GKN at a glance

GKN Driveline
- World leading supplier of automotive driveline systems & solutions
- Committed to innovation

GKN Powder Metallurgy
- World leader in the manufacture of sintered components
- Manufactures precision automotive, industrial and consumer products

GKN Aerospace
- Supplier to the global aviation industry
- Leader in the manufacture of highly complex composite aero structures and engine products

GKN Land Systems
- Supplier to the global agricultural, construction, mining and other industrial markets
- Global aftermarket distribution and service
GKN at a glance

- About 48,000 people
- Global footprint - over 35 countries
- Market leading businesses
- Above market growth

- Driveline – largest business
GKN Driveline – Product Segments

CVJ Systems
- Constant Velocity Joints
- Sideshafts

AWD Systems
- Propshafts
- Transfer Units
- AWD Couplings
- Disconnects
- Final Drive Units

Trans Axle Solutions
- Differentials
- Limited Slip & Locking Differentials

eDrive Systems
- eAxles
- eTransmissions
- eMotors
Driveline enterprise – engineering footprint

- 3 Research & Product Development Centres
- 7 Global Product Centres
- 10 Application Engineering centres
- 2 Proving Grounds
CVJ Systems - Constant Velocity Joints
Sideshafts and Propshafts
Engineering Design & Collaboration Roadmap

Enterprise Change Management

Enterprise Product Data Management (PDM)

Enterprise PLM Workflows & Democratized CAE

Enterprise Virtual Program Management (VPM)

Computer Aided Design & Engineering (CAD/CAE)
Virtual Product e-Realization
Take a look at our historical Way of Working (WoW)...
Application Engineering

- Engineers in 11 locations around the world calculating and selecting Driveline products for customer applications. Few standardized tools or processes

- Product selection dependent on knowledge of experienced individuals. Variable solutions in different parts of the world. Capacity bottlenecks

- Proposals to customers often required prototypes and physical testing to verify. Slow and not cost effective
Physical Test and Simulation

- “Design, test, break ” (and repeat) culture
  - Simulation slow, not always well correlated

- Few common simulation methods or tools
  - Different empirical tools and spreadsheets used for calculations
  - Results sometimes inconsistent

- Little re-use of physical test data or simulation models
  - The same problems solved many times over, in different sites
  - Data stored on local hard drives, seldom shared, often mis-placed

- Most simulation being done by specialists
  - Capacity bottleneck
  - Routine work using valuable resources needed for R&D

....Change was needed!
## ViPeR

### Goals

<table>
<thead>
<tr>
<th>Customer Service</th>
<th>Solutions</th>
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<tbody>
<tr>
<td>- Faster response to customer enquiries</td>
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<tr>
<td>- Reduce engineering effort per program</td>
<td>- Collect all tools and data in one place</td>
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<td>- Automate routine engineering tasks</td>
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<td>- CAD modeling &amp; Test Reports</td>
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<table>
<thead>
<tr>
<th>Engineering Quality</th>
<th>Solutions</th>
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<tr>
<td>- Consistent product selection and performance predictions</td>
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<tr>
<td>- Increase &quot;Right First Time&quot;</td>
<td>- Standardize key engineering tools and processes for Application Engineering</td>
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<td>- Make expert knowledge available to our engineers worldwide – 24/7</td>
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<tr>
<th>Cost Reduction</th>
<th>Solutions</th>
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<tr>
<td>- Reduce engineering effort per program</td>
<td>- Enable re-use of existing of test and simulation data</td>
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<td>- Reduce physical testing by simulation</td>
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Strategic Partnership

- Our partner selection criteria
  - Understanding of engineering processes
  - Enterprise Web application software
  - World-class expertise in simulation and proven tools
  - Commitment and flexibility
  - Global footprint and resources for a worldwide large project

- Based on the above, GKN Driveline selected MSC Software as strategic partner for the development of ViPeR
ViPeR Schematic

MSC.SimManager Enterprise

GKN Tools

MSC Solvers

GKN Controlled “Living Data”

Enterprise PDM
ViPeR Schematic

MSC.SimManager Enterprise

Modules

- Product Type
- Product Sizing
- Product CAD
- Application Engineering Product Selection
- Test Request
- Test Execution
- Test Results
- Test Engineering Product Testing

Foundation

GKN Controlled "Living Data"

- Product CAD Data
- Test Reports
- Product Bookshelf
- Enterprise PDM
- Test Result Database
- Individual Product Performance Buckets
- GKN data files
- Infolinks Templates User Guides
- ViPeR Specific

GKN Tools

MSC Solvers
ViPeR Schematic

MSC SimManager Enterprise

GKN Controlled “Living Data”

Modules

- Product Type
- Product Sizing
- Product CAD

Application Engineering Product Selection

Test Engineering Product Testing

Test Request
Test Execution
Test Results

Empirical (GKN Data) Tools
Numerical (Simulation) Tools
Non-Specialist Engineering Virtual ToolKit

Methodology Studies

GKN Tools
MSC Solvers

GKN data files
Infolinks
Templates
User Guides
ViPeR Specific

Physical
Virtual

Physical
Virtual

Physical
Virtual

Physical
Virtual

Physical
Virtual

Physical
Virtual

Physical
Virtual
Virtual ToolKit (VTK) & Democratized CAE
ViPeR Schematic

- **Modules**
  - Application Engineering
    - Product Selection
  - Test Engineering
    - Product Testing

- **Foundation**
  - GKN Controlled
    - "Living Data"
  - Methodology Studies
  - Non-Specialist Engineering
    - Virtual ToolKit (VTK)
  - CAE Solvers
    - Empirical (GKN Data) Tools
    - Numerical (Simulation) Tools

- **MSC.SimManager Enterprise**
  - GKN Tools
  - Automated Reports
    - Metrics
  - GKN Driveline

- **ViPeR Specific**
  - Infolinks
    - User Guides
  - Test Request
    - Test Execution
    - Test Results

- **GKN CAD Data**
  - Product
    - CAD
  - Empirical (GKN Data)
    - Tools

- **Numerical (Simulation) Tools**
  - Virtual ToolKit (VTK)

- **Application Engineering**
  - Product Selection

- **Test Engineering**
  - Product Testing
Virtual ToolKit (VTK)

“library of standardized tools”

Legend
Empirical
Numerical

Strength & Fatigue
Function
NVH
Joint Endurance
Boot FEA

<table>
<thead>
<tr>
<th>Strength &amp; Fatigue</th>
<th>Function</th>
<th>NVH</th>
<th>Joint Endurance</th>
<th>Boot FEA</th>
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<tbody>
<tr>
<td>TF Fatigue Inline</td>
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<tr>
<td>Barbell In &amp; at Angle</td>
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<td>Tripod Body In &amp; at Angle</td>
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<td>KoJaC, ProE, Marc, MSC Fatigue</td>
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<td>Plunge Angle Diagram (Tripod, VL, DOJoints)</td>
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<td>Joint Clearance (Fixed, Tripod, DOJoints)</td>
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<td>Bending Articulation Torque</td>
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<td>Axial Cyclic Force Gen.</td>
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<td>Max. Articulation Angle</td>
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<td>Front Wheel Drive</td>
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<td>Rear Wheel Drive</td>
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<td>AC, ACi, UF3.0, GIi, GI3.0 LifePro</td>
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<tr>
<td>AARI, VILP, VILIPS</td>
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“can utilize tools independently in all engineering phases”

PSE

“can utilize tools within Product Selection process …calculation engines linked where appropriate”

GKN Driveline
“Limits of Applicability” displayed on tool’s first page - updated thru xml as we learn

Info link displays tool assumptions - html updated as we learn
VTK Report Template

Tool assumptions, objective for running, and user comments printed on output report.

Inputs

Outputs
VTK CAE Democratization

Key features include:

- Standard simulation solutions are handled using input templates
- Thin client machines interact with Web Application coupled to centralized compute clusters
- VTK portal is accessible 24/7 over the intranet
VTK CAE Democratization

User – Simulation Automation Launches

CAD: Step files

User Interface – non specialist

MSC. Patran: Pre-processor

MSC. Marc: Solver

MSC. Patran: Post-processor

MSC. FATIGUE: Life Prediction
VTK CAE Democratization

Business Value:
- Non-specialist engineers can use complex analytical solutions - for standard use cases!
- Global teams can manage Interpretation of predictions.

- Frees up simulation specialists for more complex R&D!
Lessons learned

- It is vital to have executive sponsorship for large scale enterprise projects.
- The project statement of work (SOW) needs to be comprehensive and unambiguous
  - Be sure to include clear ‘user experience’, web performance & quality targets
- Define and optimize your business processes before you automate them!
  - It will save a lot of rework effort
- Be realistic about your internal resource commitment
  - Your technical experts need to be available for the duration of the project, deployments and production support
- Don’t underestimate the organizational challenge
  - In a multi-site / multi-national operation, people will fight to keep their local way of working
- Avoid a Big Bang approach – make it modular
  - “Think big, start small, act now”
GKN Driveline has:

Automated Enterprise Process (& workflow) for Application Engineering

PSE: Product Selection Engine
GKN Driveline has:

Automated Enterprise Workflow for

Test Engineering

PTE: Product Test Engine
GKN Driveline has:

- Collected all key calculation tools in one place
- Democratized CAE for Non-Specialist Engineers

VTK: Virtual Tool Kit
Key business PLM Workflows and Democratized calculation tools…. for the GKN Driveline Enterprise!

475 users/12 sites
A NEW ERA BEGINS.