

AutoMatIC Member Update:

Jaguar Land Rover



6th AutoMatIC Meeting Hosted by John Deere

17th/18th May, 2017



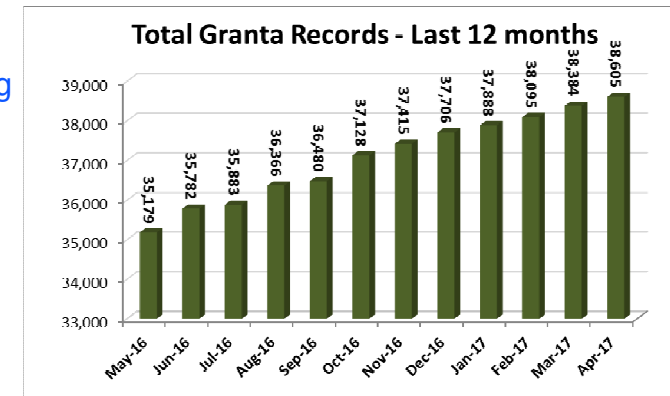
GRANTA
MATERIAL INTELLIGENCE

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Implementation summary

- What is the structure of your implementation:

- 8 references databases – find CAMPUS ABAQUS export useful
- 12 JLR Databases – [Expanded Paint \(Coatings\)](#), [Virtual Engineering](#)
- [38,600 records](#) and growing at 200-500 per month
- [1 Production, 1 QA – 32 bit server – hence still using Granta v6](#)
- 300 User Licences –Administer through Windows User Groups
 - Read only (CAE, Materials Eng, Prod Development)
 - Edit (Mainly each database owner)
 - Admin (1 Fulltime Granta SW application Engineers)

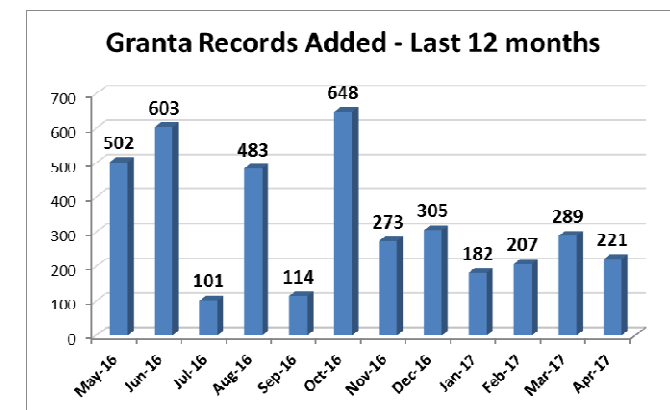


- What will the final system look like?

- Materials Engineering store all relevant material data for the company
 - Reports, Test Data, Analysis Data, Test Specs, Material Specs.
- Interfaces to CAD and CAE software
- 64 bit server using latest Granta functionality
- Licensing issues to be addressed – Cant use current model.

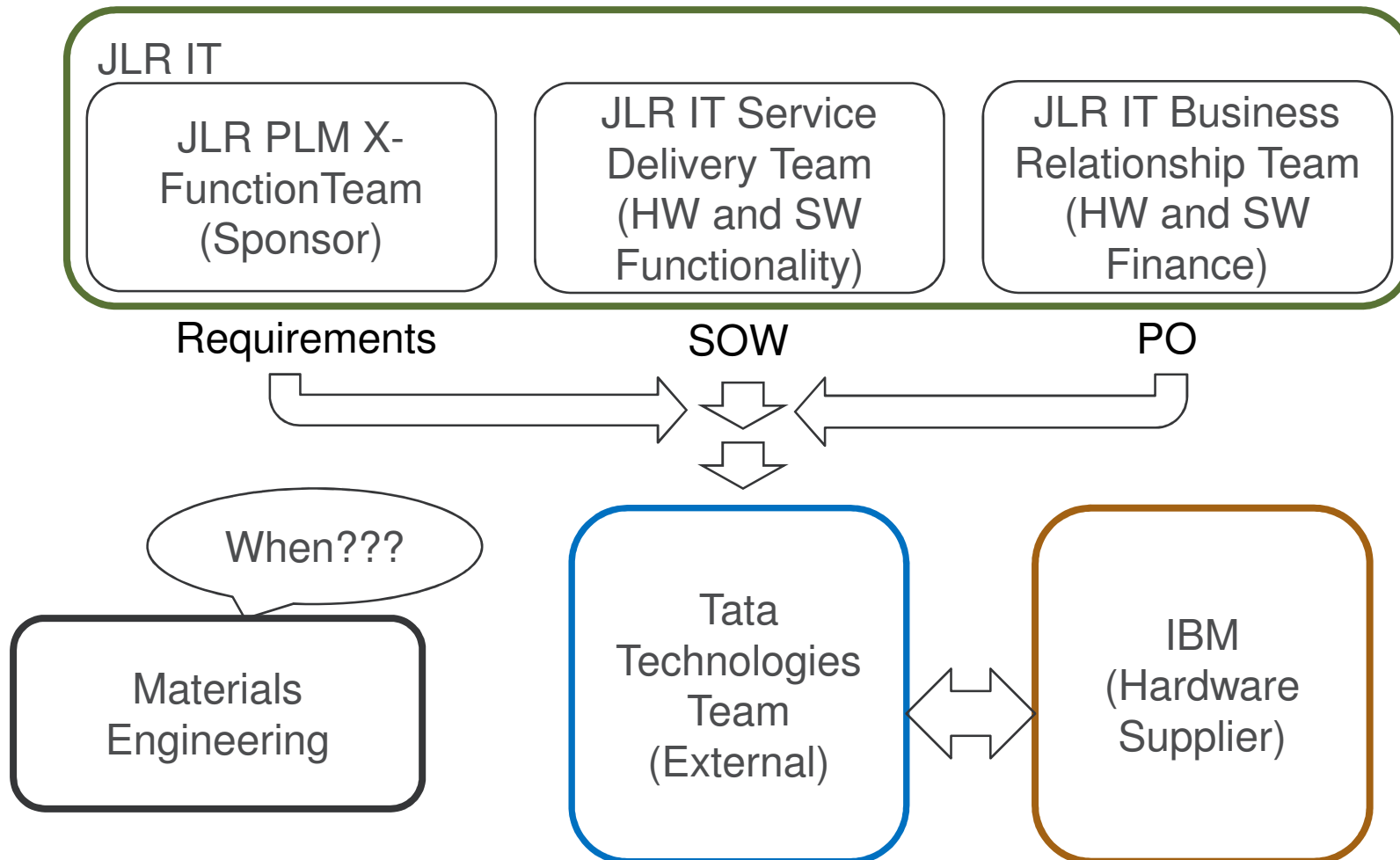
- How close are you to this?

- Four years in – growing but not quick enough!
 - [Server upgrade needed](#)
 - [Benefit evaluation \(no PLM users yet\)](#)
 - [Deploying to rest of company \(non materials experts\)](#)
 - [Limited PLM Integration](#)



Server Upgrade Project

Slow progress – too many involved, no one responsible
Current server nearly unusable – lost weeks work, lots of time outs.



Database Developments - Characterisation

Final Vision- Characterisation (Design stage)

Updated VEMH Project – CAE and CAD data

Recreated CATIA V6 table –

Improved PLM material data

All DYNA decks written from Granta

Metals

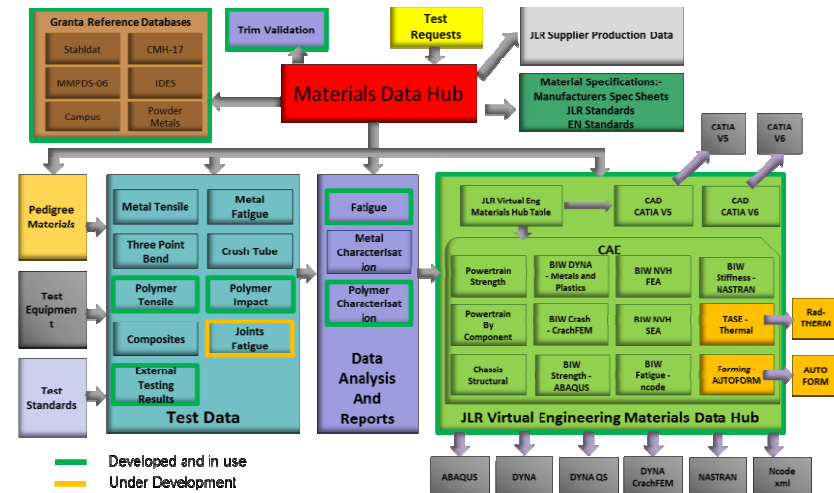
Metals (QS)

NonMetals

NonMetals (QS)

CrachFEM

2017 added ABAQUS and NASTRAN and ncode – Granta as master for BIW CAE



Completed Forming (Autoform) database

New customer for Materials Engineering

Binary file format – single export per record

Can we export multiple binary file formats in one zip file?

Googlesheets – Summary page - hyperlinks

Want to be alerted for 'old' data – Doing this in Googlesheets

Can this be done with MI Explore? Or with Python script?

Material Card Name	Material Category	Material Family	Material Grade Name	Thickness	Material Age	Material Supplier	CAE Card Expiry Date	Grant Record URL
BH220 - Arcelor - Thickness All - Age All	Steel	Steel Bake Hardened (BH)	BH220	All	All	Arcelor	28-Oct-17	https://granta.ilrint.com/mi/index.aspx?history=208839&dbKey=MI_JLR_VEMH
BH220 - TATA - 0.4 - 0.8 - Age All	Steel	Steel Bake Hardened (BH)	BH220	0.4 - 0.8	All	TATA	14-Oct-17	https://granta.ilrint.com/mi/index.aspx?history=208870&dbKey=MI_JLR_VEMH
BH220 - TATA - 0.8 - 1.2 - Age All	Steel	Steel Bake Hardened (BH)	BH220	0.8 - 1.2	All	TATA	14-Oct-17	https://granta.ilrint.com/mi/index.aspx?history=208871&dbKey=MI_JLR_VEMH
BH220 - TATA - 1.2 - 1.6 - Age All	Steel	Steel Bake Hardened (BH)	BH220	1.2 - 1.6	All	TATA	14-Oct-17	https://granta.ilrint.com/mi/index.aspx?history=210551&dbKey=MI_JLR_VEMH
BH220 - TATA - 1.6 - 2.0 - Age All	Steel	Steel Bake Hardened (BH)	BH220	1.6 - 2.0	All	TATA	14-Oct-17	https://granta.ilrint.com/mi/index.aspx?history=208872&dbKey=MI_JLR_VEMH
BH260 - Arcelor - Thickness All - Age All	Steel	Steel Bake Hardened (BH)	BH260	All	All	Arcelor	28-Oct-17	https://granta.ilrint.com/mi/index.aspx?history=208841&dbKey=MI_JLR_VEMH
BH260 - TATA - 0.4 - 0.8 - Age All	Steel	Steel Bake Hardened (BH)	BH260	0.4 - 0.8	All	TATA	14-Oct-17	https://granta.ilrint.com/mi/index.aspx?history=208873&dbKey=MI_JLR_VEMH
BH260 - TATA - 0.8 - 1.2 - Age All	Steel	Steel Bake Hardened (BH)	BH260	0.8 - 1.2	All	TATA	14-Oct-17	https://granta.ilrint.com/mi/index.aspx?history=208874&dbKey=MI_JLR_VEMH
BH260 - TATA - 1.2 - 1.6 - Age All	Steel	Steel Bake Hardened (BH)	BH260	1.2 - 1.6	All	TATA	14-Oct-17	https://granta.ilrint.com/mi/index.aspx?history=208875&dbKey=MI_JLR_VEMH

CAE - Granta as Master for Body CAE data

Six DYNA decks exported (380 material datasets)

- Metals (Dynamic and QS versions)
- NonMetals (Dynamic and QS version (March 2017))
- CrachFEM
- CrachFEM NonMetals
- -> NASTRAN Exporter - Polymers (April 2017)

Use 2 attributes to control:-

- DYNA Export Master Deck
- CAE Card Approved to Use (Y/N) (Basic manual version control!)
- Custom search->Add to List-> Export
- Add manual header block – release notes

[Whats the best practice for controlling releases/versions?](#)

ABAQUS (March 2017)

- Removed 60 obsolete grades
- Standardised Colours (Aligned with CAD system)
- Next step - Standardised Naming (Group Materials together)

NASTRAN/OptiSTRUCT (April 2017)

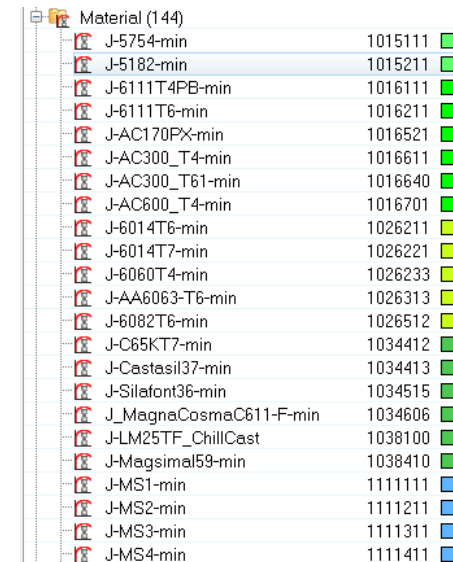
- Removed 40+ obsolete grades
- Standardised Colours (Aligned with CAD system)
- Standardised Naming (Group Material together)

Ncode (March 2017)

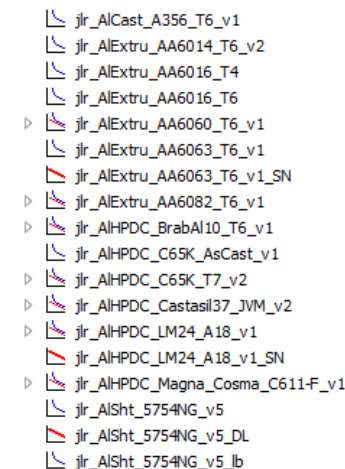
- Use Xml file output

All created directly from record attribute data

- Lots of exporters needed!



Material (144)		
J-5754-min	1015111	■
J-5182-min	1015211	■
J-6111T4PB-min	1016111	■
J-6111T6-min	1016211	■
J-AC170PX-min	1016521	■
J-AC300_T4-min	1016611	■
J-AC300_T61-min	1016640	■
J-AC600_T4-min	1016701	■
J-6014T6-min	1026211	■
J-6014T7-min	1026221	■
J-6060T4-min	1026233	■
J-AA6063-T6-min	1026313	■
J-6082T6-min	1026512	■
J-C65KT7-min	1034412	■
J-Castasil37-min	1034413	■
J-Silafont36-min	1034515	■
J_MagnaCosmaC611-F-min	1034606	■
J-LM25TF_ChillCast	1038100	■
J-Magsimal59-min	1038410	■
J-MS1-min	1111111	■
J-MS2-min	1111211	■
J-MS3-min	1111311	■
J-MS4-min	1111411	■



jlr_AlCast_A356_T6_v1
jlr_AlExtru_AA6014_T6_v2
jlr_AlExtru_AA6016_T4
jlr_AlExtru_AA6016_T6
jlr_AlExtru_AA6060_T6_v1
jlr_AlExtru_AA6063_T6_v1
jlr_AlExtru_AA6063_T6_v1_SN
jlr_AlExtru_AA6082_T6_v1
jlr_AlHPDC_BrabAl10_T6_v1
jlr_AlHPDC_C65K_AsCast_v1
jlr_AlHPDC_C65K_T7_v2
jlr_AlHPDC_Castasil37_JVM_v2
jlr_AlHPDC_LM24_A18_v1
jlr_AlHPDC_LM24_A18_v1_SN
jlr_AlHPDC_Magna_Cosma_C611-F_v1
jlr_AlSht_5754NG_v5
jlr_AlSht_5754NG_v5_DL
jlr_AlSht_5754NG_v5_lb

CAE – Granta Developments

JLR mainly use LS-DYNA (explicit) and ABAQUS (Implicit)

QS modification – wanted DYNA QS card

- Added QS Modulus attribute and populated
- Changed exporter (Choose Dynamic or QS option)
 - QS Modulus
 - One Stress-strain curve
 - No FAIL value
 - Appends _Quasi Static to Card name
- Also allows an improved ABAQUS (implicit) export

Material Property Data		
Density (RO)	1100	kg/m ³
Young's Modulus (E)	2500	MPa
Dynamic Young's Modulus (E)	3000	MPa
Poisson's Ratio (PR)	0.35	

Exported Data	
Exported Data	
The export file for LS_DYNA (model 'Automatic') is shown below	
<pre>*MAT_PIECEWISE_LINEAR_PLASTICITY_TITLE PP-GF25 - LyondellBasell Softell TKG300N (+23C) LTIM 4mm mesh_Quasi-Static \$ \$[---MID---][---RO---][---E---][---PR---][---SIGY---][---ETAN---][---FAIL---][---IDEL---] 16102131 1.1E-09 2500 0.35 12 0 0 0</pre>	

NASTRAN exported from DYNA polymer deck

- NVH team wanted to use better data (DYNA QS modulus)
 - Rewrite NASTRAN exporter
 - Fix card type – MAT1
 - Preset colour options

```
$ANSA_NAME;16001031;MAT1;PP - Dow DT150 (Ambient);$
$ANSA_COLOR;16001031;MAT1;0.5;0.5;0.5;1;
$HNAME MAT 16001031"PP - Dow DT150 (Ambient)" "MAT1"
$HNCOLOR MAT 16001031 2
$
$--01--][--ID--][--E---][--G---][--NU--][--RHO--][--A---][--TREF--][--GE---][--10--]
MAT1 160010312277.8 0.41 1.02E-09
$--01--][--ST--][--SC--][--SS--][--MCSID][--06--][--07--][--08--][--09--][--10--]
```

Error suppression in pre-processor (Improve CAE deck debugging)

- Add \$PR_SUPPRESS term into some record exports
 - Added Suppress Errors Attribute
 - Modified exporter to write text line if needed

Common LS-DYNA Parameters	
FAIL (Std Mesh)	0
FAIL (1mm Mesh)	
FAIL (10mm Mesh)	
Dynamic viscosity coefficient (MU)	
Rayleigh damping coefficient (DAMP)	
Decay constant beta (BETA)	
Suppress Errors	Yes

Exported Data	
The export file for LS_DYNA (model 'Automatic') is shown below	
<pre>*MAT_PIECEWISE_LINEAR_PLASTICITY_TITLE PA6 GF40 - DSM Akulon PG6 Cold Data - PAB Housing \$PR_suppress_item_check \$</pre>	

Database Developments – Smarter use of data

CAD to CAE name (Hub Data) mapping –

- Automate CAE model build (CATIA V5 and CATIA V6 – Hyperworks and ANSA)
- Same data could now be used for a CAD bolted joint checking tool in development

Every record has a “Hub Reference” attribute

Hub Reference

Aluminium/Aluminium 5000 Sheet/AA5182

Hub Table links same “Hub Reference” records into master table

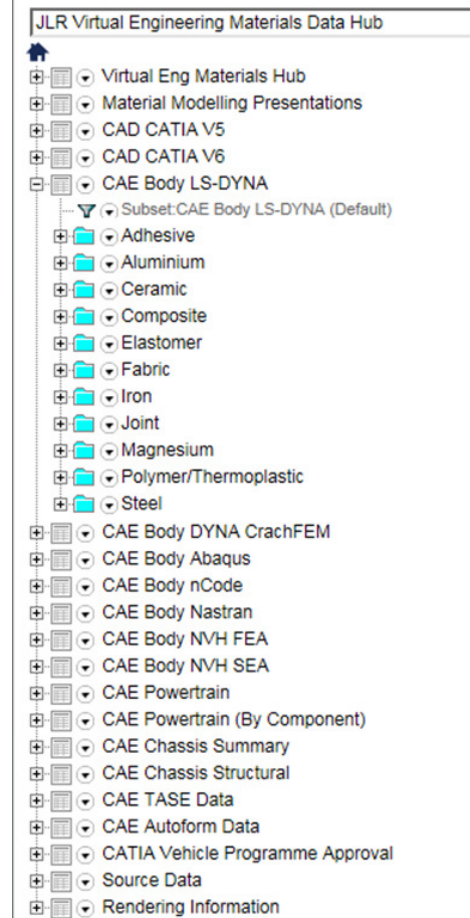
AA5182	
General Information	
Material Equivalencies	
CAE Data Links	
<div> <div>Linked CAE Body LS-DYNA Records</div> <div> <div>AA5182 0% (Novelis, A Carr, August '06)</div> <div>AA5182 3% (Novelis, A Carr, August '06)</div> <div>AA5182 5% (Novelis, A Carr, August '06)</div> <div>AA5182 8% (Novelis, A Carr, August '06)</div> </div> </div>	
Linked CAE Body DYNA CrachFEM Records	No Linked Records
<div> <div>Linked CAE Body Abaqus Records</div> <div>J-5182-min</div> </div>	
<div> <div>Linked CAE Body nCode Records</div> <div>Jlr_AISht_AA5182_v2</div> </div>	

Have to manually export report from every table to excel and use VBA script lookups to map data into one file

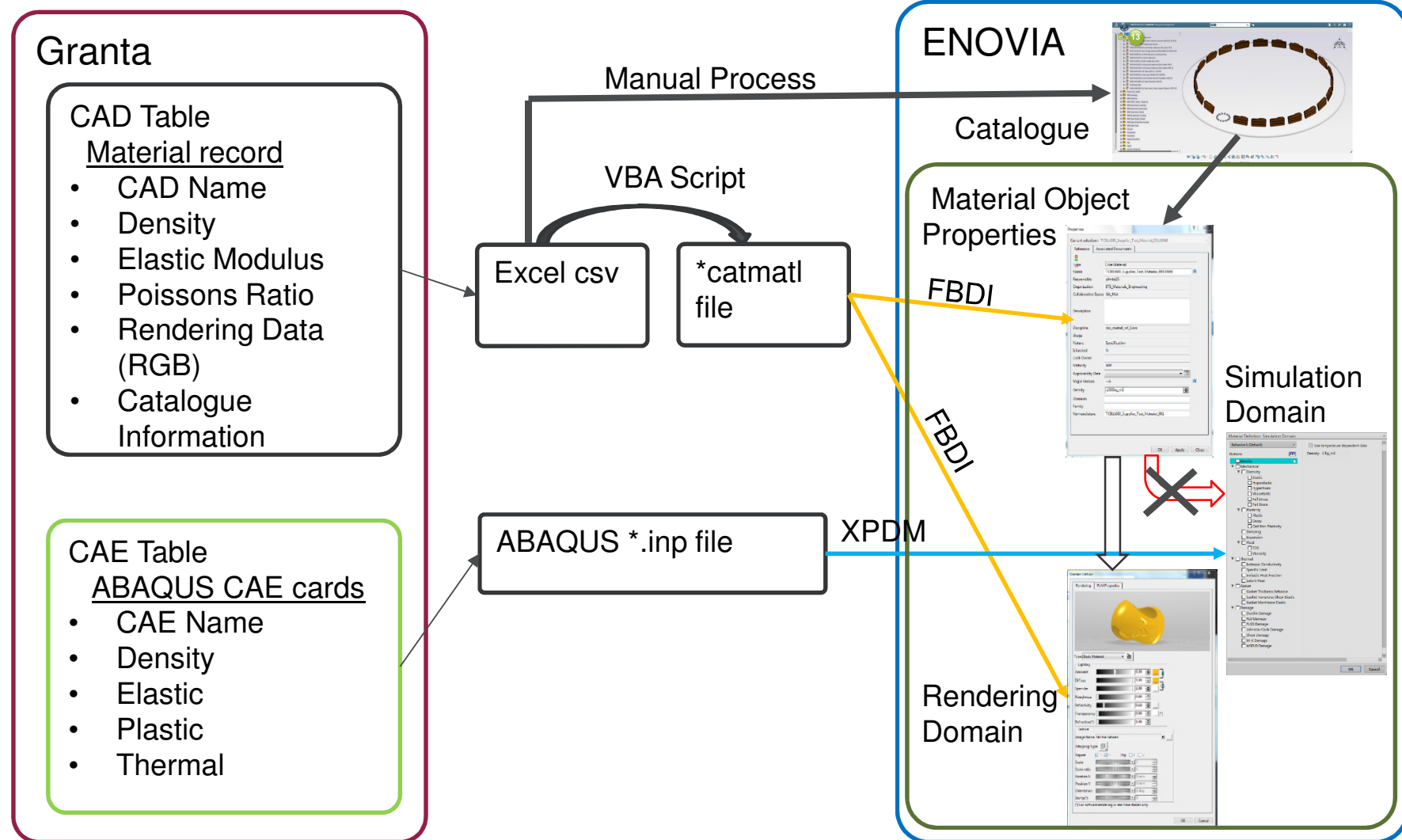
Hub Reference	Table	No records	Record names		
Aluminium/Aluminium 6000 sheet/AA6111-T4	CATIA V6	1	STJLR.50.5004 Type A (AA6111 T4) + STJLR.50.5002 Type A + STJLR.50.		
Aluminium/Aluminium 6000 sheet/AA6111-T4	LS-DYNA	10	1016111	6111T4 COLD 0%	1016112
Aluminium/Aluminium 6000 sheet/AA6111-T4	ABAQUS	4	M1016122;J-6111T4-min H	M1016121;J-6111T4-min	M1016112;J-6111
Aluminium/Aluminium 6000 sheet/AA6111-T4	NASTRAN	1	1016111	J-6111T4PB-min	

Therefore needs to be done everytime a record is added!

Can this be done with MI Explore? Or with Python script?



CAD - Granta to CATIA V6 Process



CAD - Granta to CATIA V6 Process

Process very time consuming and open to errors:-

- Two files (excel csv and ABAQUS inp)
- Two import processes (FBDI and XPDM)
- Plus manual catalogue creation – no method to transfer this data into Enovia at present!
- Manual copy of data for attachment of Simulia domain to Material Object

Issues resolved/still to be resolve:-

- Enovia only imports SI units – modify ABAQUS exporter – 1 hour!
- Technical limitation with CATIA. It is not possible to delete or replace a Simulation Domain from below a Material Object once it has been created. – Has stopped progress on this!
- Technical limitation with CATIA. Cant transfer catalogue structure data into Enovia.
- Enovia adds internal numbering to end of name if needed – not sure how often this happens.

It was easier to do the bulk of the work directly into Enovia and Granta separately from a spreadsheet.

Maintenance is being done using Granta as master but seen as making process slower!

[We need to understand proposed Granta Gateway functionality](#)

[Does this align with other CATIA V6 users requirements \(PSA?\)](#)

CAD - Granta to CATIA Future Process

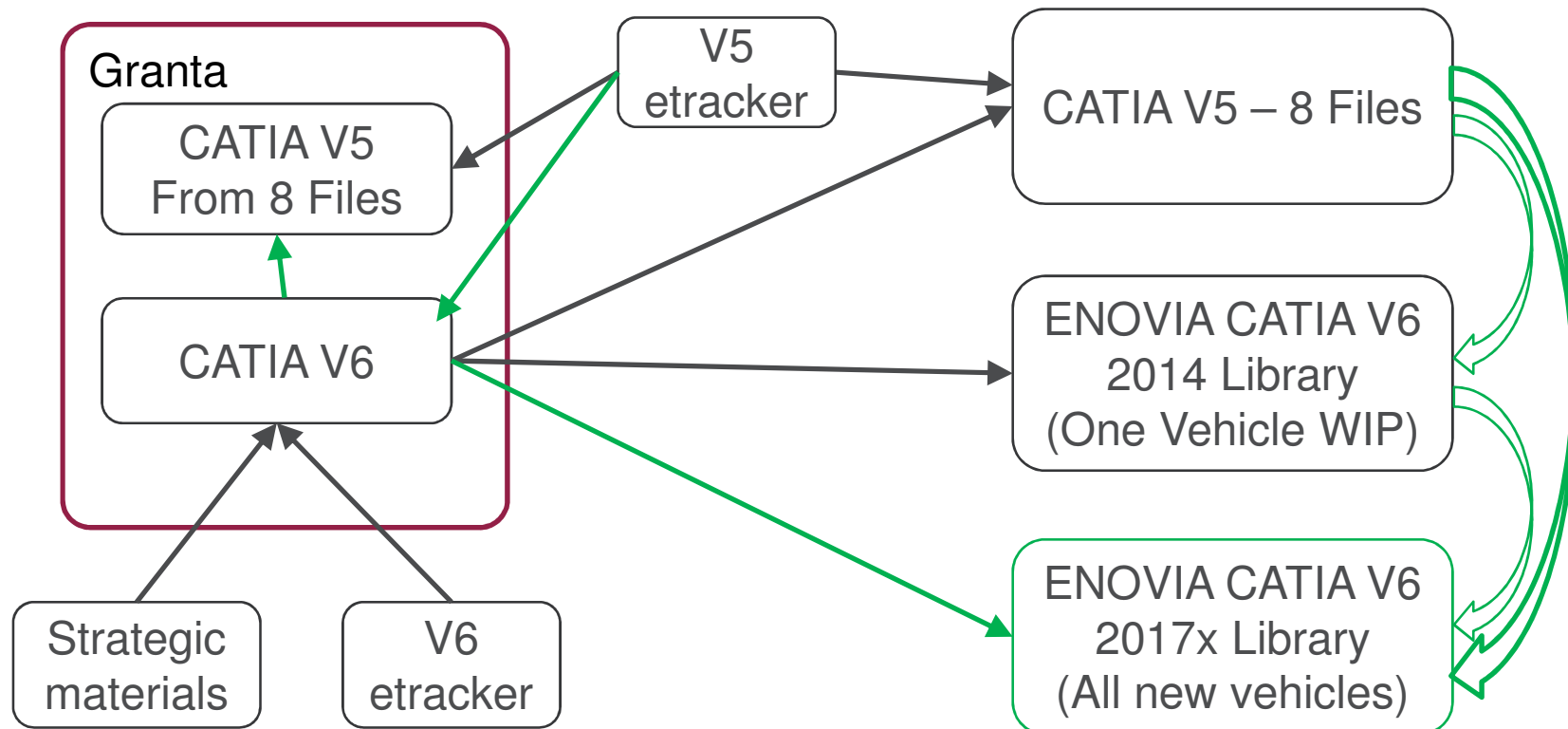
New Cross-Attribute PLM team – looking at getting Materials Assignment process working!

Introducing a new version of Enovia (better functionality!) for new programmes – Mid 2017.

- One programme in Enovia 2014.
- Additional programmes will migrate from V5 – with frozen material assigned!

Need to keep V5 and two V6 material libraries in sync!

Not sure how Granta will help with synchronisation (apart from be master reference)

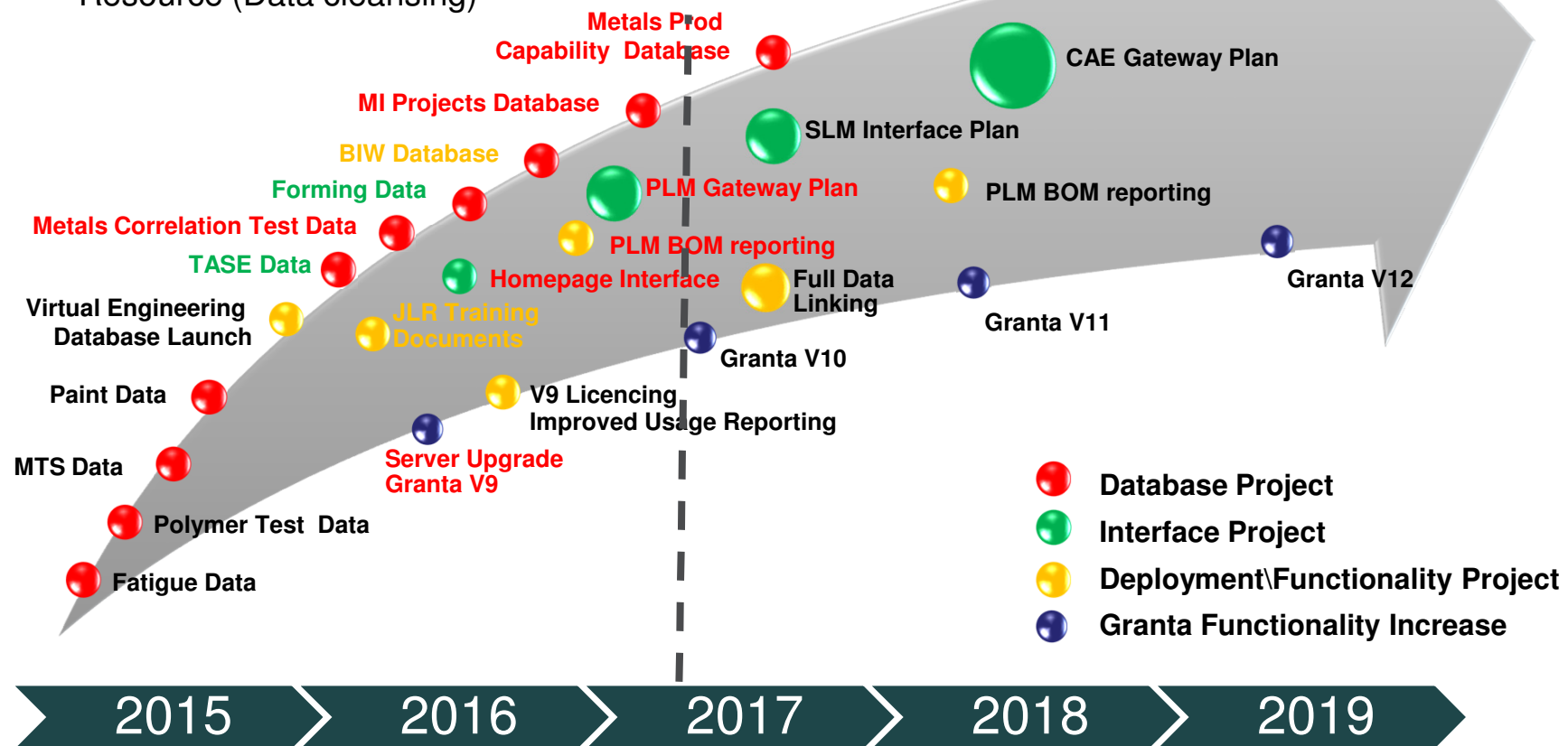


Looking ahead – Defining Strategy

Developed Strategy to Expand Granta Data and Functionality

Issues:-

- Launching current databases (Too many iterations due to lack of understanding of 'art of the possible')
- Data readiness
- Software functionality (waiting until after upgrade) - Hyperworks gateway introduction planned
- Resource (Data cleansing)



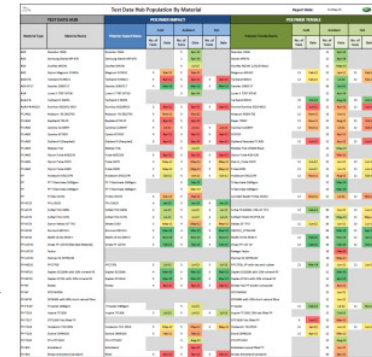
Looking ahead - Functionality

What would you like to change?

Make it easier for new users/non-Granta experts to use – getting users actively using is not easy

How to easily search Granta without end user being a Granta expert

- Cross – table searches don't work (ie material modulus from all CAE tables)
- Tabular data searches don't work
- Have to know record structure/attribute setup to create searches



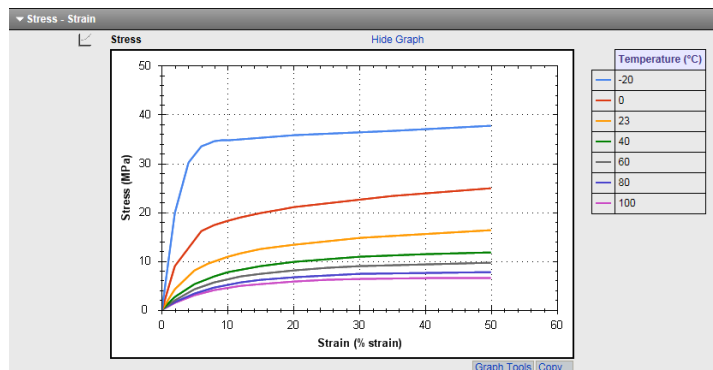
How to easily get data out of Granta without end user being a Granta expert

- How to assemble report from multiple tables? →
- Report templates aren't obvious! →
- Graph data exports (save to excel) aren't logical! →

Report : Attribute List

Report Template

Choose a report template from the list.



Temperature (°C)	Strain (% strain)	Stress (MPa)	Est
-20	0	0	N
-20	2	19.8	N
-20	4	30.2	N
-20	6	33.5	N
-20	7	34.1	N
-20	8	34.5	N
-20	9	34.7	N
-20	10	34.8	N
-20	20	35.7	N
-20	35	36.7	N
-20	50	37.7	N
0	0	0	N
0	2	8.97	N
0	6	16.1	N
0	8	17.4	N
0	10	18.3	N
0	12	19	N

Summary

- Your number one issue to put for discussion and feedback with other members
 - Licensing method doesn't work for our intended use – Has there been any progress on this?
 - Maintenance
 - Occasional users
- Other issues
 - How are others evolving internal Granta MI development capability?
 - MI:Admin/MI:Toolbox/XML/VBA/Excel/VisualStudio/html/python
 - Getting Data out of Granta
 - Best methods for developing reporting tools from Granta?
 - Python scripting – Examples of whats possible
 - Customising view for different levels of user (Summary tables, reduced datasets, etc)
 - MI Explore – Examples of whats possible