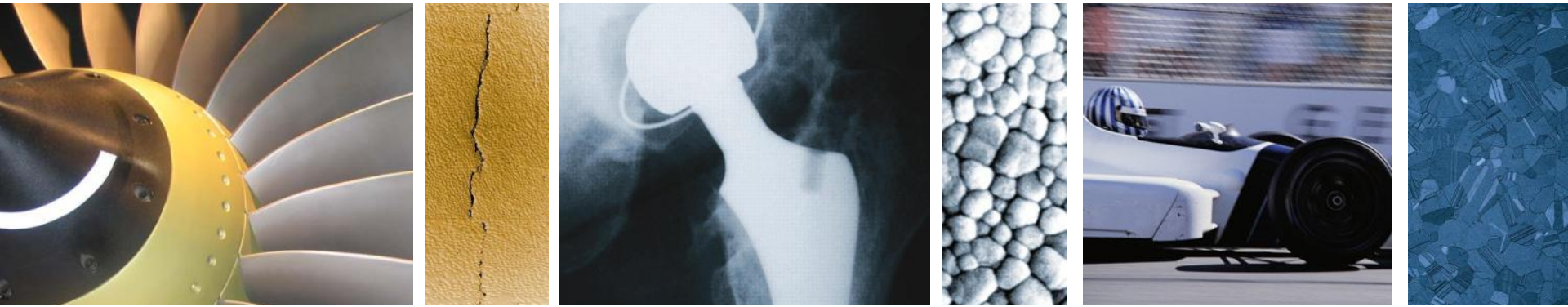
GRANTA
MATERIAL INTELLIGENCE

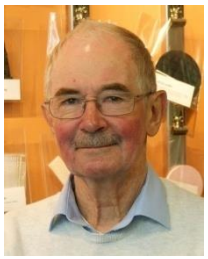


Composites – challenges and benefits of well-structured materials data management

3. Fachkongress Composite Simulation

Sebastian Schwägele, Thomas Weninger, Dr Will Marsden

Granta Design—innovating since 1994



UNIVERSITY OF CAMBRIDGE

ASM INTERNATIONAL®
The Materials Information Society

Materials information management

Authoritative materials reference data

Materials decision support tools

Materials applications for CAD, CAE, PLM…

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Selected partners

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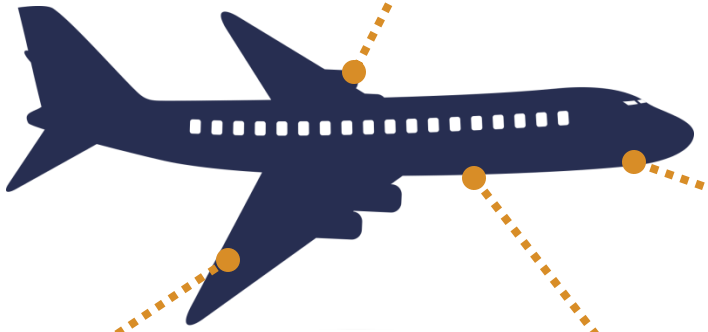
MATERIAL INTELLIGENCE

Engineering???

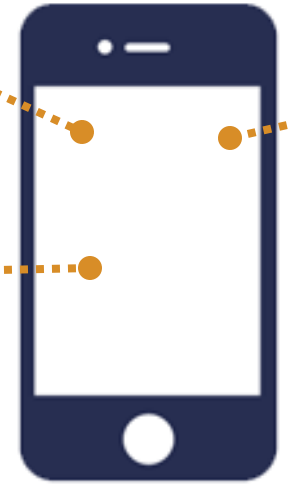
Why does materials information matter?

Do I have statistically-validated design data for these conditions?



What's the environmental footprint?

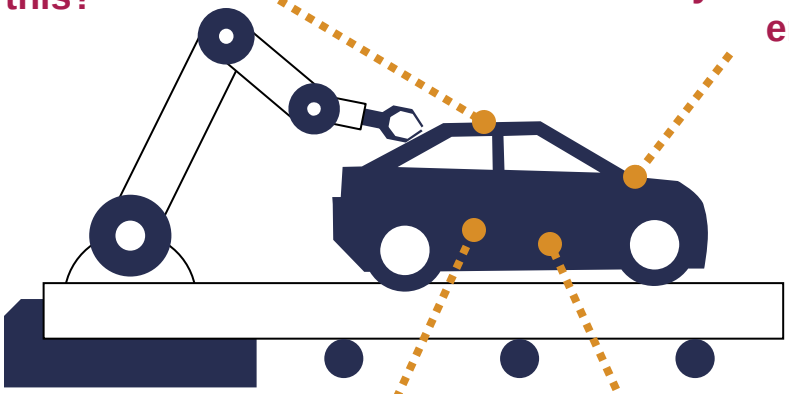
Could I make this at a lower cost?



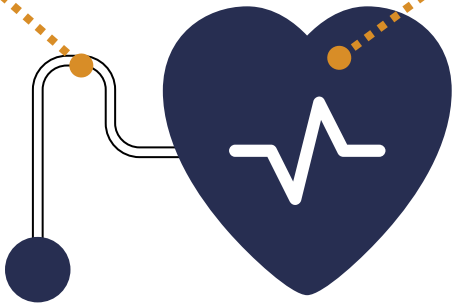
Do the materials inside this use restricted substances or conflict minerals?

How can I 'lightweight' this?

Is my material strong/stiff enough?



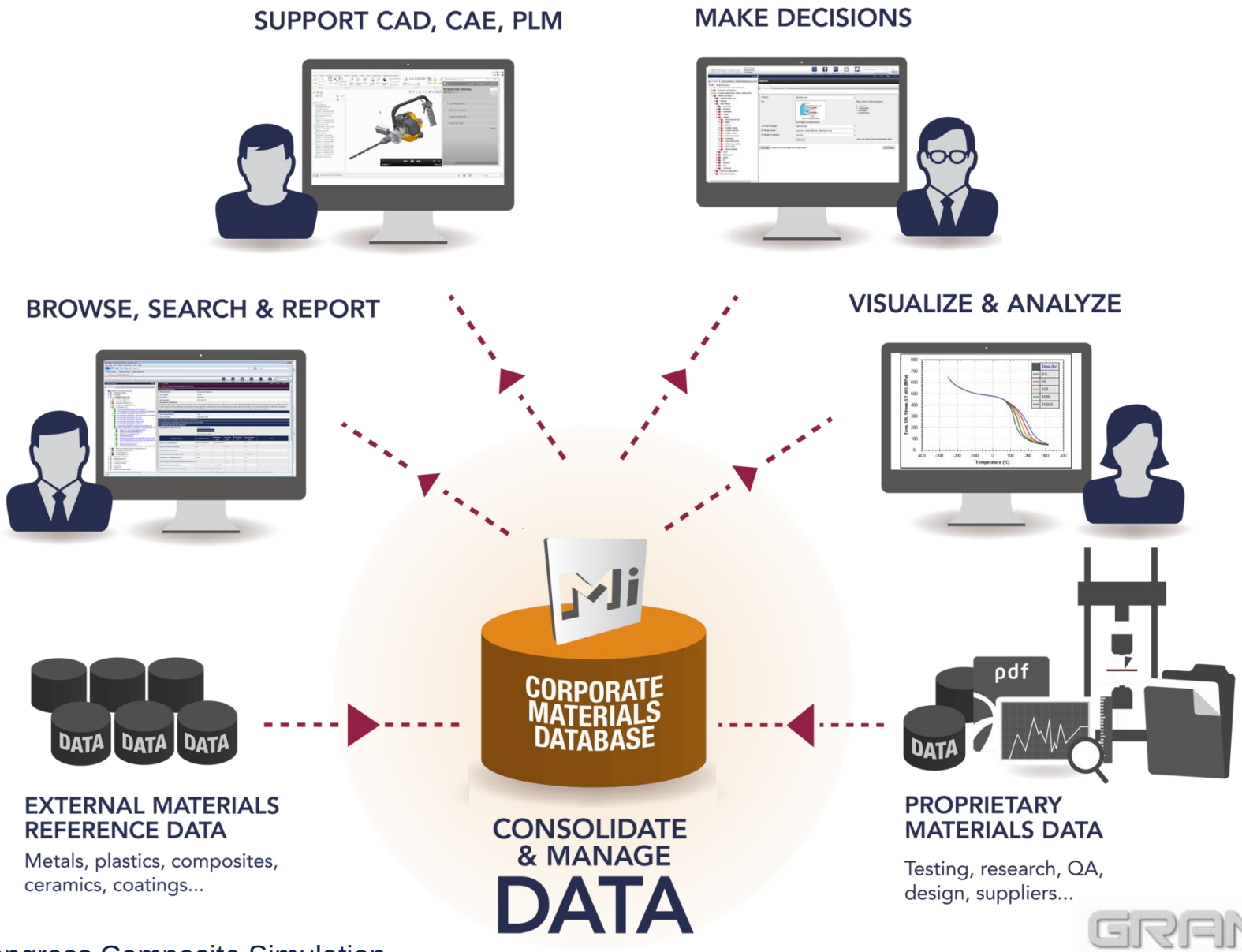
Are there biocompatibility issues?



Can I perform a reliable crash simulation?

What's the equivalent grade for manufacturing in China?

GRANTA MI – data management



Focus on composites data

Composites materials cannot be created independently from components

- Composite materials cannot be characterized independently of processing
- Composites cannot be fabricated, tested and then subsequently formed into a component

Composite materials are manufactured by involved multi-step processes

- Process histories for composites are important, complex and very varied

Composites data - challenges

The complexity lies in the processing history.

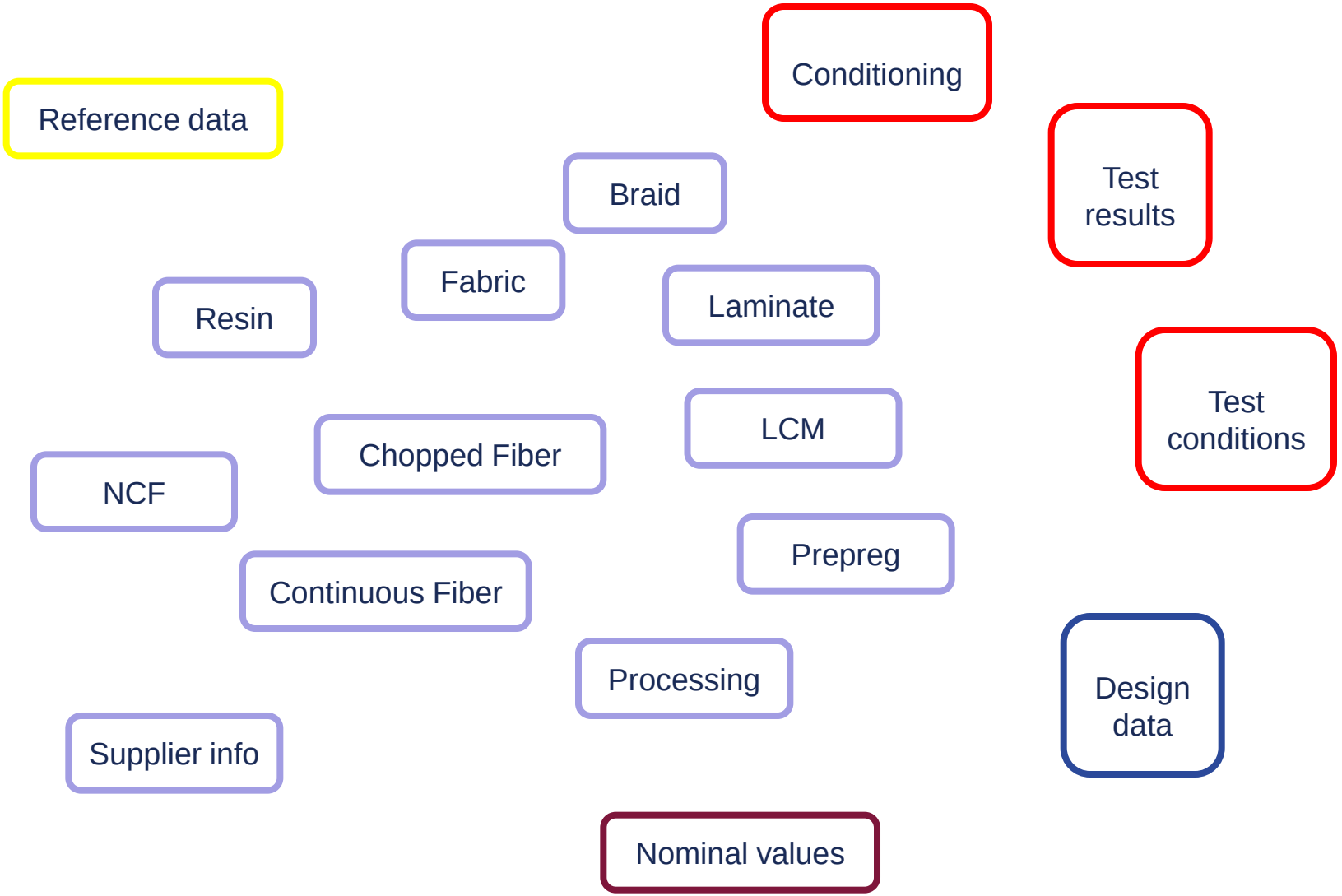
Data needs to be captured at each and every step.

Property data and processing parameters must be tagged to a specified location in the processing route.

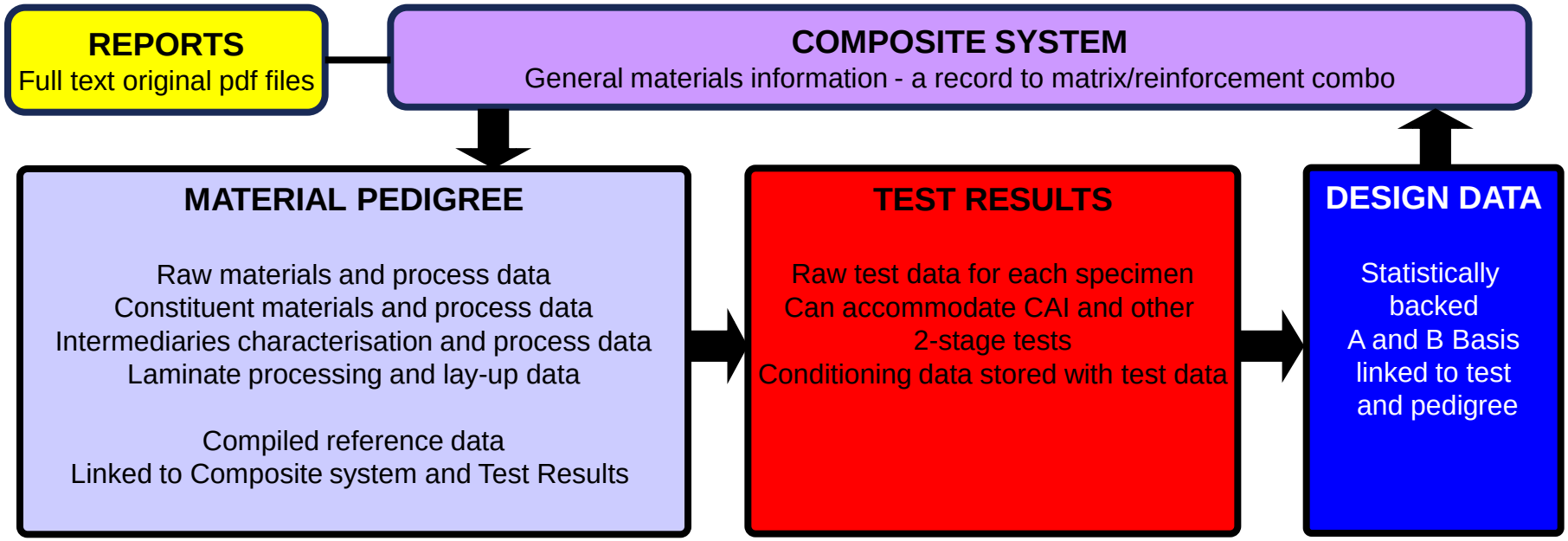
Each single aspect of the data or meta data is equally important.

→ Multiple classification structures are possible and one has to be defined!

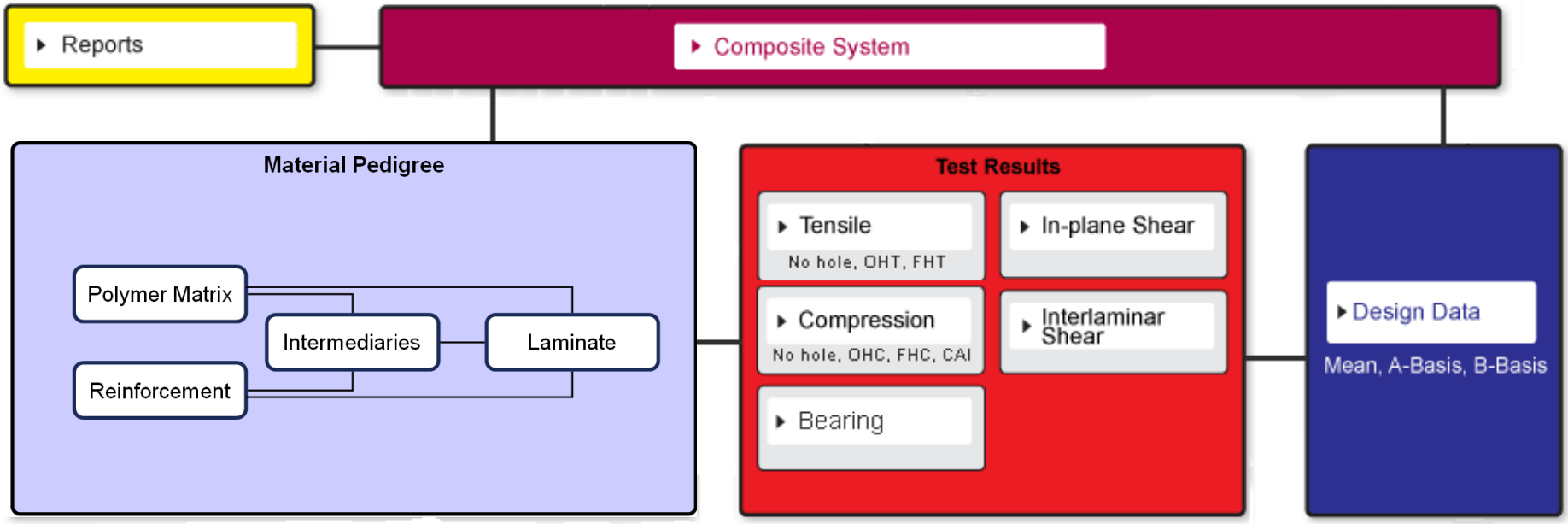
Composites data



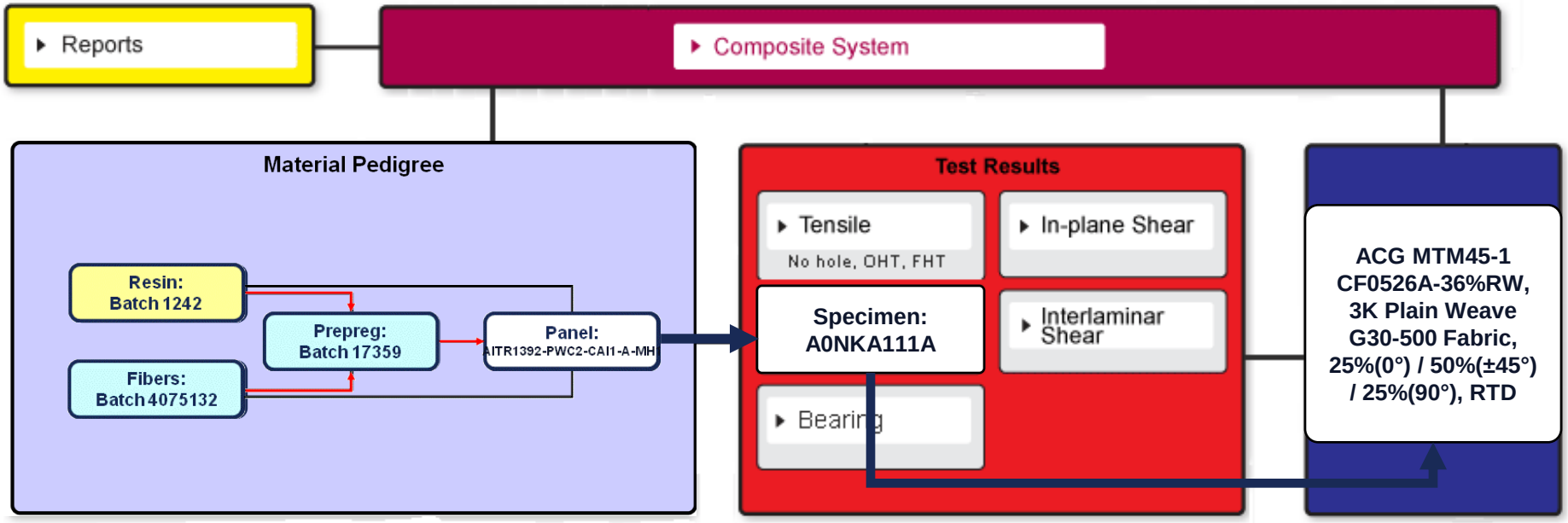
Composites database concept



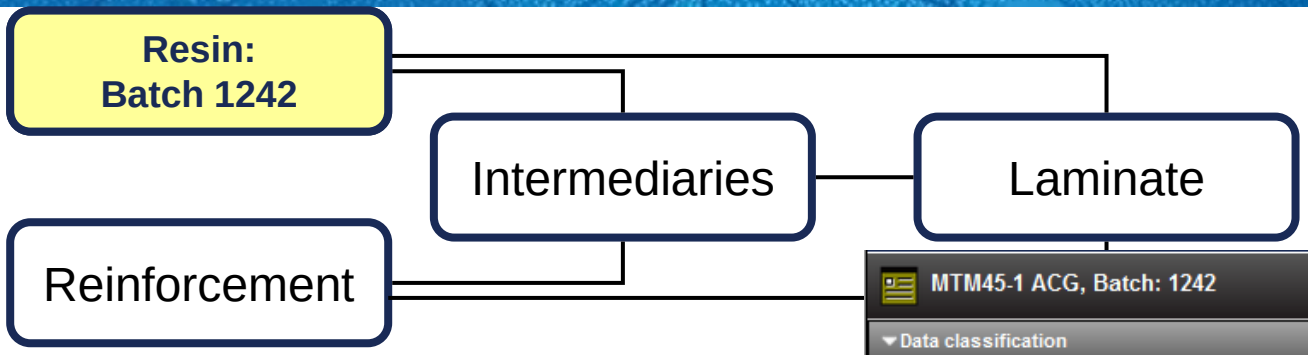
Composite data flow



Test results and design data



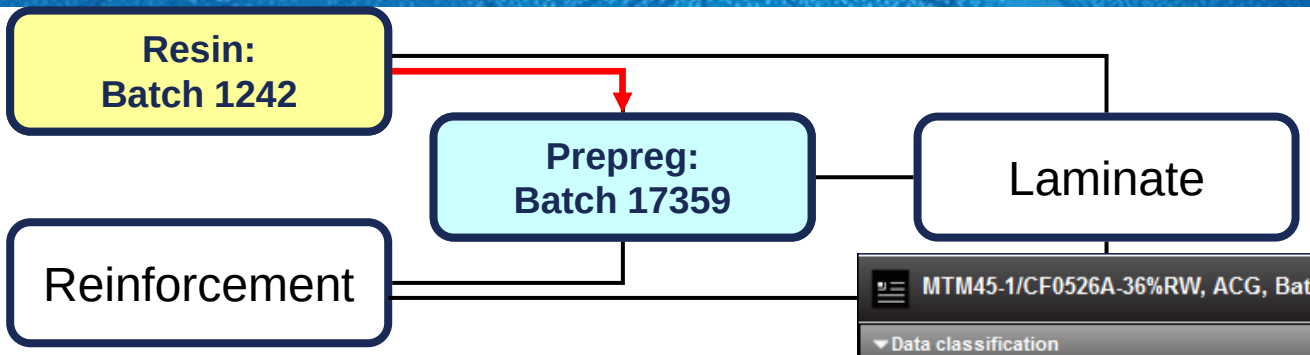
Traceability and processing history



MTM45-1 ACG, Batch: 1242

Data classification		
Funding program	NCAMP	
General information		
Material ID	MTM45-1 ACG, Batch: 1242	
Material designation	MTM45-1	
Material manufacturer	ACG	
Material lot number	1242	
Matrix information		
Matrix type	Epoxy (EP)	
Matrix incoming date	6 December 2005	
Matrix notes	Production location: Tulsa	
Constituent information		
Resin designation	MTM45-1	
Resin manufacturer	ACG	
Resin lot number	1242	
Resin type	Resin	
Vendor supplied properties		
Nominal density, cured (vendor measured)	74	lb/ft^3
Traceability		
Document reference	NCP-RP-2008-003 Rev A	
Original report		
Qualification Material Property Data Report, NCP-RP-2008-003 Rev A		
Comments		
Prepregs manufactured		
MTM45-1/CF0526A-36%RW, ACG, Batch: 17359		

Traceability and processing history

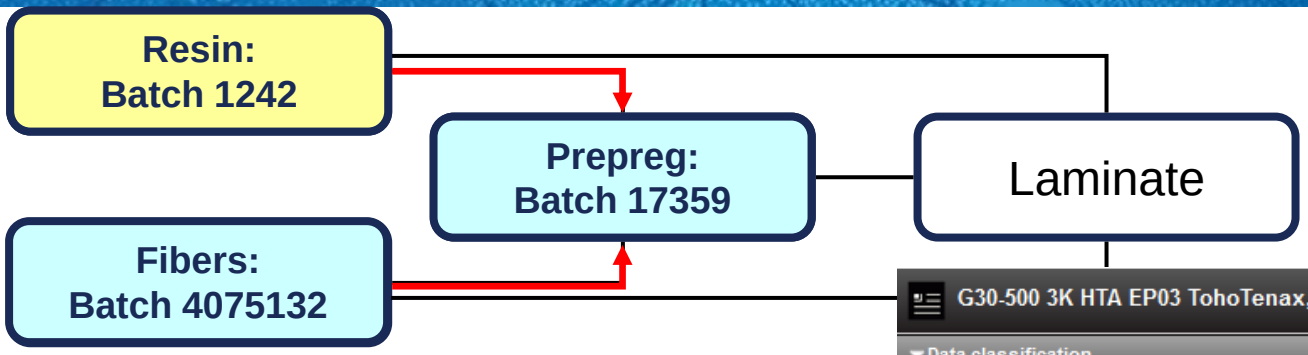


MTM45-1/CF0526A-36%RW, ACG, Batch: 17359

Data classification		
Funding program	NCAMP	
General information		
Prepreg information		
Prepreg matrix content, %wt (nominal)	36	%
Prepreg thickness (nominal)	0.0079	in
Further matrix information		
MTM45-1 ACG, Batch: 1242		
Processing		
Date of manufacture	6 December 2005	
Processing notes		
Production Location and Line Number: Tulsa, HM-1		
Receiving inspection		
Prepreg matrix content, %wt (measured)	37.3	%
Volatile content (measured)	0.32	%
Gel time (measured)	60.4	min
Resin flow (measured)	22.1	%
Drape (measured)	Medium	
Tack (measured)	Medium	
Fabric areal weight (measured)	0.0382	lb/ft^2
Traceability		
Document reference	NCP-RP-2008-003 Rev A	
Original report		
Qualification Material Property Data Report, NCP-RP-2008-003 Rev A		
Comments		
Laminates manufactured	54 Associated Records Show All	

mation		
Fabric areal weight	0.0395	lb/ft^2
Weave type	Plain weave	
ent details		
Reinforcement details	Show table	
mation		
Matrix manufacturer	ACG	
Matrix lot number	1242	
Matrix composition	Epoxy (EP)	
Further matrix information		
MTM45-1 ACG, Batch: 1242		
Date of manufacture	6 December 2005	
Processing notes		
Production Location and Line Number: Tulsa, HM-1		
spection		
Prepreg matrix content, %wt (measured)	37.3	%
Volatile content (measured)	0.32	%
Gel time (measured)	60.4	min

Traceability and processing history



G30-500 3K HTA EP03 TohoTenax, Batch: 4075132

Data classification		
Funding program	NCAMP	
General information		
Reinforcement description		
Reinforcement density (nominal)	110	lb/ft^3
Fiber tow twist (nominal)	0	
Fiber tow denier (nominal)	200	
Fiber count in tow (nominal)	3000	
Fiber yield (nominal)	2460	ft/lb
	7 January 2004	
signation	Epoxy, EP03	
reatment	1.3	%
sured)	81.2	lb/ft^3
or measured)	0.000134	lb/ft
ndor measured)	34	10^6 psi
	81.8	lb/ft^3
sured)	0.000137	lb/ft
asured)	564	ksi
easured)	34.6	10^6 psi
Traceability		
Document reference	NCP-RP-2008-003 Rev A	

Fabric information

Fabric areal weight	0.0395	lb/ft^2
Weave type	Plain weave	

Reinforcement details

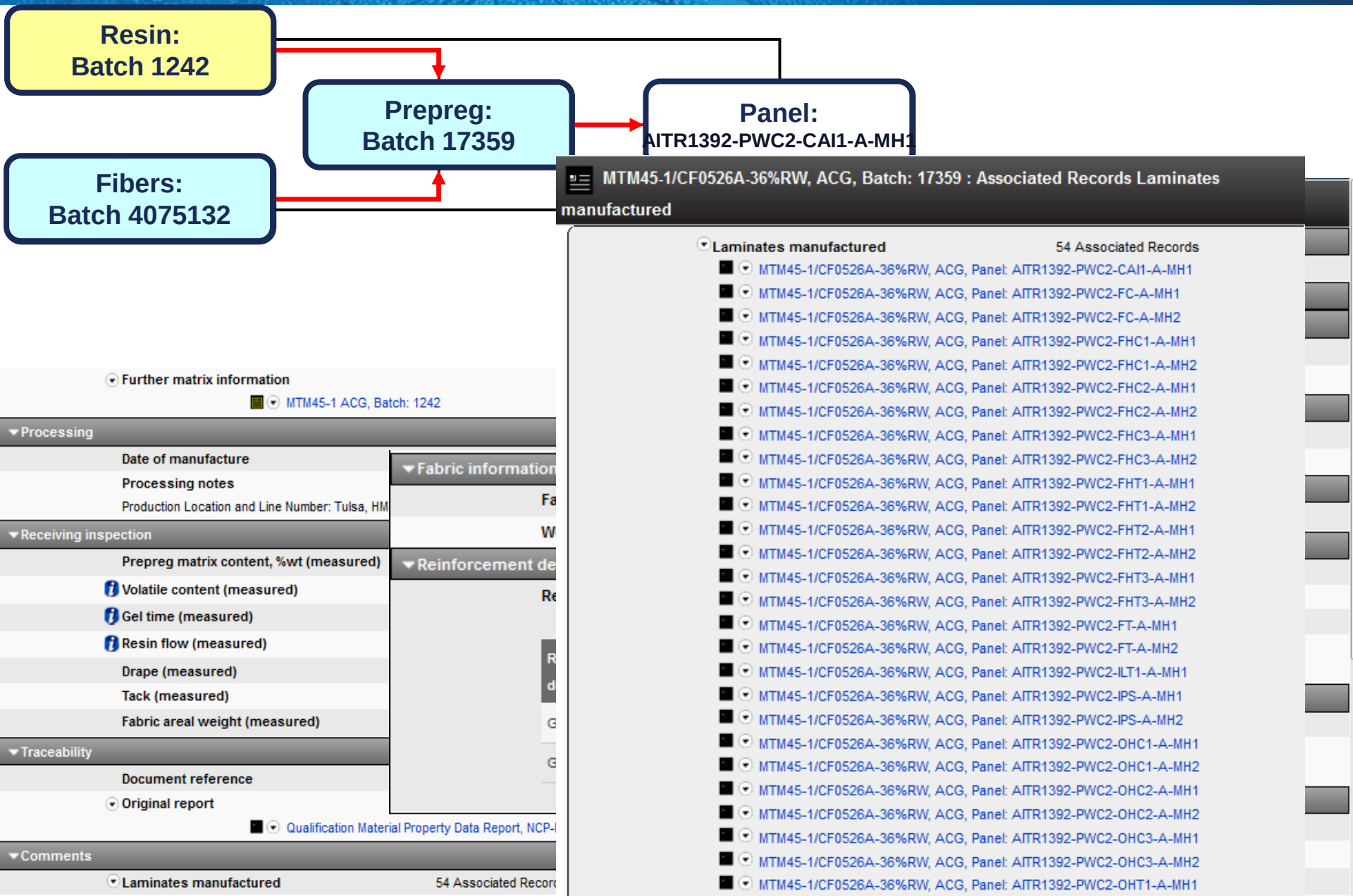
Reinforcement details — Hide table

Save To Excel (CSV) | Copy To Clipboard

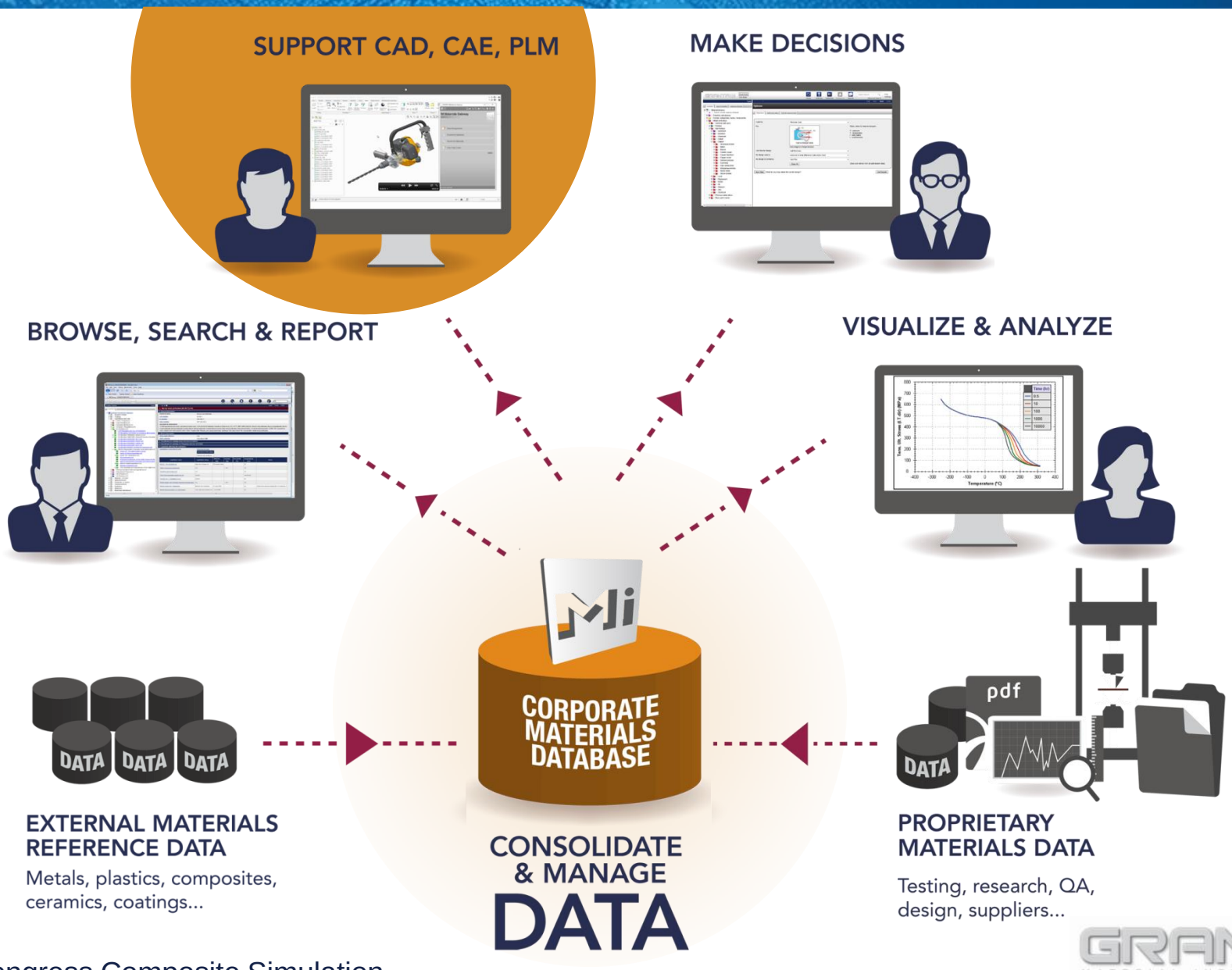
Reinforcement designation	Reinforcement manufacturer	Reinforcement lot number	Reinforcement direction angle (°)
G30-500 3K HTA EP03	TohoTenax	4075132	0
G30-500 3K HTA EP03	TohoTenax	4075132	90

Save To Excel (CSV) | Copy To Clipboard

Traceability and processing history



Integrate with your business environment



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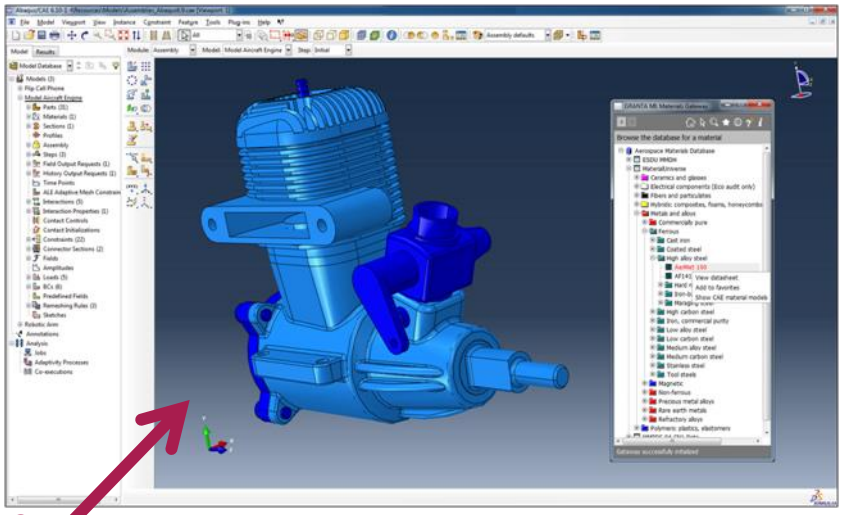
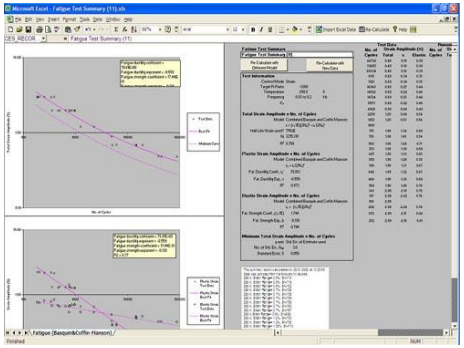
Integration options

Providing engineers with:

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





Test data

Interactive Gateway

CORPORATE MATERIALS DATABASE

Export

API

Design curves
FE material cards

Exported Data

The export file for Abaqus 6 (model 'Temperature-dependent, isotropic') is shown below

```
** MI PROPERTIES : Elongation,  Value:  0.0539,  Units: <No Unit>
** MI PROPERTIES : Thermal conductivity,  Value:  157,  Units: W/m.K
** MI PROPERTIES : Electrical resistivity,  Value:  0.0000000449,  Uni
** MI PROPERTIES : Specific heat capacity,  Value:  <No Value>,  Units
** MI PROPERTIES : Dielectric constant (relative permittivity),  Value
**
*MATERIAL, NAME = Wrought_aluminum_alloy_2024_T6
**
*ELASTIC, TYPE = ISOTROPIC
8.278e+10, 0.337, 77.5
7.786e+10, 0.337, 190
7.451e+10, 0.337, 270
7.261e+10, 0.337, 328
7.178e+10, 0.337, 370
6.896e+10, 0.337, 420
6.482e+10, 0.337, 463
5.912e+10, 0.337, 502
5.521e+10, 0.337, 527
5.200e+10, 0.337, 551
**
*FAIL STRESS
4.490e+8, 3.770e+8, , , , , , 298
**
*FAIL STRAIN
0.0539, , , , , 298
```

Save To Disk | Copy To Clipboard

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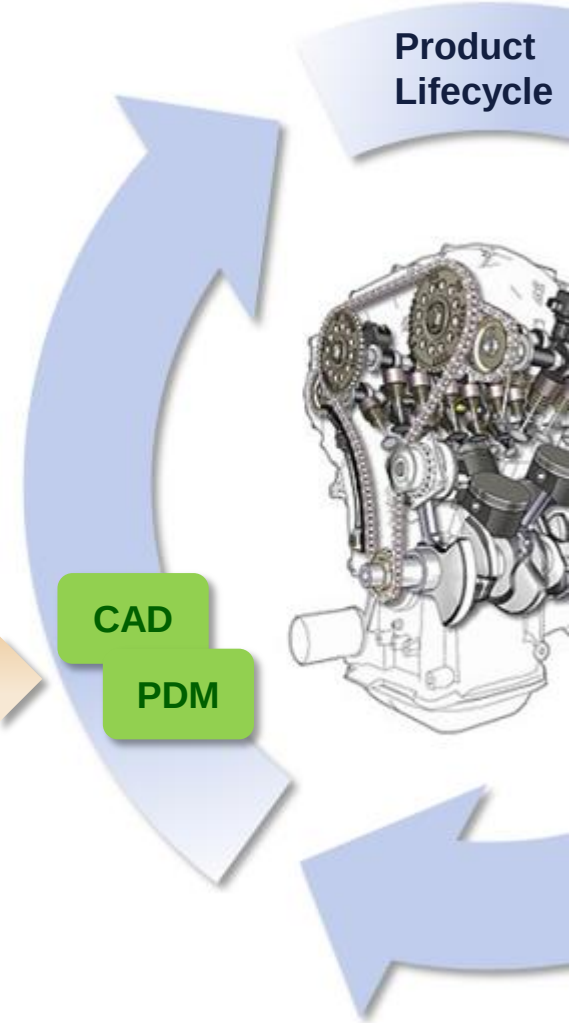
Assigning materials and their properties

"Gold Source" managed database and software tools

- All materials – in development *or* in production
- Full, detailed characterization and properties
- Restricted substances / eco data
- Price / Supply / Availability information
- Specs, certs, Standards…
- Current *Materials Strategy,* selection rules, etc.

Select and assign

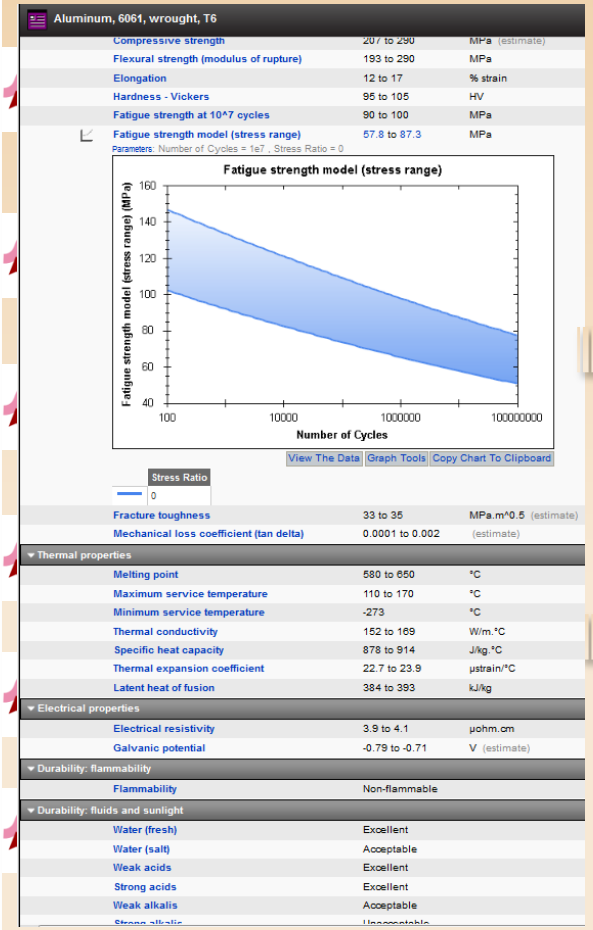
Name	Aluminum 6061	
Density	2.71	kg/m^3



GRANTA MATERIAL INTELLIGENCE

Assigning materials and their properties

“Gold Source” managed database and software tools



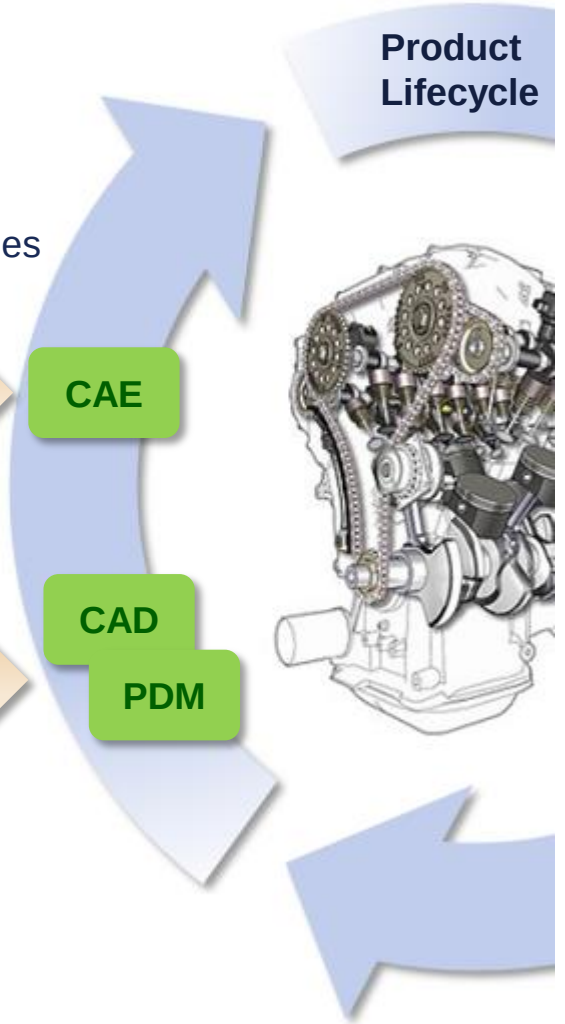
Name	Aluminum 6061	
Density	2.71	kg/m^3
Youngs Modulus	68.9	Gpa
Poissons Ratio	0.33	
Yield Strength	241	Mpa
Ultimate Tensile Strength	290	MPa
Thermal Conductivity	167	W/m °C
Thermal Expansion	23.6	µstrain/°C

Relevant, *correctly-versioned* properties made available when requested

Get accurate, up-to-date properties

Select and assign

Name	Aluminum 6061	
Density	2.71	kg/m^3



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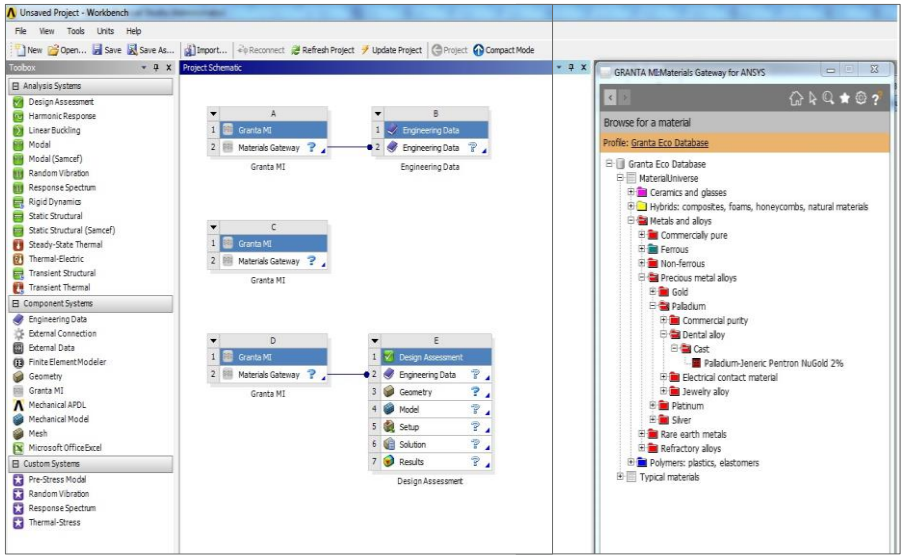
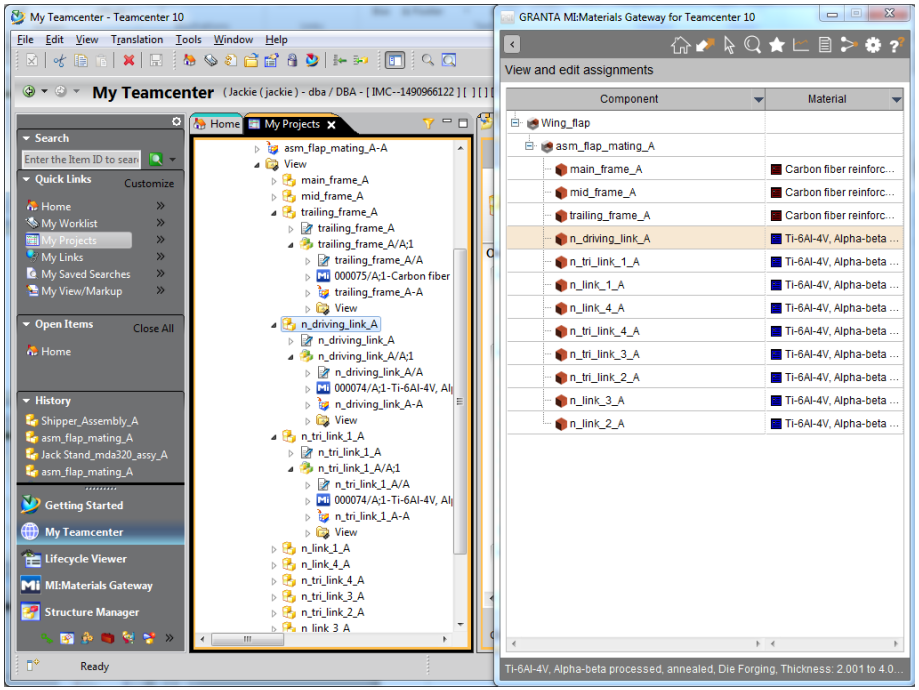
Gateways for material import to CAE

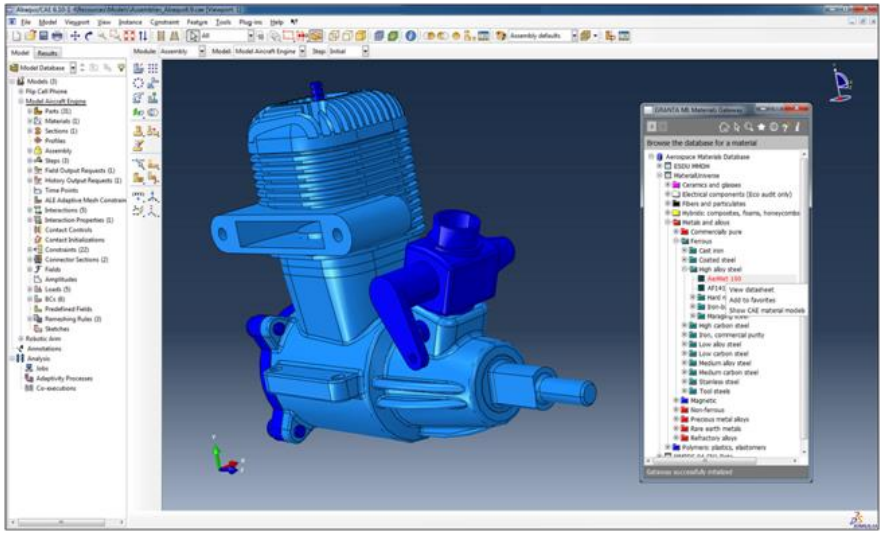
ANSYS Workbench



Siemens Teamcenter



Abaqus/CAE from Dassault Systèmes / SIMULIA



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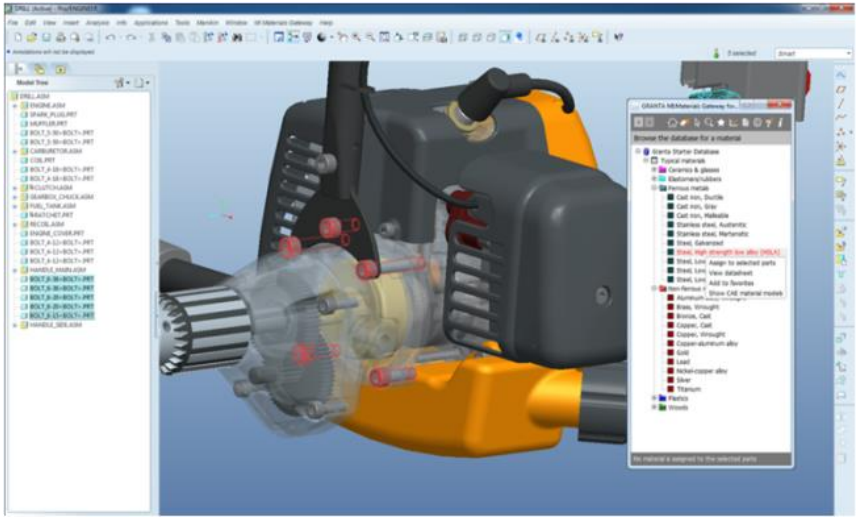
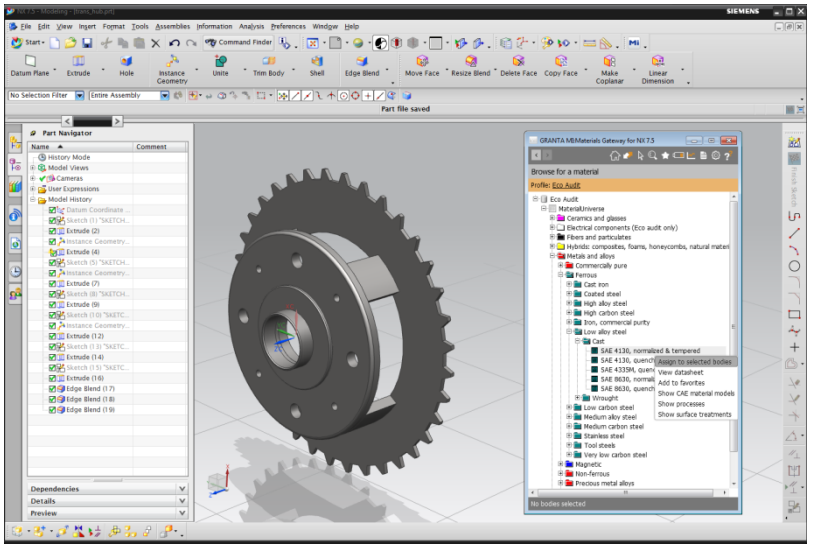
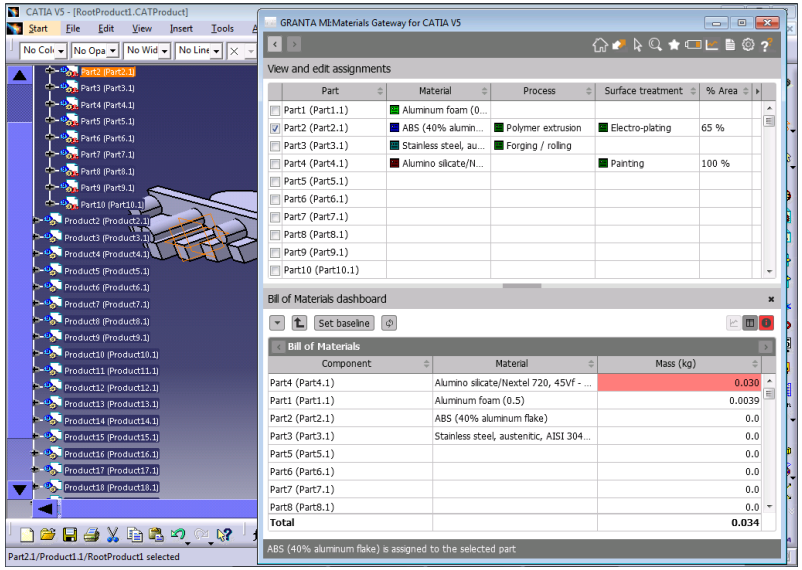
Gateways for material assignment in CAD/CAE

Pro/ENGINEER and Creo from PTC

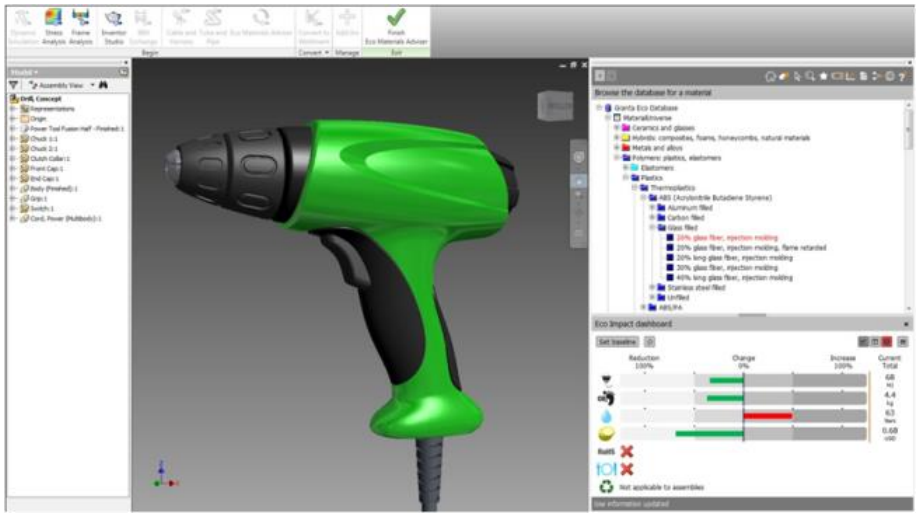


NX from Siemens PLM





CATIA V5 from Dassault Systèmes



Autodesk Inventor

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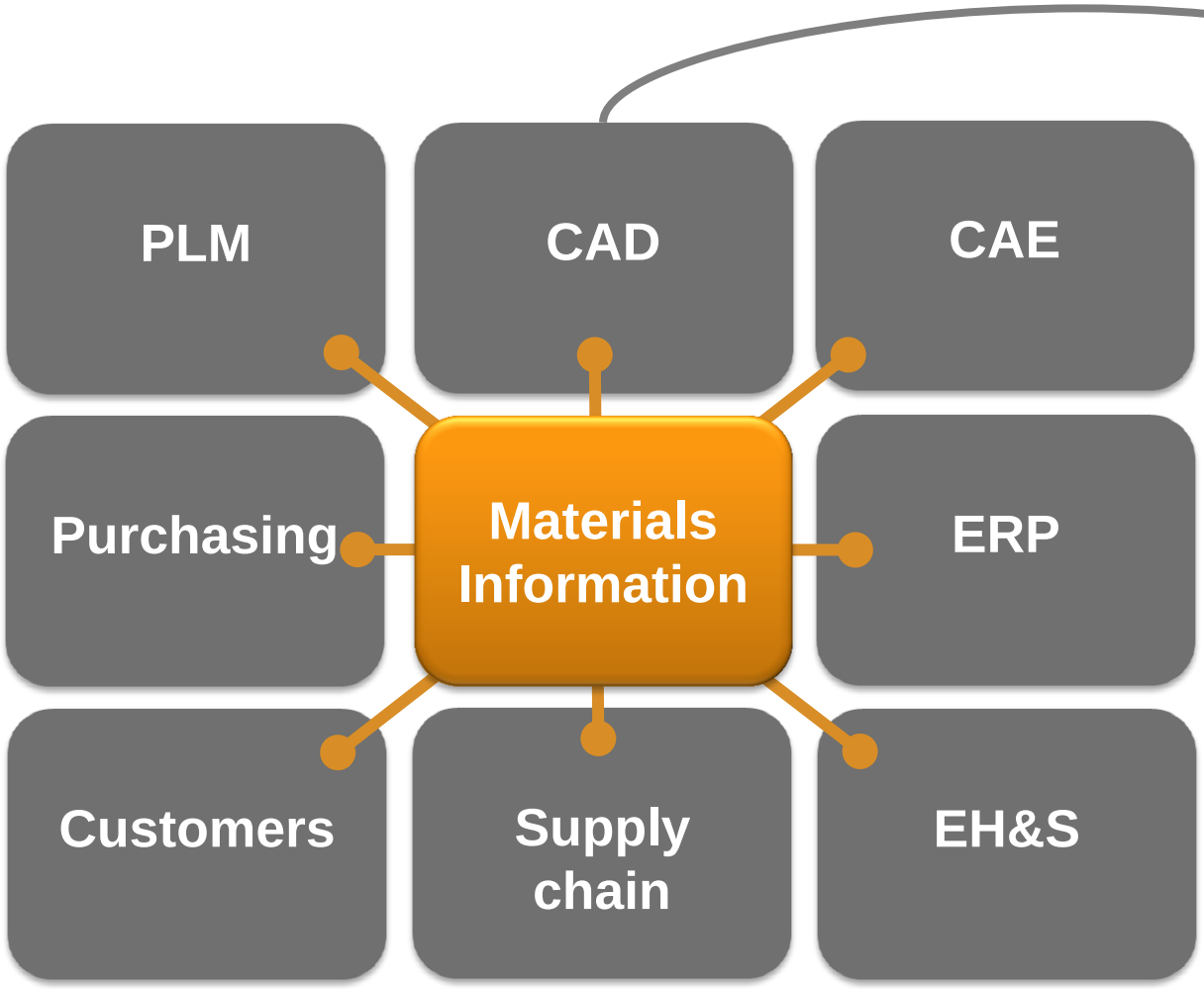
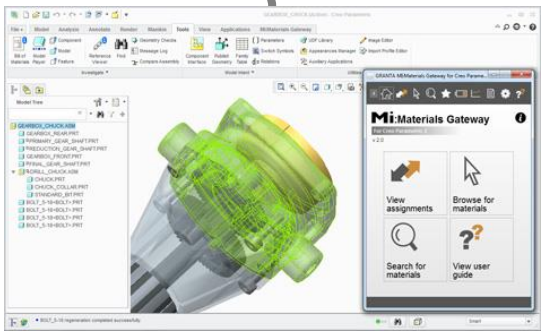
Incorporation of materials data





Single, reliable, controlled source for corporate materials data

Materials data and applications, when and where you need them

GRANTA MATERIAL INTELLIGENCE

Granta MI for Composites

A mature materials information management system

- Used and developed over many years in conjunction with key customers, technology and partners
  - MDMC; especially the Composites sub-committee
    Boeing, Northrop Grumman, NASA, Raytheon, Rolls-Royce, …
  - Customers; Airbus Helicopters, Airbus Defence and Space, Airbus, and many others
- Specialized features and capabilities to manage the complexities of composite materials

Integration in product development and software environments are highly relevant – Gateway

- Providing rapid access, enterprise-wide, controlled and traceable
- Consistent and repeatable process to derive CAE parameters from measured materials data

Thank you – any questions?

Sebastian Schwägele
Account Manager Central Europe

sebastian.schwaegele@grantadesign.com

Thomas Weninger
Director Sales Central Europe

thomas.weninger@grantadesign.com

Dr Will Marsden
Director Industry Relations

will.marsden@grantadesign.com