

Democratization

Lessons Learned from an Enterprise Practitioner

Glenn Valine

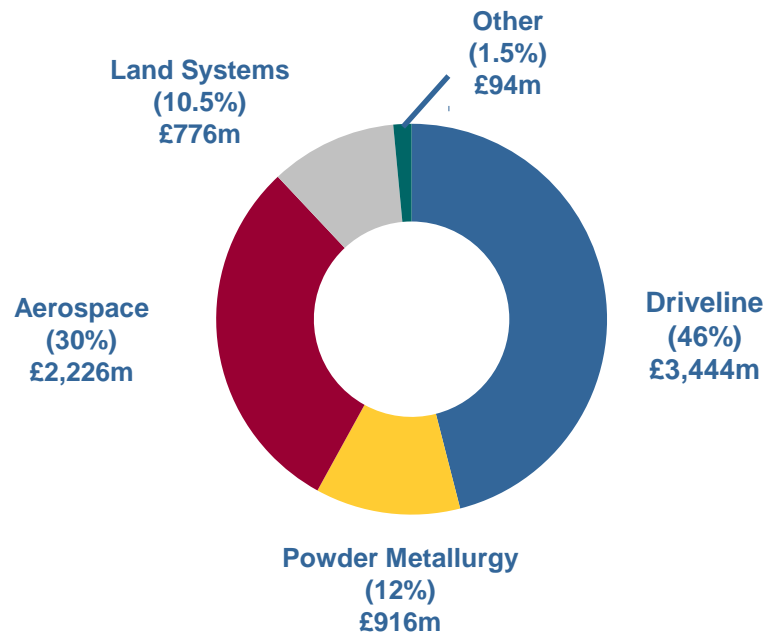
GKN Driveline North America, Inc.

GKN at a glance

Tier 1 Supplier to the major OE manufacturers

- > Global engineering group
- > Sales of £7.4 billion in 2014
- > More than 50,000 people in more than 30 countries
- > **Driveline – largest business**

2014 - Sales by division



GKN Aerospace

A leading first tier supplier to the global aerospace industry.



GKN Driveline

A world leading supplier of automotive driveline systems and solutions.



GKN Powder Metallurgy

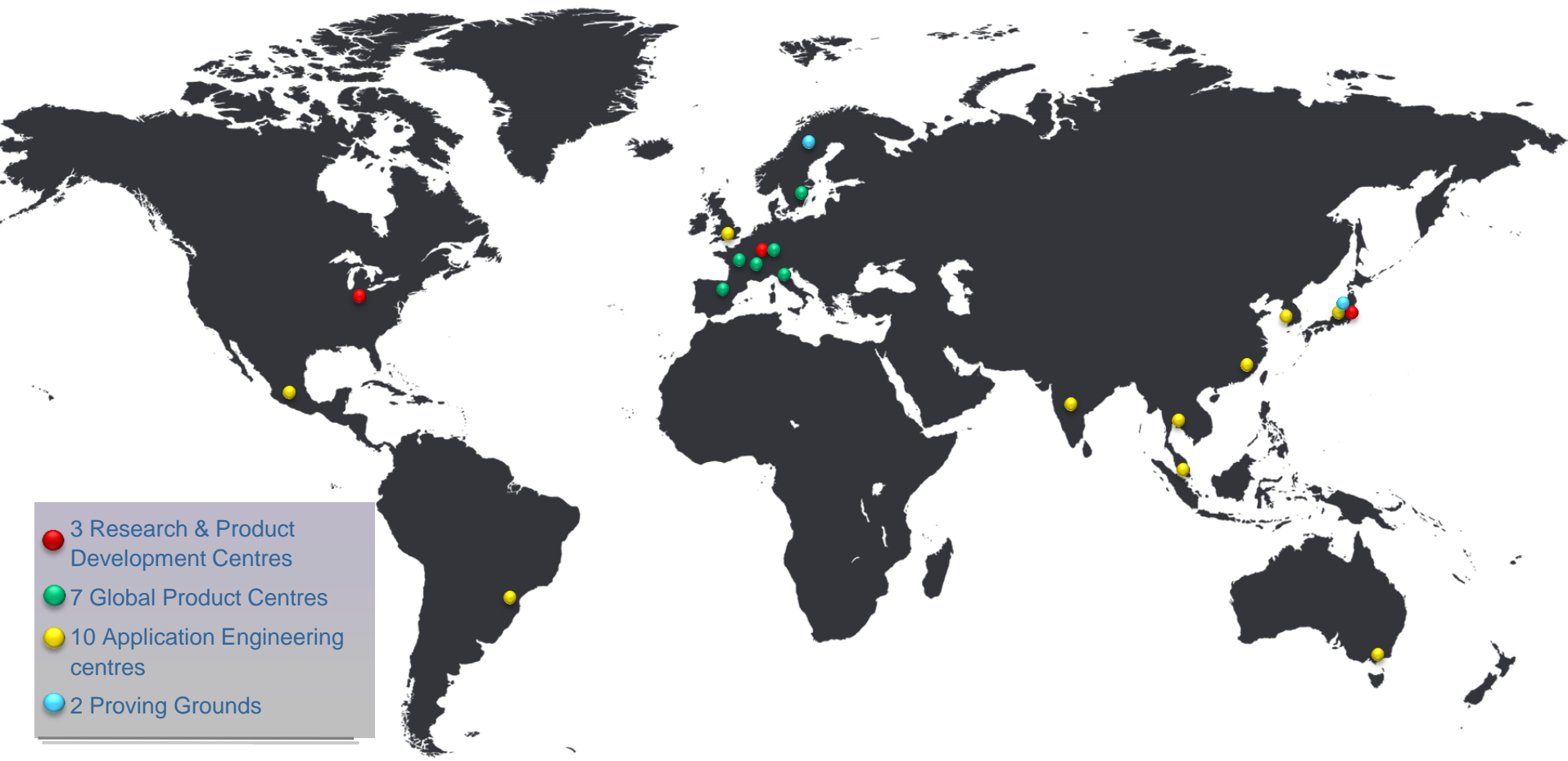
One of the world's largest manufacturers of metal powder and sintered components.



GKN Land Systems

A leading supplier of engineered power management products, systems and services.

Driveline enterprise – engineering footprint



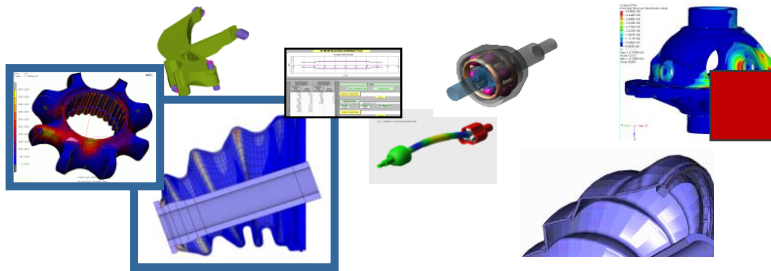
Lessons learned (1)

- > **Democratized CAE are not bolt-on's, to your existing Simulation group's Way-of-Working**
 - They are part of a spectrum of approaches to augment simulation opportunities in your company.
 - They are about the role in your business, not simply changes in software technology. (credit to joe walsh)

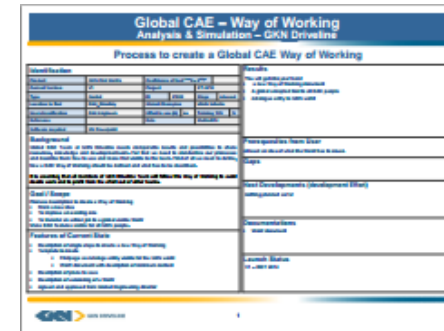
Simulation Approaches

and path to Democratization

Classic or Individual



Standardized Way of Working (WoW) Verified, agreed and comparable results



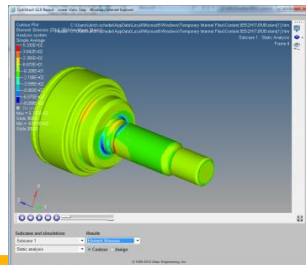
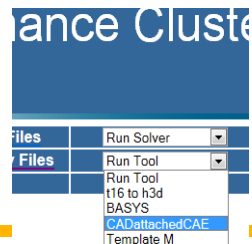
1 – Methods Dev. & Adhoc (Sr. Analyst)

3 - CAD attached CAE (Designer)
Small CAE loops earlier in the design period

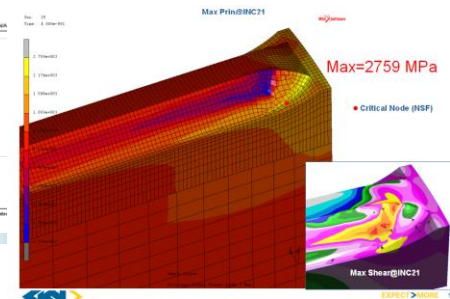
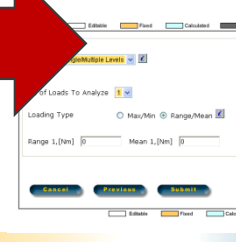
2 – Guided/Recipes (Analyst)

4 – Democratized Tool Apps (Engineer)

Individual templates for comparable design loops
Minimal CAE knowhow for CAD necessary



CAE for regular engineers – intuitive front end
Verified automation of CAE jobs (absolute correlations)
Analyst knowhow for user unnecessary



Lessons learned (2)

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- > **Engineer Analyst has a new important role**
 - Define, commonize and validate your worldwide processes/workflows before you start
 - Your Experts need to be available for the duration of the project, deployments and non-Expert support

Engineer Analyst (Expert) – New Role

- **Participate within a global team of Expert Analysts**
 - Synchronize worldwide CAE knowledge, recipes and processes
 - Lean up processes and drive new developments in one common direction

New Capabilities

Efficiency

Productivity

- **These are the underpinnings of Democratized CAE!**
- **You will likely realize that your existing WoW/recipes are not robust and/or repeatable for process automation. Once you address this, you'll have a much improved manual WoW - as well.**

Global CAE – Way of Working Analysis & Simulation – GKN Driveline

CAE - Way Of Working Analysis & Simulation - GKN Driveline

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V. Frequency Response Analysis

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VI. FEM Method and Physical Test comparison

6.1 Correlation table

VII. Crash

VIII. Suggestion

I. Preface

Preparation of the M&M model propshaft is explained in the following report. Additionally described are the Modal Analysis and Frequency Response analysis which can be utilized for the comparison or validations or calculations of the propshafts.

II. Components (Propeller Shaft) - Joints

High speed for joints (Universal, U-Joint, Rubber Coupling)

Universal joint

Rubber Coupling

II. Components (Propeller Shaft) - Tube Shaft Assemblies

Tube - Tube with flange

Tube - Tube with flange and bolt

Many other combinations

II. Components (Propeller Shaft) - Multipiece Shafts

1 - Piece

2 - Piece

3 - Piece

III. Procedure

FE software's used to assist the analysis are

1. Windchill 10.1
2. Creo Parametric 2.0
3. Hyperworks 12.0
4. MSC Nastran

3.1. REQUIREMENT

Input Files

1. Model files - CAD files (step files can be used but prefer native CAD)
2. Material files to be used from previous analyses (if exist)
3. Extracted masses and inertias from internal and external CAD assemblies. Examples include IR, CAGE, and Ball masses and for bat joints

Output Files

1. Complete M&M file for propshaft
2. Saved WAVE file for post-processed modes (if needed)
3. H3D file of each mode shape with animation (also AVE if requested)
4. Nastran input files (*.bdf, *.mas). OEM may request input decks.
5. Powerpoint of model setup with boundary conditions

Note: The above mentioned files are to be delivered only for V&V (Model analysis, but depends on the customer request and type of analysis)

3.2. FE-Modelling (Ball, Universal, and Rubber Coupling Joint)

Ball joints

U-Joint

Rubber Coupling

- De-feature all DR, fillets, and RC geometry of un-needed rounds and chamfers. Make sure solid geometry is maintained
- 2D mesh with 1st order elements using H8. Target element size of 4-6 mm.
- Check 2D element quality before solid tet meshing. Fix accordingly
- Solid Tet mesh the component. Element quality has to be maintained as per quality guidelines. Re-mesh if necessary
- Change 1st order elements to 2nd order
- Create the 2D shell elements created in first meshing step

3.2. FE-Modelling (Stub Shaft) - Method-1 - Solid Hex/Penta

Stub Shaft

- Cut the stub shaft geometry to 1/8" part
- Mesh the face of geometry as shown in figure with quad and tria elements
- Spin the elements with an angle of 360° using SPIN option in H8 and use N1/H2 option for direction of spin
- Starge all coincident nodes
- Maintain the element size as 3-5 mm
- Maintain the quality criteria as per guidelines
- Create 2D elements used to create solid elements

3.2. FE-Modelling (Stub Shaft) - Method 2 - Tet

Another method using Hex 8-noded elements to be added

- Mesh similar to description of Outer Races of ball joints
- De-feature as necessary
- 2D mesh with 1st order elements using H8. Target element size of 3-5 mm.
- Check 2D element quality before solid tet meshing. Fix accordingly
- Solid Tet mesh the component. Element quality has to be maintained as per quality guidelines. Re-mesh if necessary
- Change 1st order elements to 2nd order
- Create the 2D shell elements created in first meshing step

3.2. FE-Modelling (Tube) - Method-1 - Solid Hex

Tube

- Cut the tube geometry to 1/8" part
- Mesh the face of geometry as shown in figure with quad elements. Use min of 3 elements over thickness
- Spin the elements with an angle of 360° using SPIN option in H8 and use N1/H2 option for direction of spin
- Starge all coincident nodes
- Maintain the element size as 3-5 mm
- Maintain the quality criteria as per guidelines
- Create 2D elements used to create solid elements

3.2. FE-Modelling (Tube) - Method-2 - Quad/Shell

Tube

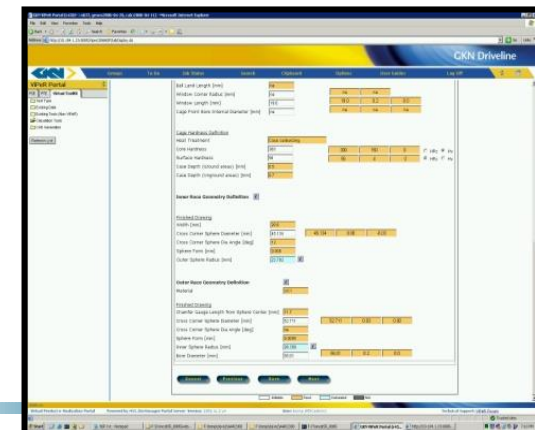
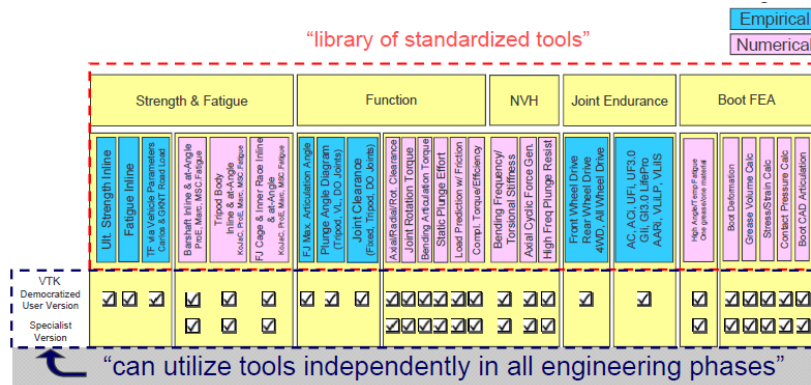
- Create mid-surfaces - Auto
- Mesh the mid surfaces of geometry as shown in figure with quad elements
- Maintain the element size as 3-5 mm
- Maintain the quality criteria as per guidelines
- Create FEMILL properly to define the thickness of the tube

Lessons learned (3)

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- > **Engineer Analyst have a new important role**
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- > **Now how do we get to Democratization?**
 - Let's take a look...

How to get to CAE Democratization

- Identify your target user community – Product Development, Application, and/or Test Engineers
- Agree on a globally available delivery platform/application – Thick / Thin / Web / HTTP / Tablet
- Present a User interface in the terminology that they already speak
 - Design an intuitive front end/user interface and process that mimics the non-analyst way of working (i.e., resembles the physical domain)
 - The easier it is (e.g., less mouse clicks), the more likely the Democratized user is to become self-starter
 - Don't make it too easy – offer enough technical capability, robustness and correlation to deliver accuracy/insight in order to expand the use of simulation in the product development process
- Consider bundling your Democratized Tool App's into a toolkit



Lessons learned (4)

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- > **Don't underestimate the organizational challenge**
 - In a multi-site / multi-national operation, people will resist to keep their local way of working
 - These business transformations will challenge some users, however the overall effect will be positive for the organization once fully adopted and supported appropriately
 - You could address this challenge by...

Don't Underestimate the Organizational Challenge

➤ You could address this challenge by...

➤ **Formation of a Global Engineering IT group**

- Experienced product development and process engineers, that are IT savvy
- To handle your enterprise engineering Ecosystem of applications
 - PLM/PDM, CAD, CAE, Democratized Tool App's, etc.
- Provide a bridge between the Experts, your external partners and your Corporate IT Group
- To translate your Expert knowledge and make it accessible through appropriate means to a broader group of users
 - e.g. into templates for process automation
- Keep your Tool App's relevant, as your product designs and processes evolve

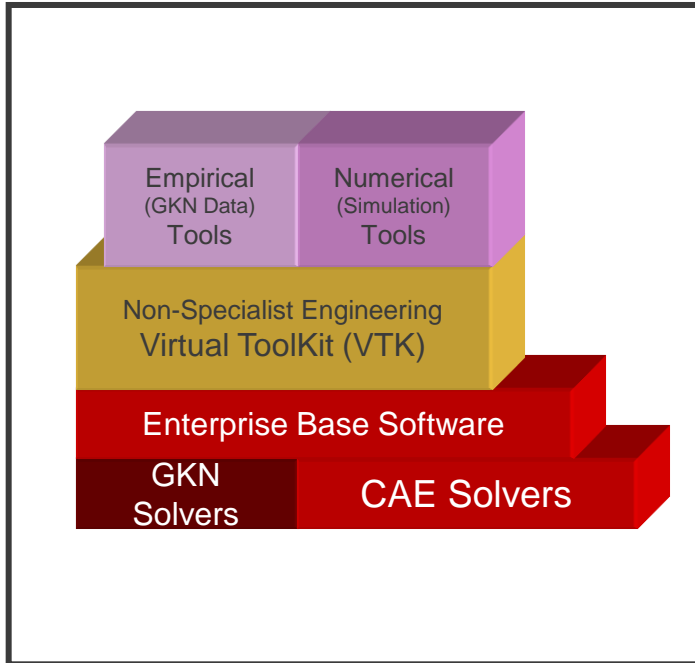
➤ **Your Corporate IT Group handles systems hosting and IT infrastructure, etc.**

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 - Address this challenge by...
- > **It is vital to have executive sponsorship for enterprise standardization projects, because...**
 - Democratized CAE are medium-to-long term enablers of intrinsic value within your engineering organization, versus short term cash generators
 - Some key benefits and business value...

Enterprise Democratization

Key Benefits & Business Value



- Non Expert engineers can use complex analytical solutions, for standard use cases – Safely!

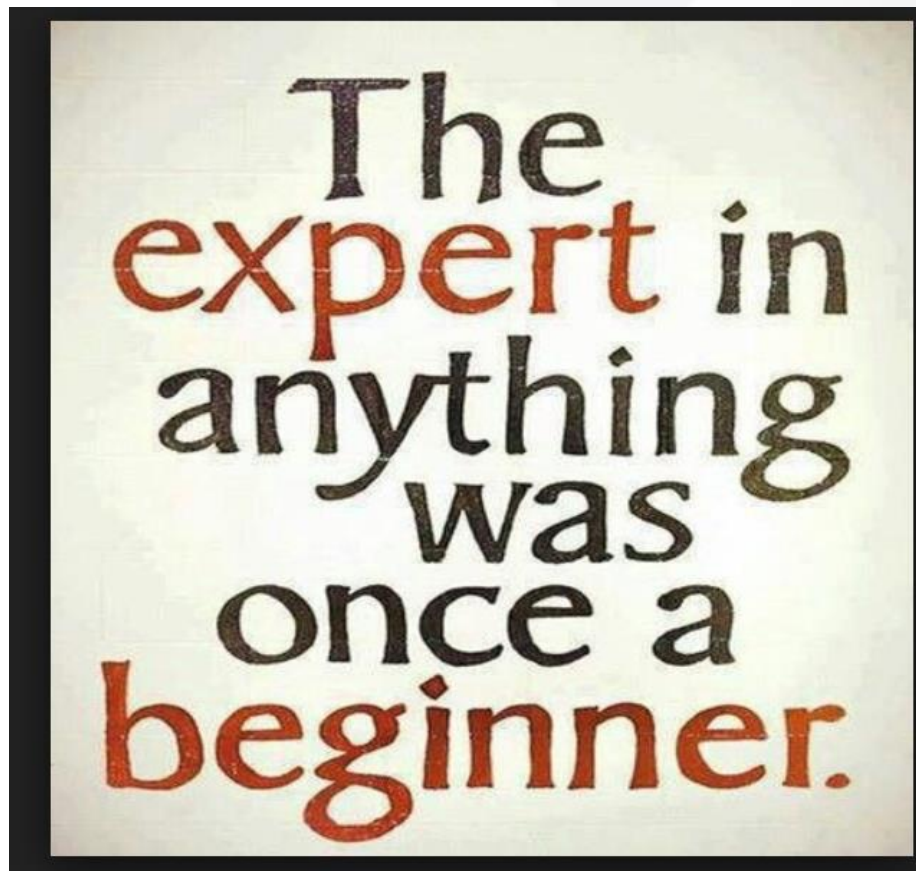
- Simulation process automation manages inputs and outputs

- Solutions are handled using input templates (ease-of-use) developed by Expert Analysts for non-Experts

- Each process step contains embedded rules and logic for the tool or use case (i.e. knowledge capture and reuse)

- Global teams can manage interpretation of predictions – as required





- by Helen Hayes

Thank You!