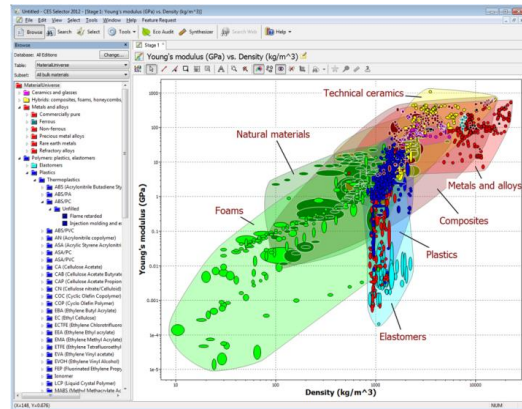
- Non-compliance with regulation
- Security & pedigree of data
- Materials obsolescence
- Future regulatory impact on material and process choices
- Price volatility
- Legal challenge due to inaccurate product information



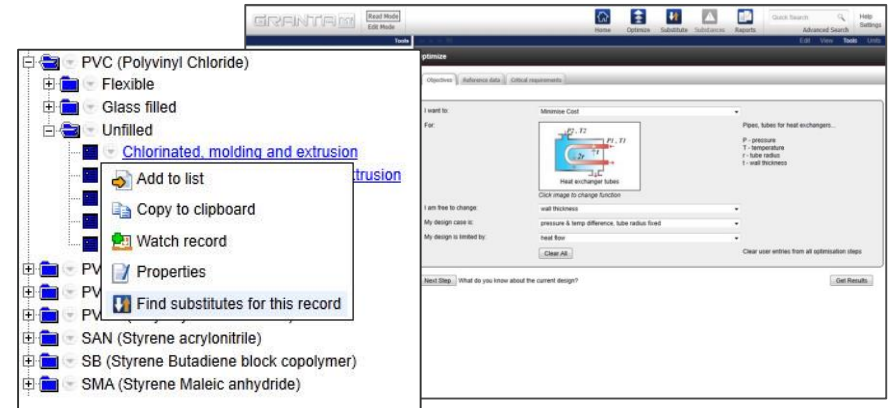
Energy	
Manufacturer Model	
More efficient	A
A	
B	
C	
D	
E	
F	
G	
Less efficient	
Energy consumption kWh/cycle (based on standard test results for 60°C cotton cycle)	0.95
Actual energy consumption will depend on how the appliance is used	
Washing performance	A B C D E F G
Spin drying performance (A: higher (2) lower (1) spin speed (rpm))	A B C D E F G
Capacity (cotton) kg	5.0
Water consumption /	55
Noise (dB(A) re 1 pW)	Washing 52 Spinning 70
Further information is contained in product brochures	

Dodd-Frank
Public Law 111-203
111th Congress
An Act

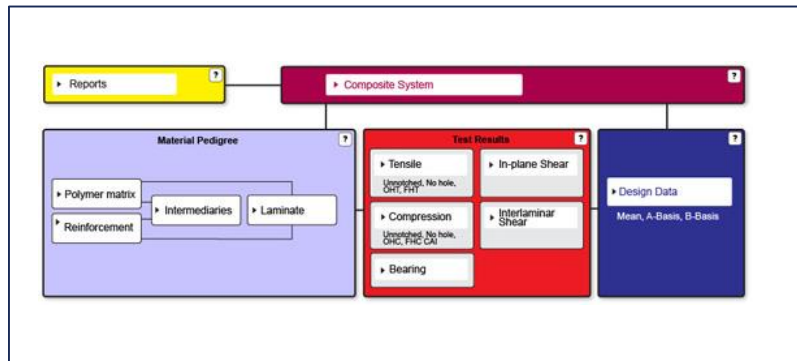
Tools when and where they are needed, e.g.



CES Selector
Enable expert materials decisions



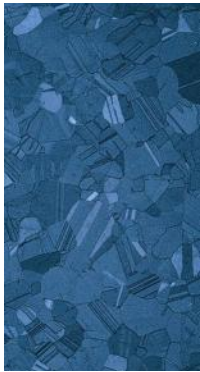
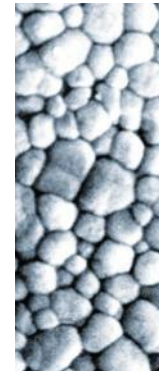
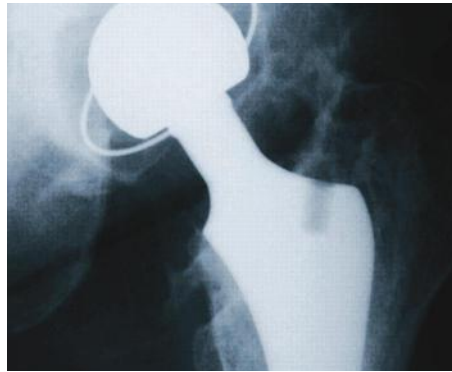
MI:Materials Strategy Package
Deploy business rules on cost, suppliers...



MI:Composites Package
Manage complex composite test data

Legislation name	Legislation rating	Effective date	Amount (kg)	Threshold (%)	Geographical area	Notes
REACH - The Candidate List	High risk of phase-out	28 October 2008		> 45.4	EU	
CERCLA Hazardous substances	n.a.			> 45.4	US	
The EPA's List of toxic (LUL)	n.a.			> 45.4	US	
ASD-STAN Dangerous Substances List	Caution			> 45.4	Worldwide	
The SRS List 1.1 (Substitute it now)	Caution			> 45.4	EU	
EPORA Section 304, Extremely Hazardous Substances	n.a.			> 45.4	US	

MI:Restricted Substances Package
Assess and reduce restricted substance risk



Thanks

Thomas.Weninger@grantadesign.com

+49 89 921 315 231