# LuK innovates manufacturing processes through forming simulation with Simufact

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In the automotive supplier industry, innovative product design and manufacturing solutions are essential for being competitive.

Components and subsystems are engineered to achieve highest quality standards and must be offered at a competitive price. As those parts are usually produced in large quantities, a failure of only one component can lead to very expensive recalls, let alone the damage of the manufacturer's reputation. Design and simulation solutions are required to offer an environment that delivers a mature and robust way to archive a greater knowledge about the optimal design and the manufacturing process, while giving the engineers the ability to find innovative solutions.
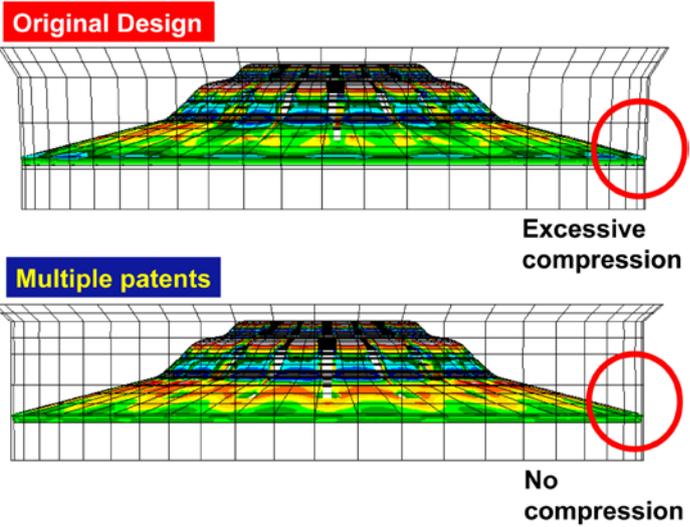
Simufact.forming was used to drive inventive product design and to eliminate damages

## LuK – synonymous for strength of innovation

For more than 40 years, LuK, today part of the Schaeffler Group, has been synonymous for strength of innovation, customer focus, and quality for numerous products in the automotive drivetrain industry.

LuK supplies customers around the world with systems and components, guaranteeing first-class technology, quality, and delivery standards. They meet customers' requests with products, that are tailored to the special requirements and needs of each customer. In North America, LuK manufactures torque converters, manual transmission clutches and double clutches.

Current development efforts are particularly focused on components for forward-looking dual-clutch transmission systems or alternative drive concepts such as efficient subassemblies for economical hybrid drives.

## LuK counts on highly sophisticated simulation tools

LuK attaches great importance to the development of innovative products and therefore counts on highly sophisticated simulation tools in their development activities.

At the LuK R&D Center in Ohio, the company develops innovative solutions for components of clutch and transmission systems. Within the development of those components, the engineering team of LuK uses the process simulation tool Simufact.forming. The software is used for a wide variety of applications, all focused on an optimal process design.

LuK started to use Simufact.forming for stamping simulations in 2006, and today the software family is used to simulate forming, tooling, riveting, and heat treatment applications. An additional solution, Simufact.welding, is going to support the welding application engineering.

Dr. Kunding Wang, Principal FEA Analyst at the LuK R&D Center, is the simulation expert of the company and one of the main users of Simufact.forming. It is his responsibility to provide services to the manufacturing and production departments. Among the many challenges facing in his daily work, Wang is primarily in charge of the simplification of complicated physics within the production processes. The simulation of these processes helps designers or production engineers to fully understand the physical details of the process and to learn which parameter modifications will result in an optimal manufacturing process. This approach is valid for every application area Simufact.forming is used in. Under his guidance, the Simufact.forming software is also used directly by the production design engineers themselves to design & optimize the tooling for LuK's progressive stamping processes.
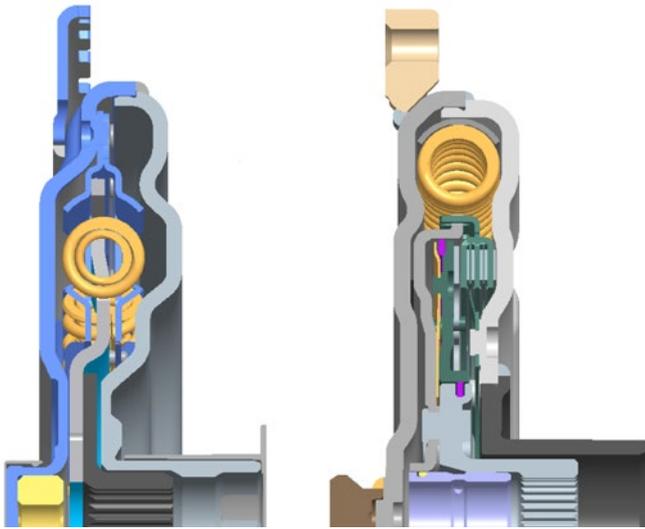
Rivet joint modelling to investigate the optimal process layout
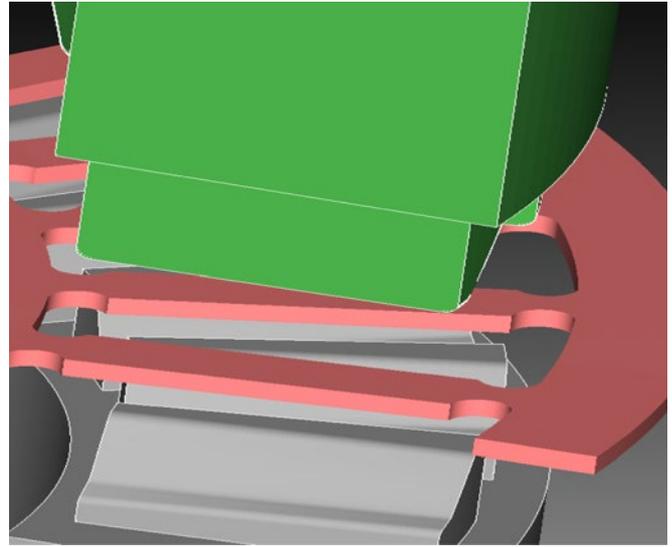

Stamp stator optimization to optimize stator performance and to reduce costs

## LuK – a manufacturer with a permanent need of innovation

Some of LuK's recent projects have been a flange forming optimization for stamping, a stamp stator optimization, a blind riveting simulation, and a quenching process simulation. Particular for a manufacturer with a permanent need for innovation, the blind riveting project proved the value of simulation.

In this project, Simufact.forming was used to develop a new product line of an overbend torque converter clutch. For almost 20 years, the development of the component has been a significant engineering challenge in the industry, with all competitors attempting to solve the problem. Before simulation, it would have taken LuK about two years to realize such a component from concept to production.  With Simufact.forming, LuK could solve the conceptual issues in two weeks.

To improve the product, Luk based the new design on an existing system, could handle the assembly in a shorter time and reduced the overall development time by half. Instead of the two years that were needed before applying Simufact.forming, the development process from concept to production could be handled in only one year.

## Physical tests reduced to almost zero

When starting the project, LuK's major objectives were the optimization of the design and the manufacturing process, enabling the riveting in a very limited space. Before using simulation, the engineers had to test the design both on prototypes and within the associated production process. With the test results at hand, changes were made and another physical test followed to validate the new design.

Since every insight into the tested clutch would have destroyed the product, the engineers could not follow the traditional testing process in this project. Therefore, the LuK engineers made use of a virtual alternative and applied Simufact.forming to their development process. This approach helped LuK to reduce the physical tests to almost zero, keeping only a validation test in the end to confirm the simulation results.

> **With Simufact's simulation software you can see the physics in action, which means the products response to external influences such as heat treatment, welding, riveting or external forces. These are the details we need for effective engineering. Simufact provides a bridge to engineers who have the issues and is a strategic tool for being innovative and developing optimized processes and better products".**

**Dr. Kunding Wang,**
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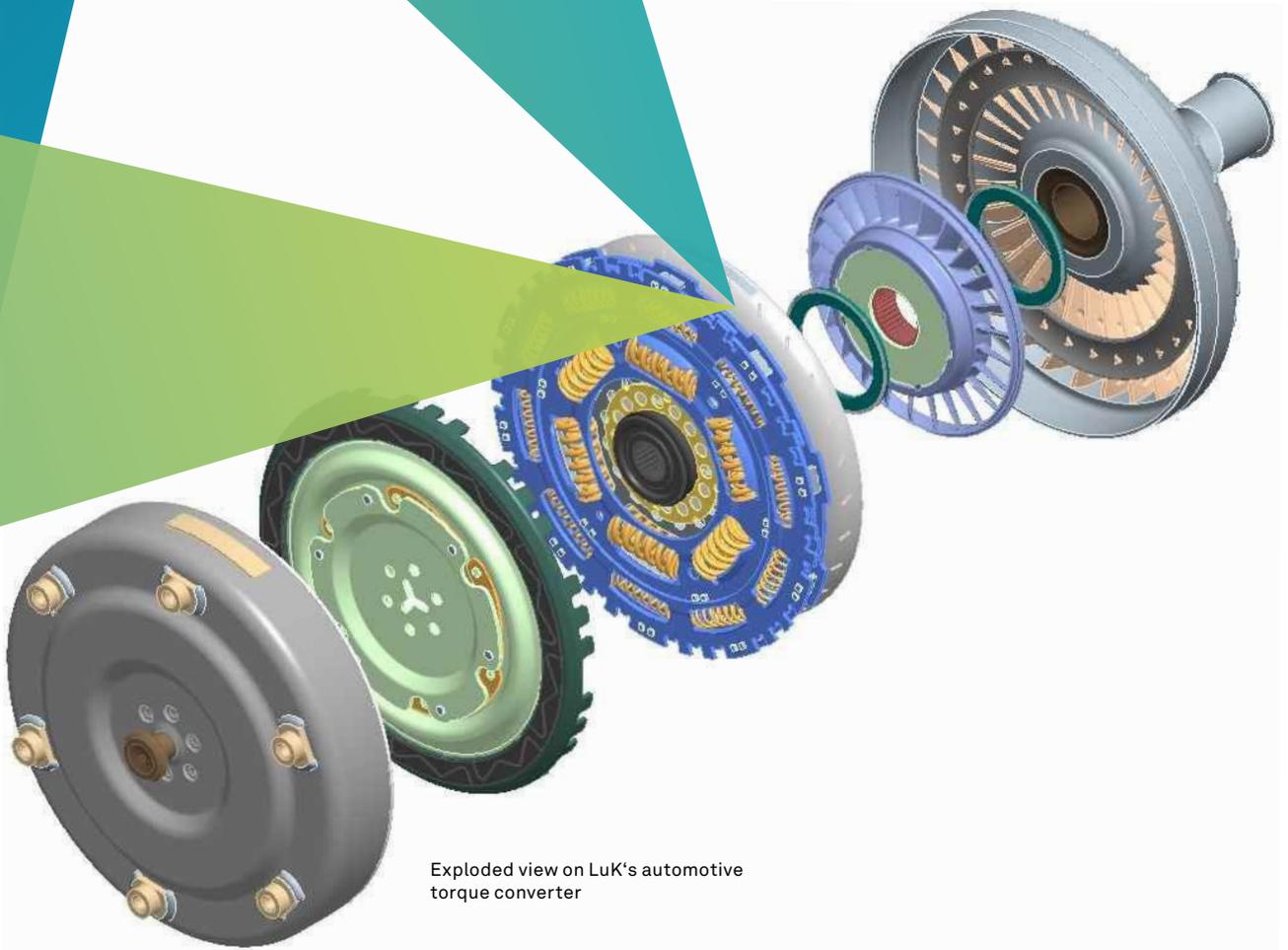


Exploded view on LuK's automotive torque converter

## Shorter development times, less prototypes and reduced testing efforts

What makes this design innovative is the use of the component itself as a tool, giving the rivet the final form and at the same time having it fulfilling its function as the cover for the torque converter clutch. With this in mind, LuK used the simulation to find the ideal design for a feasible manufacturing process. To handle the riveting, the tools have to contact the rivet and make it join. By means of simulation, LuK could see the exact effects of each change and could modify the tool and the component accordingly. The key was to use the part as a combination of the final product and the production tool.

On the whole, the simulation capabilities provided by Simufact.forming enabled LuK to shorten development time, to reduce the number of prototypes, to reduce testing efforts, and to drive an inventive design and process layout.

## LuK and Simufact Engineering GmbH are working in close cooperation

Dr. Kunding Wang is working in close cooperation with Simufact's engineers, especially when software modifications and enhancements are necessary to meet additional requirements for a single application. In the future, LuK will extend the use of Simufact to more application areas such as welding capabilities and heat treatment applications. For welding applications, LuK is currently using the Simufact.welding BETA release.

Simufact.welding is a new tool within the Simufact product family, designed for special applications in the manufacturing industry. Its user friendly interface enables welding specialists to access even very complex simulation technologies.

The official release of the module is planned for 2011. Also due in 2011 are further enhancements of Simufact.material, which will cover the simulation of heat treatment studies.

## Ease of use of the Simufact product familiy

In addition to the broad application spectrum of the Simufact product family, LuK is also very impressed by the ease of use of the software. In accordance with an overall trend, Simufact Engineering wants to provide a software environment that enables design or production engineers to conduct simulations and variations on their own while

being supported by simulation specialists for detailed analysis. The specialists will be responsible to design best practices for building the simulation models and will offer support in simplifying the physics to a representative virtual process.

Ideally, increasing the virtual testing will reduce the physical tryout to final validation tests – all this leading to shorter development times, reduced prototypes, less failures and better products.
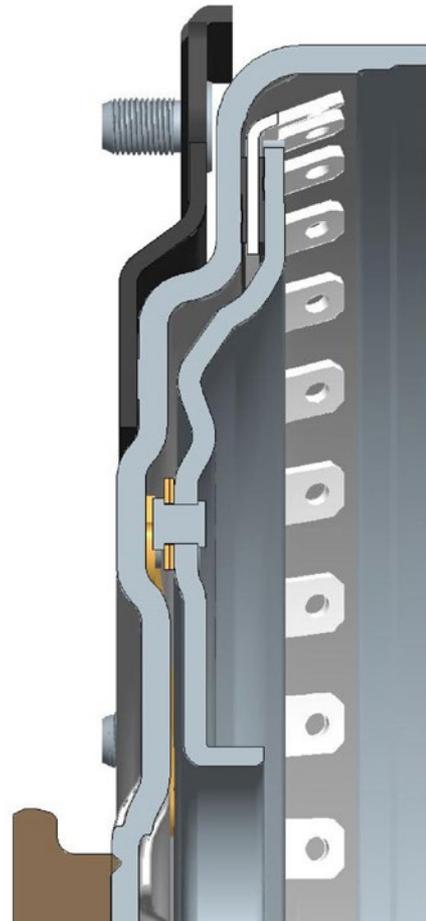


The key to a successful manufacturing and product design was to use the part as a combination of final product and production tool

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