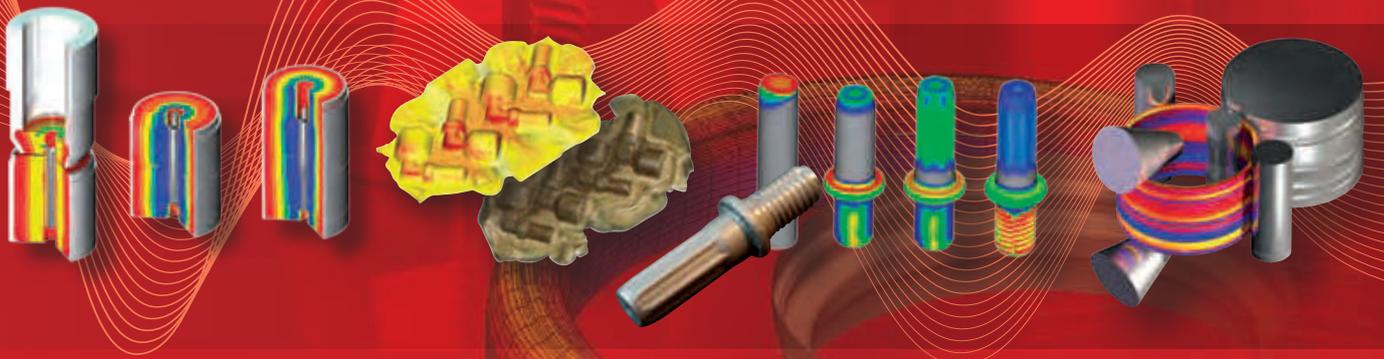


simufact.forming  
Professional Forming Simulation



well formed

# Challenges in Forming Technology

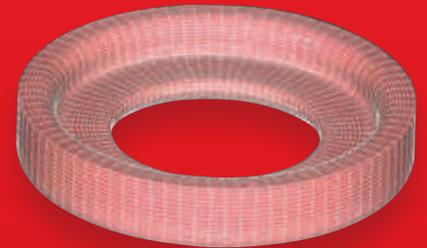
Global competition, smart R&D investments to create innovative products with the best possible quality at competitive prices, these are just some of the challenges today's forming industries have to cope with. Increasing requirements are forcing companies to optimize their design and manufacturing processes.

So it is helpful to gain detailed insights into development and manufacturing processes, in order to minimize the risk of failure within the development process and to assure that innovative ideas find their way into production.

Today, more and more companies in the forming industry worldwide rely on process simulation which frontloads the

manufacturing process into the virtual world even before production has started. This approach allows companies to control their manufacturing processes and expenses related to process layout and production – and the ability to give a flexible response to special requirements.

Simufact's product and service offering has been developed to meet the needs of the forming industries. Simufact provides production technology and process simulation for the design and optimization of production processes. The core solution for the simulation of all kinds of forming processes is Simufact.forming – an industry sector solution, easy to implement, user friendly, and based on leading standard technologies.



*„Essentially we have been able to improve our overall process regarding process stability with simulation. It helped us to improve quality, productivity, and to save material. To us, forming simulation means progress, innovation, and cost savings“.*

**Gerald Oppelt,**  
Manager Production Technology, Uponor



*“The cooperation with our technology partner Simufact has evolved over many years, especially in the area of ring rolling. Today, by combining the experience of our engineers with simulation technology, we are in the position to receive process simulation results that are between 90 and 98 percent close to reality.”*

**Jürgen Schöler,**  
Leader Technical Planning, Neumayer Tekfor



*“The importance of simulation within the forming industry is constantly increasing and helps to be one step ahead of your competition, because companies within our industry, that use simulation, can save energy and material, and are able to produce lighter components.”*

**Dr. Theodor L. Tutmann,**  
Managing Director, German Forging Association (IMU)

*„By using simulation software, my abilities as a forging die designer have enhanced with many folds. It helps me to visualize the concept of the physics of metal flow in the cavities of different stages of impressions. This is a very powerful and recommended tool for a designer. And in the end it saves company money.*

**Senior Manufacturing Engineer**  
Cornell Forge Co, Chicago U.S.A

# Frontloading of Physical Testing into the Computer

**process reliability - method optimization - cost reduction**

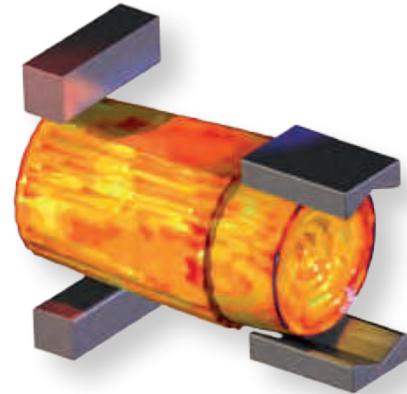
## What if ...

- ... the first physical test could already provide the approval for production?
- ... you could assure that production uses the most cost-efficient process?
- ... you could guarantee that the know-how of forming processes gathered by your experienced employees stays within your organization if someone leaves?
- ... you could reduce cycle times for the development of new parts from several weeks to just one?

What sounds like a sweet dream are real daily-work challenges in the forming industry. In order to successfully withstand tough competition in this market companies need to deploy suitable instruments which help reducing manufacturing risks, give freedom for new and innovative ideas, and provide detailed insights into manufacturing processes. It is crucial to define the best possible manufacturing process without repetitive physical tests. This is where the product and service offering of Simufact is fitting in.

Companies in the bulk metal forming industry banking on process simulation

confirm that they have managed to reduce physical testing by 50%, right after the implementation of the new methods. Moreover they confirm that cycle times for new part developments can be reduced from 3 weeks to 1 week – a huge cost saving potential. With the growing experience of the users, these numbers can even be exceeded. Traditionally, companies could answer questions about forming faults, tool forces or the related tool life quantity only after the first (second or third...) physical test. Nowadays, thanks to virtual testing, mistakes can be found earlier, can be avoided and as a result costs can be saved.



**Benefits provided by process simulation:**

### Process stability through:

- ... better knowledge about details of the forming process
- ... less faults in forming
- ... evaluation of more variants and risk free testing of new ideas

### Method optimization through:

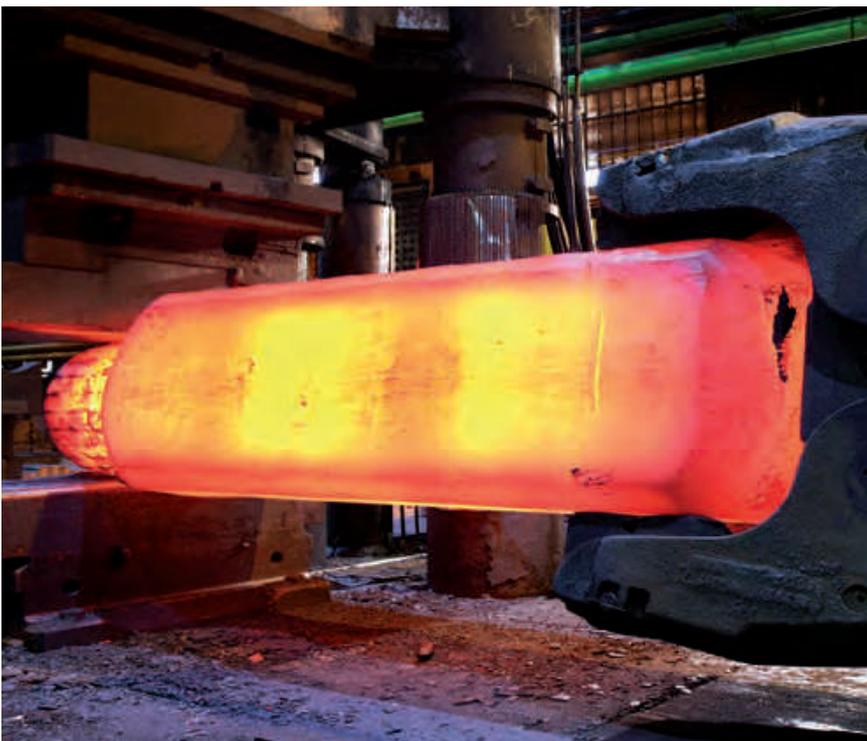
- ... reduction of forming operations
- ... less machining
- ... optimized material usage

### Reduced costs in tool and process development through:

- ... fewer testing of tools
- ... less production downtimes for trial runs
- ... shorter development times

### Cost reduction in serial production through:

- ... increased tool life
- ... optimized utilization of machine capacity
- ... increased production line availability
- ... less material waste

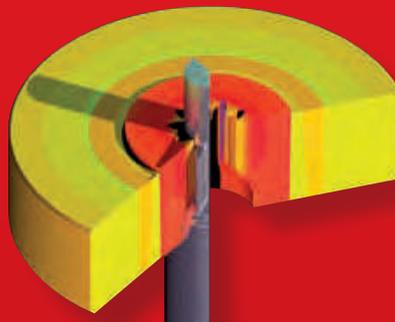


# Simulation Technology for Practical Use

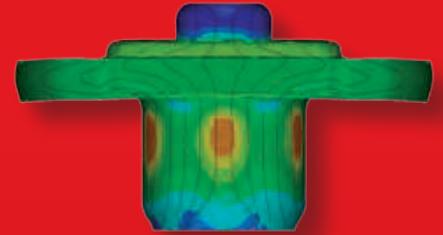
Simufact.forming is a software solution for practical use in forming technology. Competing simulation environments often require experts with computer science knowledge for programming complex models. Simufact.forming is different. Users do not need to deal with the mathematical forming theory nor have to handle simulation specific details. Simufact.forming is an easy-to-learn software application. So the forming experts can focus on details of the forming process instead of dealing with the software.



CAD data can automatically be imported via direct interfaces.



Simufact.forming's user interface allows an easy and intuitive operation of the software. Simufact.forming is the layout software of choice for tool and process developers, simplifying their daily work. Just by a few mouse clicks all standard forming processes can be built and evaluated. But Simufact.forming offers even more: Many additional functions are available to enable the experienced user to model any complex process imaginable.



Flow lines can be defined easily. Shear trap or middle line tracing as well as fibre flow visualisation deliver essential information for the evaluation of the forming process.

The calculation of tool forces and stresses helps to define the best possible tool layout, and to avoid premature tool failure.



Simufact.forming covers all areas of forming technology and guarantees a realistic representation of the processes. It includes, among others:

- ... full 3D functionality and 3D representation of all tools & parts
- ... the actual kinematics of a machine, no matter what type or how complex it might be
- ... material behavior - elasticity, plasticity, increase and decrease of strain hardening as well as temperature and velocity related effects
- ... friction and contact between tools and forming parts
- ... self contact of forming parts to predict folds
- ... thermodynamics of the process: initial heating conditions, heat transfer into tools and environment, temperature increase due to forming energy and friction, etc.

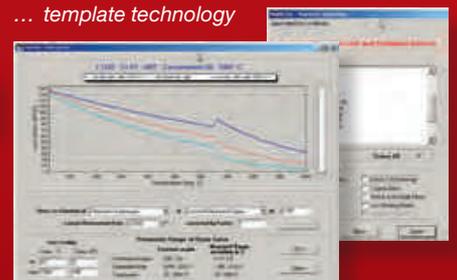
High quality results are guaranteed since Simufact.forming is based on MSC Software's first class standard solvers MSC.Marc - the high-end finite element solver for nonlinear applications - and MSC.Dytran - the powerful finite volume solver. Both products are continuously being enhanced and thus enable the representation of complex nonlinear physics of the forming process with high precision.

Simufact.forming stands out by its ease-of-use and short learning phase. The main characteristics of the practice-oriented user interface are:

- ... easy and intuitive windows-like user operations (drag & drop)
- ... all capabilities available in one single environment (support of 2D, 3D, model preparation, analysis, and results evaluation)
- ... quick and easy to learn
- ... terminology of forming industry
- ... clear separation into object area (tools, machines, material, etc.), process area (forming operations) and graphical model/ results area
- ... all objects can be made available in the database
- ... template technology



Fully automated remeshing capability for hexahedral and tetrahedral meshing technology



All types of low-alloyed and stainless steel, copper alloy, brass, aluminum alloy, and inconel are available within the material database.

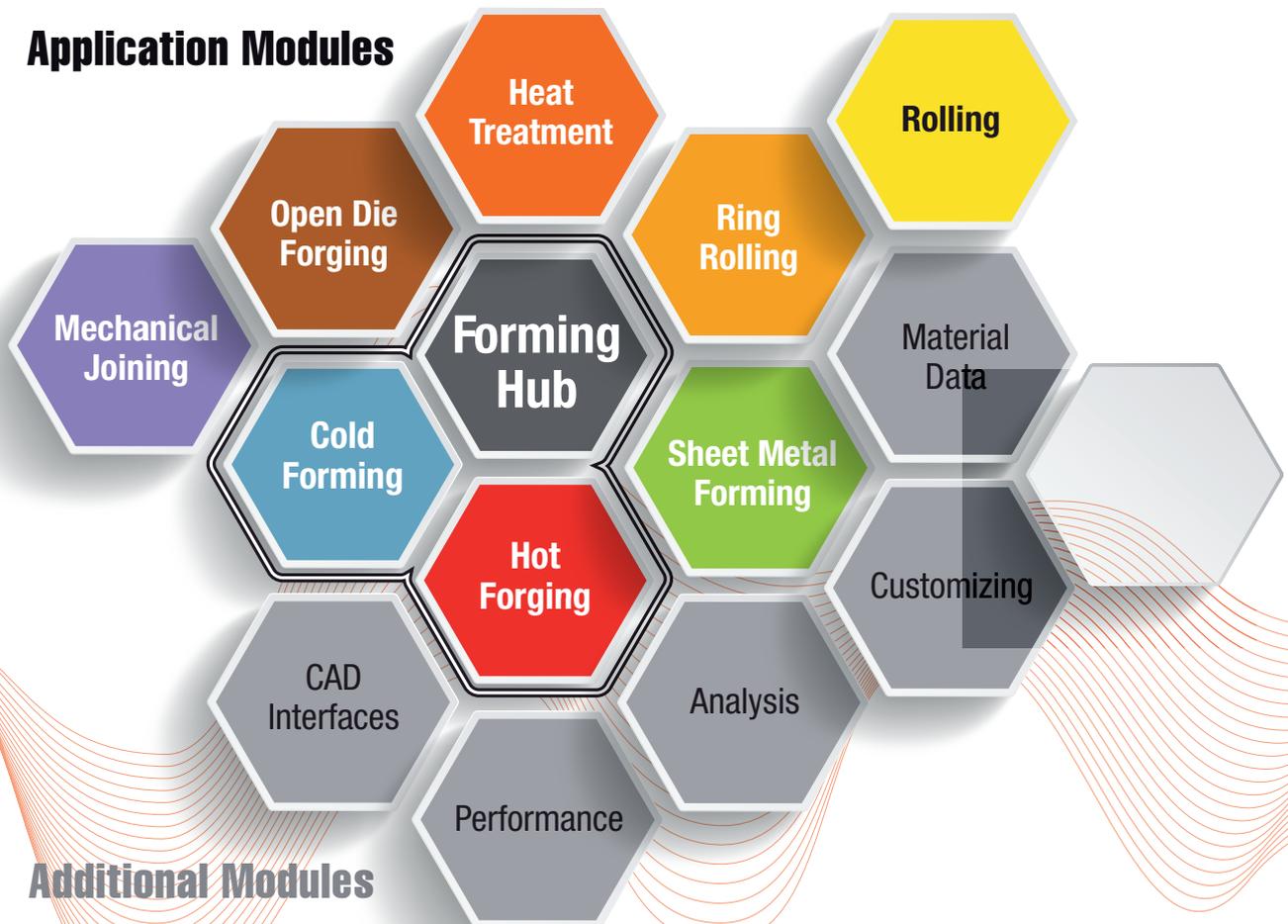
# Product Portfolio Simufact.forming

## Modular Concept

Simufact.forming is a functional comprehensive simulation solution that covers the whole range of forming applications by standard. Additional modules provide more functionality for the day-to-day usage of the software. This modular concept of Simufact products helps you to pick out the relevant product functionality that fits your needs. This approach is cost-effective and adjusts to changing requirements.

Simufact.forming offers a toolbox and enables virtual design and development of manufacturing processes. The functionalities of the application modules allow for the simulation of individual process steps and can also be combined to simulate entire manufacturing process chains.

## Application Modules



## Additional Modules

The Forming Hub is the basis module for the Simufact.forming product line, including basic functionality necessary for the operating and handling ability of the simulation software (GUI, solver, material database, mesher, etc.).

Traditionally, the Forming Hub comes with process-related functionality for Cold Forming and Hot Forging processes.

## Application Modules



### Cold Forming

#### simufact.forming Cold Forming

serves to simulate bulk metal forming processes below the recrystallization temperature of the material. The module helps you avoid typical manufacturing defects such as fold formation on the component. Simufact.forming Cold Forming considers all relevant boundary conditions including the tool reinforcements and spring-controlled tools. Essential for a high-precision simulation of cold forming processes is the realistic prediction of the forces involved in the forming process while taking into account the effects of spring-back and the elastic-plastic material laws.



### Hot Forging

#### simufact.forming Hot Forging

serves to simulate bulk metal forming processes above the recrystallization temperature of the material. The unique dual solver approach (FE solver and FV solver) helps you get the most realistic prediction of typical metal flow failures, like i.e. folds, under-fill issues and flow through defects. Most flexible kinematic definitions, local coordinate systems and different kinds of spring-types allow for realistic description and consideration of all equipment related effects, like i.e. press elasticity and press tilting.



### Sheet Metal Forming

#### simufact.forming Sheet Metal Forming

serves to simulate sheet metal forming processes, including thick sheets and hollow cylinders with moderate changes of the wall thickness. One of its key features is the dedicated meshing technology for sheet-like geometries which allows for efficient simulation of thick sheet components like structural automotive parts, amongst many others. This is achieved by a dedicated volume hexahedron mesher for sheet structures providing highest accuracy, especially related to sheet thickness changes, inner and outer radii, and spring-back. Our sheet mesh algorithm increases calculation speed while reducing hardware requirements.



### Rolling

#### simufact.forming Rolling

enables an easy creation of any kind of models with rotating tools. Independent of the temperature of the rolled workpiece, both sheet as well as bulk geometries can be rolled. The rolled workpiece can move translationally or rotationally. One highlight is the most user friendly definition of any rolling axis just by three mouse clicks on a given radius. The number of rolls is unlimited and it is possible to include any type of kinematic of the rolling process; drag rolls and powered rolls. This module can be used, amongst others, for flat- and profile-rolling, cross-rolling, spin- and flow forming, as well as reducer rolling.

## Application Modules



### Ring Rolling

#### **simufact.forming Ring Rolling**

serves to simulate cold and hot ring rolling processes. It is suitable for both axial and radial ring rolling. This special kinematics control unit provides generic control strategies for the guiding rolls, axial rolls, controlled by the growth of the ring. This allows for a close representation of ring rolling machines from various machine vendors. The module includes a special ring-mesher technology, which provides highly accurate edge detection, whilst reducing computational effort.



### Open Die Forging

#### **simufact.forming Open Die Forging**

is a dedicated module to simulate any kind of open die forging processes like cogging and radial forging. A special kinematics control unit allows defining arbitrary forging strategies following predefined forging sequences. Pass schedules and kinematics for the forging dies are provided that are controlled by the geometrical development of the workpiece during the forging process. Any kind of tools, billet movements and multiple manipulators are supported.



### Heat Treatment

#### **simufact.forming Heat Treatment**

serves to simulate heat treatment processes with consideration of phase transformations. It is a module for the prediction of material properties and the simulation of heat treatment processes. Based on Simufact.forming Heat Treatment all phases of a heat treatment process can be simulated – this covers heating, holding, quenching, but also targeted cooling. For correct material selection the user can recourse to a comprehensive material database providing parameters which are key to a realistic heat treatment simulation.



### Mechanical Joining

#### **simufact.forming Mechanical Joining**

serves to simulate mechanical joining processes, such as clinching, blind-, punch- and self-piercing-riveting. The software module helps to predict the connection formation and the characteristic joint parameters (e.g. interlocking) at different joining set-ups. It allows for robustness analyses for deviations, concerning: material thickness or properties (e.g. Rm), lubrication, and press properties. You can virtually investigate the behavior of joining points under load (e.g. cross tension test) and also the connection formation with adhesive between the components. Moreover, 3D calculations for multi-point-consideration are supported.

## Additional Modules

### Analysis

#### simufact.forming Analysis

offers modules for die analysis and microstructure calculations: **Simufact.forming Die Analysis** simulates tool stresses providing detailed insights into the internal tool loads. This can be done for any complexity of tools, like pre-stressed dies and tool reinforcements, with an unlimited number of components. Analyze tool failure and evaluate alternative tool concepts. Both coupled and decoupled die analysis computations are supported. **Simufact.forming Microstructure Matilda** is the special module for microstructure calculations of steels and nickel based alloys (e.g. dynamic and static recrystallization, grain size prediction), based on 'Matilda' technology from GMS, Bernau.

### Performance

#### simufact.forming Performance

covers additional technology that helps you increase the performance of your simulation solution. Choose **Simufact.forming parallel core** for parallel solving based on domain decomposition technology to increase the simulation speed. **Simufact.forming Additional Job** allows you to run jobs simultaneously. Also additional licenses for pre- and postprocessing can be purchased.

### Customizing

#### simufact.forming Customizing

provides a toolbox to develop specific kinematics concepts and kinematic control. We recommend the module **Simufact.forming kinematics** for the facile modeling of arbitrary machine and tool motion sequences. Usually this module is customized to the customer's needs in a separate project.

### CAD Interfaces

#### simufact.forming CAD Interfaces

helps you smoothly to import geometries from native CAD files. Interfaces are available for the most relevant CAD systems and file formats like STEP, VDA, DXF, ACIS, Parasolid, CATIA V4, CATIA V5, PRO/E, Unigraphics, SolidWorks, and Inventor.

### Material Data

#### simufact.forming Material Data

offers different arrays of **JMatPro Software** licenses to calculate material data. This covers nickel alloys, titanium alloys, copper alloys, general steels and stainless steels. Please ask for more types (e.g. aluminium).

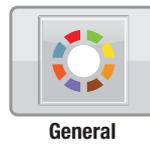
*Please contact our sales team for more information and for an evaluation of your specific needs.*

## AFS Technology

With product version 12, Simufact has introduced the newly developed AFS technology (Application Function Sets).

After starting the software, the user can now decide for a specific field of application. Specific process-dependent setups, such as the selection of the appropriate solver, meshing technologies, process-specific kinematics and advanced settings are provided. The application-specific functions are activated and the software limits itself to the process-relevant functions while specific functions for other application fields are hidden.

As a result, the AFS technology greatly improves the usability of the software: streamlined and simplified, the simulation setup becomes more intuitive, faster and more effective.



Any forming process not included in the specific process types and application modules can be simulated with the process type **General**. Advanced process simulation knowledge is recommended.



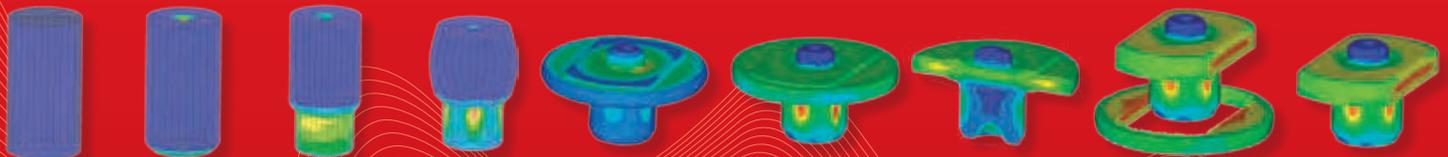
# Your Competitive Advantage with Simulation

## What can you achieve with virtual process design?

- Replace expensive tryout by efficient virtual computer-aided tryout
- Streamline the process design
- Optimize your manufacturing processes
- Enhance your use of material
- Extend tool lifecycle
- Maximize the economic exploitation of your equipment
- Increase the expert knowledge in your enterprise

## Investments Pay Off

Of course you have to invest into simulation tools before you can get started but these investments pay off quickly – thanks to lowered costs in process development and series production. Usually process simulation pays off in just a few months.



Fully Automated Multi-Stage Operations with Integrated 2D-3D Transition

„Using Simufact software helps our production functions to virtually ‘see’ product behavior in response to the manufacturing process parameters as well as the critical design parameters. The in depth technical support from Simufact has provided LuK with a tremendous simulation resource for discovering new methods for solving difficult problems.“

**Dr. Kunding Wang,**  
FEA Engineer, LuK USA LLC

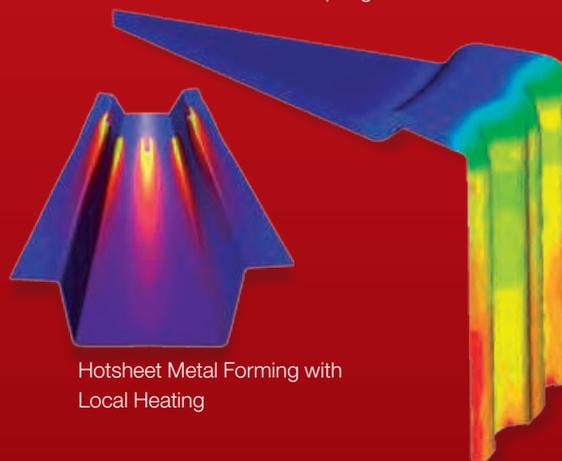
„The analysis and optimization of our complex processes is only possible with a partner that reacts to the needs of its customers and is willing to realize development requests for its software tools within a very short time frame. With Simufact we have found such a partner – here the customer is really within the center of the attention – also after the acquisition of the product.“

**Jürgen Schöler,**  
Leader Technical Planning, Neumayer Tekfor

„Simufact is one of our most important strategic partners. Without the experience and outstanding competence within the area of process simulation of Simufact we would lose an important part of our productivity. No other company in this segment has, in the area of manufacturing technique, the same skills in software development and implementation as Simufact.“

**Prof. Dr. Steinhoff,**  
Scientific Technical Director, METAKUS

Prediction of Spring-Back Effects

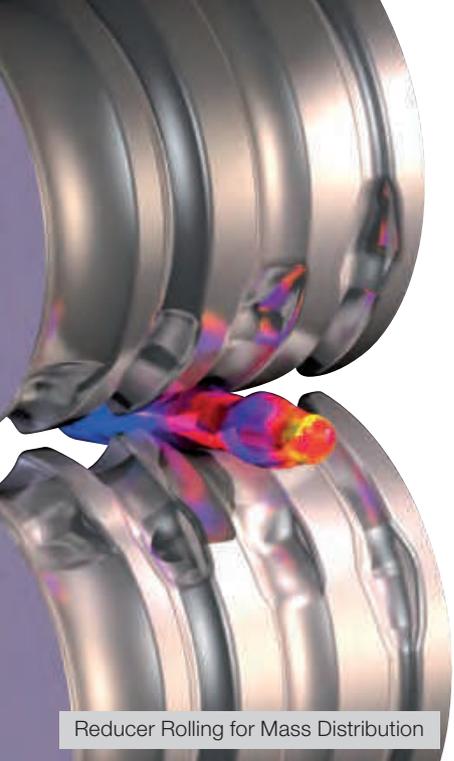


Hotsheet Metal Forming with Local Heating

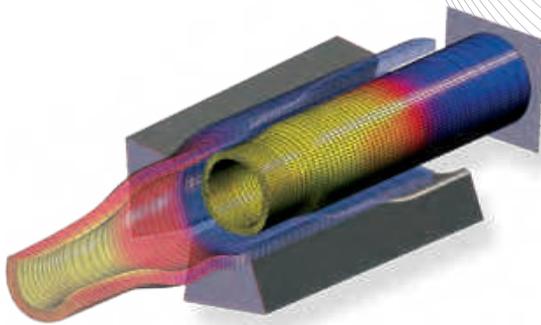
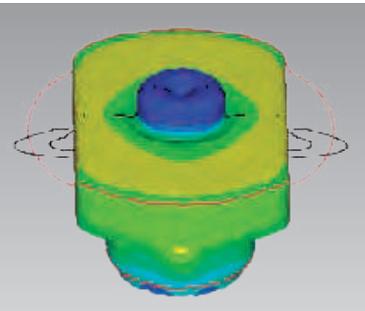
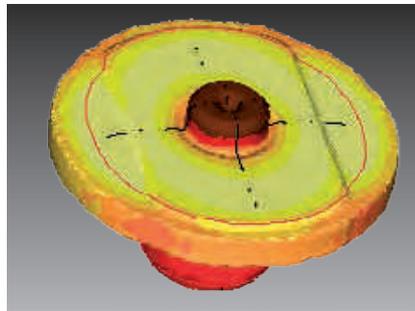
## Experience and Success

Optimize your development and manufacturing processes in cooperation with Simufact by applying the most actual technology: Simufact.forming.

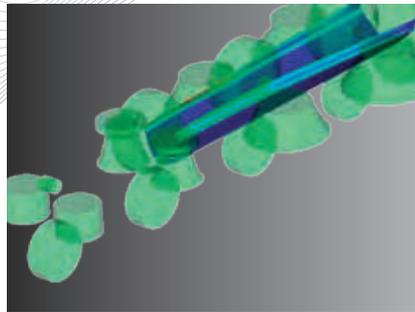
**Ensure your future competitiveness and benefit from the know-how of Simufact Engineering.**



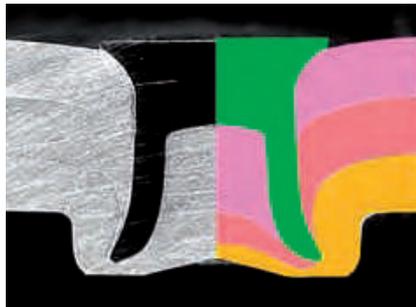
Reducer Rolling for Mass Distribution



Rotary Swaging



Multiple Rolling of Sheet Profiles



Simulation of all Mechanical Joining Applications

**For further information please contact:**

**Global Headquarters:**

simufact engineering gmbh  
Tempowerkring 19  
21079 Hamburg, Germany  
phone: +49 (0)40 790 128-000  
fax: +49 (0)40 790 128-199  
email: info@simufact.de

**Americas Headquarters:**

Simufact-Americas LLC  
11685 Spicer Drive  
Plymouth, MI 48170-4347, USA  
phone: +1 734 238-2173  
fax: +1 866 899-8386  
email: info@simufact-americas.com  
www.simufact-americas.com

**India Office:**

Simufact India Pvt. Ltd.  
Indo-German Chamber of  
Commerce,  
403, Shah Sultan, 4th floor,  
Cunningham Road  
Bangalore - 560052  
Karnataka, India  
phone: +91 7406-997805  
email: info@simufact-india.com

**Japan Representative Office:**

Acty 21 Bldg. 8F, 4-2-11,  
Shiba, Minato-ku,  
Tokyo 108-0014, Japan  
phone: +81-3-6435-2898  
email: info@simufact.jp

simufact.forming

*All pictures in this brochure are by courtesy of:  
Böllhoff GmbH & Co. KG,  
EJOT HOLDING GmbH & Co. KG,  
Neumayer Tekfor Holding GmbH,  
Schmiedag GmbH & Co. KG, ZF Sachs AG,  
Sieber Forming Solutions GmbH,  
Linde+Wiemann GmbH KG,  
MAGMA Gießereitechnologie GmbH, and  
Uponor GmbH*

*Simufact.forming,  
Simufact.welding, and  
Simufact.premap  
are registered trademarks of  
Simufact Engineering GmbH.*

*MSC.SuperForm, MSC.SuperForge,  
MSC.Dytran, and MSC.Marc are registered  
trademarks of MSC.Software.*