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유한체적법에 의한 Upset 단조공정  
시뮬레이션

한국 엠에스씨

제정신

## 유한체적법에 의한 Upset 단조공정 시뮬레이션

### MSC.SuperForge

재경신

MSC Software Korea

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### Is this Your Product Development Cycle?

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### Added Value by Increased Insight

<p><b>Shop Floor</b></p> <ul style="list-style-type: none"> <li>■ Maximum load</li> <li>■ Final shape</li> <li>■ Visible defects           <ul style="list-style-type: none"> <li>- invisible defects with time consuming and costly HDT</li> </ul> </li> </ul>	<p><b>Using Simulations</b></p> <ul style="list-style-type: none"> <li>■ Maximum load + load-stroke curve</li> <li>■ Final shape + metal flow</li> <li>■ Visible + invisible defects           <ul style="list-style-type: none"> <li>- evolution of defects</li> </ul> </li> <li>■ Distribution of stress/strain/temp.</li> <li>■ Distribution of die load</li> <li>■ Arbitrary cutting planes</li> </ul>
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### Conventional Product Development Cycle

**Reduce 's, improve time to market!**

### Simulation-Aided Product Dev. Cycle

**Be First to Market with Better and Cheaper Forgings!**

### Additional Benefits of Simulation

**Reduce Costs during Mass Production!**

### MSC provides complete solution

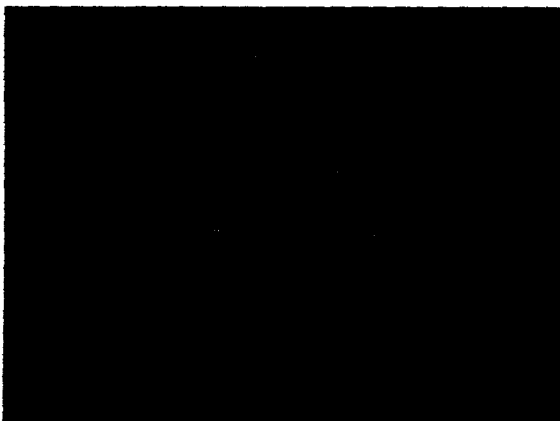
<b>MSC.SuperForge</b> <ul style="list-style-type: none"> <li>■ Finite Volume Technology</li> <li>■ Meshless Simulation</li> <li>■ Encapsulated in an easy to use, Windows based program</li> <li>■ Short learning curve</li> <li>■ Robust, Fast turnaround time</li> </ul>	<b>MSC.AutoForge</b> <ul style="list-style-type: none"> <li>■ Finite Element Technology</li> <li>■ Automatic, robust remeshing</li> <li>■ General Purpose Manufacturing Simulation</li> </ul>
Designer	Analyst

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### The Virtual Forging Shop

Full Representation for Forging Practice Software

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### Full Representation for Forging

- Comprehensive Material Data
- Realistic Press Characteristics
- Friction
- Temperature Effects
- Elasticity
- Automatic/Manual Positioning of Work Piece
- Handling of Multi-Stage Processes
- Powerful CAD Interface

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### Windows Native

- Easy to learn: works like MS-Word / MS-Excel
- Drag-n-Drop
- More functionality with less buttons
- Improved graphic performance

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### Forging Process Set-Up

- Geometry Import from CAD
- Positioning of workpiece and dies
- Predefined Industrial Presses
- Heat Transfer
- Material Models Library
- Friction

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### Results Visualization

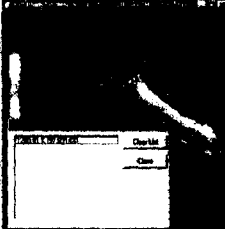
- Automatic results images
- Multi-window plotting
  - Contour plots
  - Velocity vector plots
  - Cutting planes
- 3D Animations
  - One button generation
  - Saved as AVI file
- Time histories
  - Die loads



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### Result Interpretation

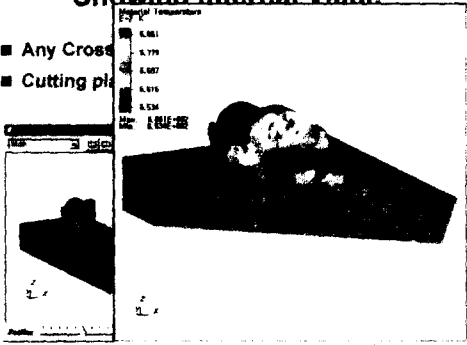
- Distance measuring
  - Interactive screen picking of deformed geometry
  - Direct thickness measurement of parts of the product
- Value query
  - Window picking of value variables on deformed geometry



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### Showing Internal Value

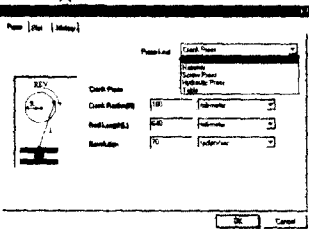
- Any Cross-section
- Cutting plane



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### Realistic Press Characteristics

- Most Press Types Available

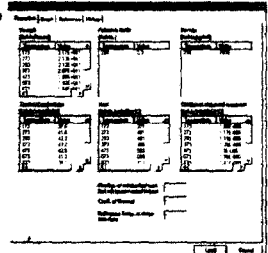


- User-extendable Database

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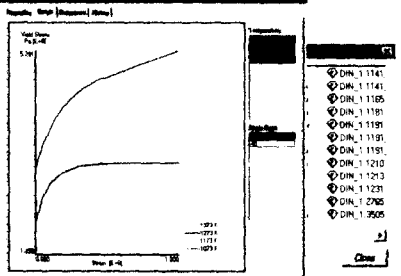
### Material Library

- Most populated material library available
- German Fließkurven database
- Over 60 pre-defined materials
- User can build his own database



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### Comprehensive Material Data



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### Friction

- Friction influences:
  - load and energy requirements
  - metal flow
  - pressure distribution
  - die wear
- Friction Models
  - Coulomb friction
  - plastic shear friction

Type of Friction

Coulomb Friction  
Static friction coefficient: 0.1

Plastic Shear Friction  
Interface friction factor: 0.01

OK Cancel

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### Temperature Effects

Needed to account for:

- metal flow
- chilling during forming
- expansion during cooling
- Transfer of Heat from Work Piece and Die
- Transfer of Heat from Work Piece and Die
- Expansion due to Plastic Deformation

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### Elasticity Effects

- Needed to account for:
  - deviation from desired shape (tolerances)
  - thermal stresses
  - proper die loads (die overclosure)
- Elastic-plastic material model

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### Multi-Stage Forging

- Fully automated and supported in GUI
- Coarsening between stages
  - Reduction of number of material surface facets
  - Improved performance
  - Less memory usage



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### Powerful CAD Interface

- CAD Transfer via STL (STereoLithography)
  - standard format used in rapid prototyping techniques
  - commonly available in all CAD packages
- No 'Finite Element' Experience Required
- No Meshing

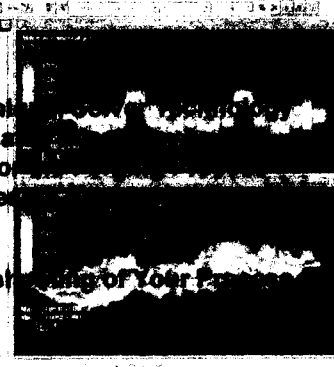
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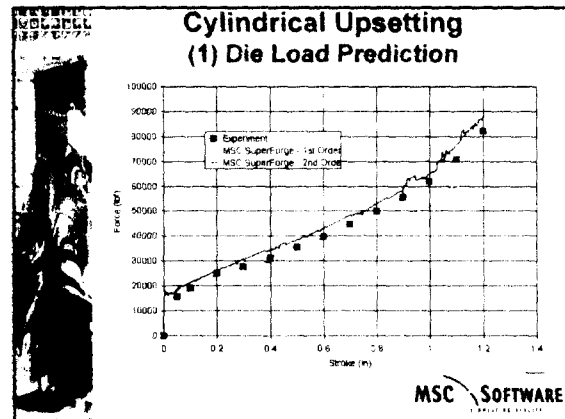
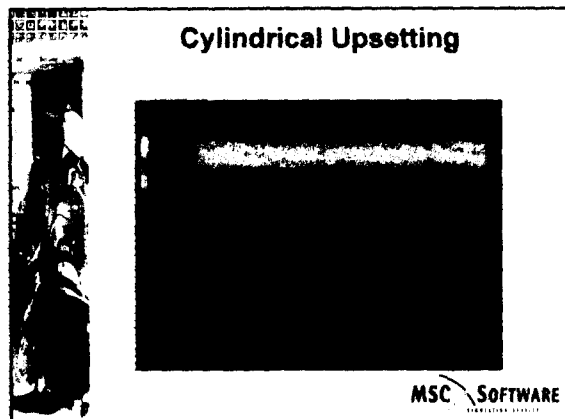
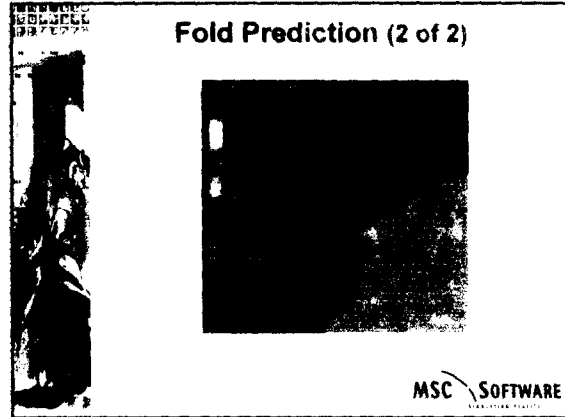
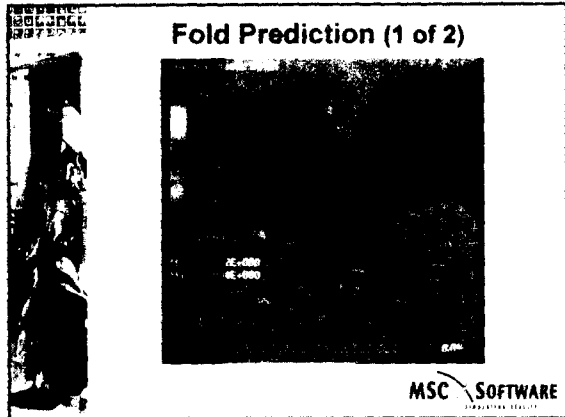
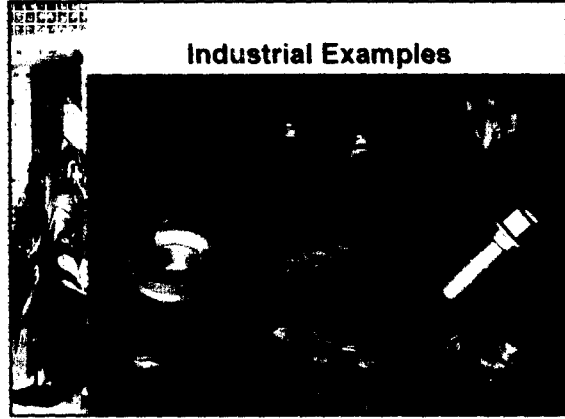
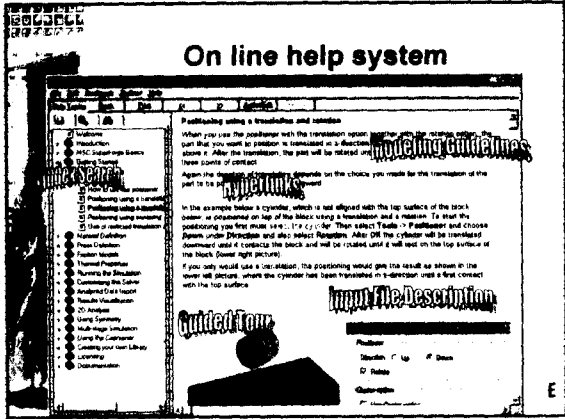
### Advanced, Unified Technology

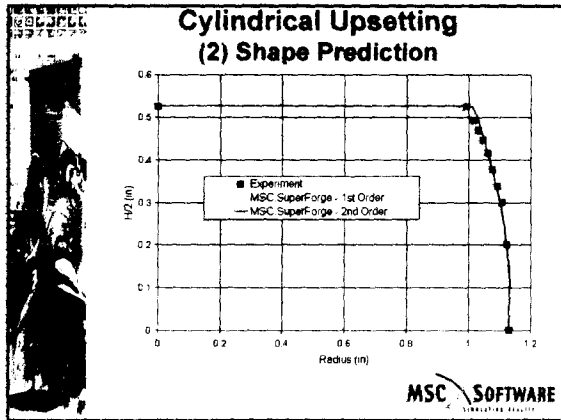
Encapsulated Product Development

Fast Troubleshooting of Your Process



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### Success Stories

- **Rolls-Royce Engines**
  - aerospace blade forgings
  - unsuccessful with FORGE3
- Comprehensive evaluation of MSC.SuperForge, including adherence to strict internal QA standards
- One year lease of MSC.SuperForge followed by paid-up license
- Annual savings of \$360K using simulation

Rolls-Royce MSC SOFTWARE  
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### Current Users

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### SuperForge 2000

- Screw Press
- Multi-Stage Enhancements
  - automated multi-blow hammer
  - multi-stage 2D
  - multi-stage 2D to 3D
- Die Wear Prediction
- Flow Lines
- Particle Tracking
- Easy Visualization of Laps

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### Why MSC as Simulation Provider?

- **Global Player**
  - worldwide service (32 direct offices)
  - 35+ years experience in simulation
  - industry leader in Mechanical Computer-Aided Engng.

MSC Software is #1 in position and in ...

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We provide infrastructure.

### Why MSC Software?

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