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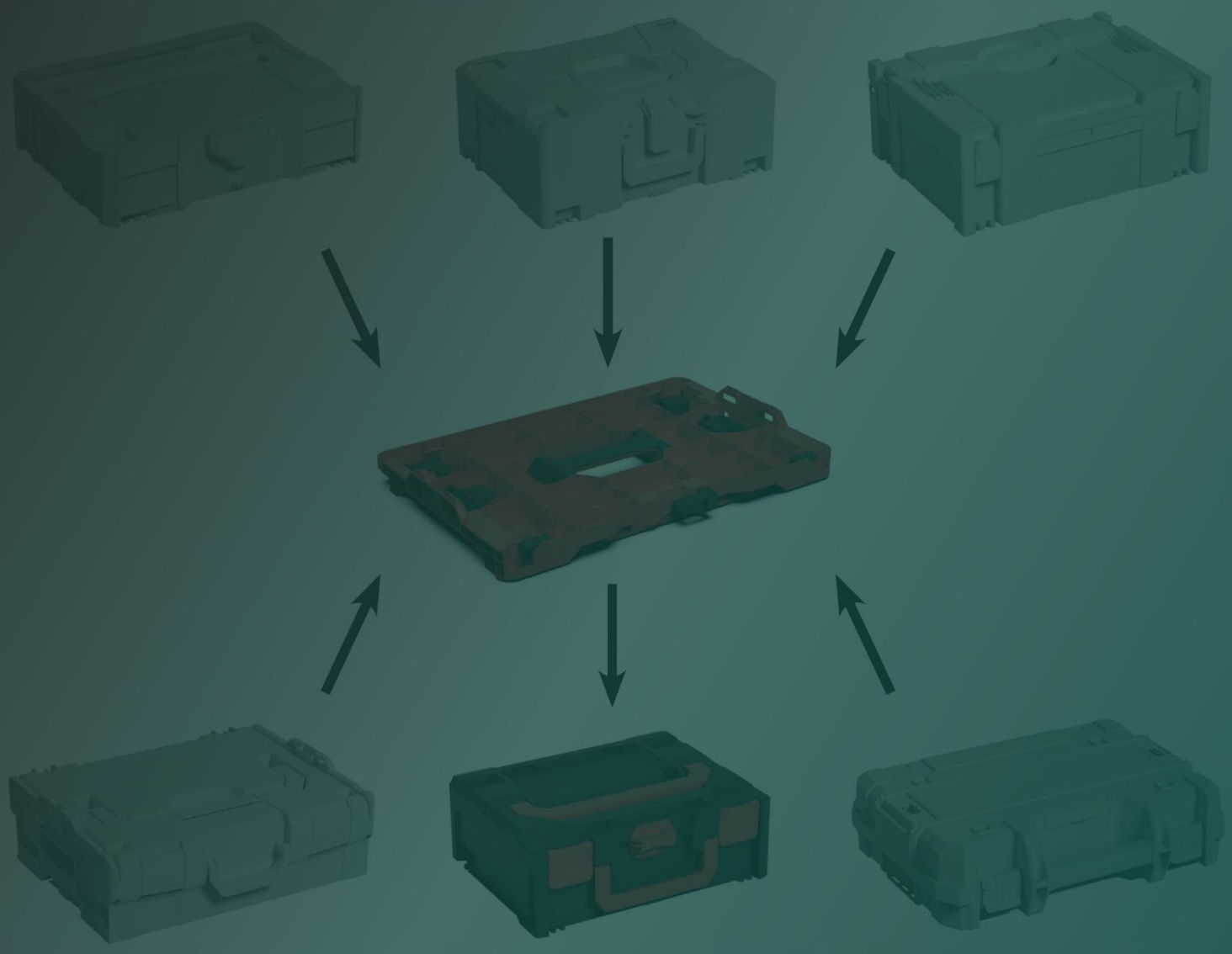

ONE ADAPTER TO STACK THEM ALL

How GOLLMER and PLASTON used simulation and VARIMOS rapid variant analysis to optimize a novel stacking adapter

Abstract

When Plaston AG developed an innovative new Hybrid Adapter Plate, warpage was one of the main challenges. Mold making and manufacturing expert Gollmer helped refine the mold design to get it into serial production quickly, and with significantly reduced warpage. To do this, they deployed a smart new way of working, which combines classical injection molding simulation to identify issues, with a novel method called rapid variant analysis using SIMCON's unique solution VARIMOS, to quickly explore solutions. Gollmer set up their variant analysis in two steps, first exploring whether injection parameters alone could fix the issue, only to discover that that was not enough, and then secondly subtly varying wall thicknesses, to get a significant improvement. The result was a mold that went into serial production rapidly, and with only minimal corrections during tryouts.

How to stack incompatible boxes?

Construction workers will often use powertools from a variety of vendors. Each of these come in their own transportation box. While these boxes are designed to be stackable, stacking is possible only within the ecosystem of a single vendor. If you have tools from different systems and brands, their boxes don't stack. The result is that you either need to use more space to transport or store them, or you'll need to perform some delicate balancing, which is a safety issue.

Is there perhaps a way to make the boxes stackable across vendors? Thanks to some innovative product design by Swiss company PLASTON, this is now possible (refer to info box on page 2 for more about the company). And thus, the Hybrid Adapter Plate project (Figure 1) was born. By placing the Hybrid Adapter Plate between boxes, it is now possible to securely stack boxes by different vendors.

One adapter to stack them all

To be viable, such an adapter needs to fulfill some important quality and cost criteria. PLASTON worked with the part and mold design experts at Gollmer Formen to tackle these challenges. In this article, we'll deep-dive into

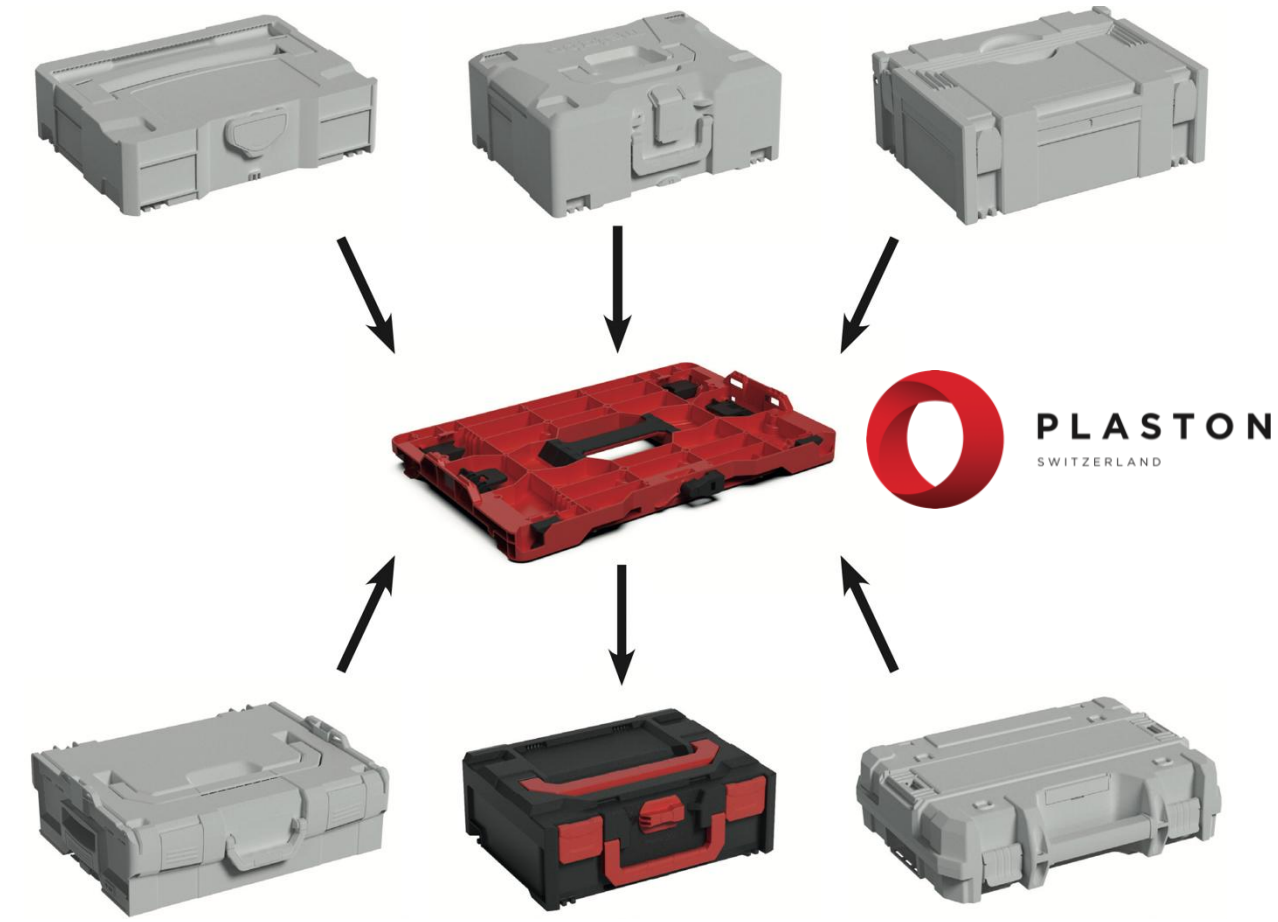

Figure 1: The Hybrid Adapter Plate is manufactured by PLASTON. The plate makes it possible to stack boxes from different vendors: Bosch L-Boxx and Sortimo L-Boxx*, DeWalt TStak**, Makita Makpac***, Tanos Systainer³,****, Sortimo International GmbH Fahrzeugausstattung (DeWalt TStak**, Tanos Systainer³,**** and Makita Makpac*** can be integrated for the first time). The Hybrid Adapter Plate can be purchased from PLASTON's retail partner Engelbert Strauss: **https://www.engelbert-strauss.ch/systemboxen/straussbox-hybrid-adapter-platte-7071220-5506280-75.html** ; Image: © PLASTON AG, all rights reserved. Producers of the compatible systems: *BS Systems GmbH & Co. KG, **Stanley Black & Decker Corporation, ***Makita Corporation, ****Tanos GmbH*

how Gollmer used modern injection molding simulation technology to solve them.

Precise, beautiful and affordable

To make a viable part, a few important criteria needed to be met.

First, the part had to be **dimensionally precise**. Since the Hybrid Adapter Plate must connect securely to a box above and a box below, accurate part measures were of paramount concern. **Second**, the part had to be **beautiful**. This meant that there could be no visible weld lines, and that the injection molding process had to be compatible with different color batches. **Third**, the part and mold had to be **produced efficiently,** meeting certain cost targets. **Fourth**, design itself needed to move **quickly**, as the Hybrid Adapter Plate was scheduled to be included in the new Engelbert Strauß catalog for 2022.

Fundamental design considerations

Both in order to avoid visible weld lines, and to meet cost targets, PLASTON decided to avoid a multi-gate hot runner system. A central single valve gate design also made it easier to handle multiple colors, avoiding the need for time-consuming mold switches during the production. A suitable gate location was found in the handle, which is the most heavily stressed area of the article. The central gate also eliminates problems with centrally converging weld lines and thus weak points on the part.

Early-stage use of simulation

The most important functional requirement for the product is to get the measurements right, and obtain an absolutely flat component.

PLASTON used a series of simulations, as well as their experience with similar parts in the past, to make a few key adjustments. For example, they adjusted wall thicknesses to improve the filling pattern, introduced and moved ribs for stiffening and warpage optimization, and chose optimal locations to position screw bosses. For these design adjustments, all the departments concerned were involved internally at Plaston in advance.

By reflecting all existing experience with comparable components and the insights from early-stage simulation, the article designs and basic concepts were already well laid out in advance.

About the companies

PLASTON:

PLASTON is the leading global producer of high-quality plastic packaging solutions and standard plastic cases. The company, headquartered in Widnau, Switzerland, also produces technical plastic parts, which they assemble precisely into components. PLASTON's services follows every product throughout its entire value chain, from development through to production and logistics.

GOLLMER Formen GmbH:

GOLLMER, headquartered in Lenningen, Germany, offers 360° solutions for design, manufacturing and procurement of injection molds, components and assemblies, from project management to engineering and manufacturing services. GOLLMER is known for its ability to secure uncompromising German-engineered quality, while also ensuring efficient component design, cost and material savings, and optimizing the manufacturability of the product or assembly.

SIMCON:

Injection molding simulation software specialist SIMCON have helped their customers tackle their most demanding injection molding part and mold design challenges for more than 30 years. Known for the industry-leading precision and speed of their solver CADMOULD, as well as their unique rapid variant analysis solution VARIMOS, SIMCON is proud to embody the standards and ideals of German Engineering: a deep attention to detail, combined with pragmatic decision-making support.

Handover to Gollmer, for mold making

To finalize and manufacture the mold, PLASTON decided to work with mold design and manufacturing experts at Gollmer Formen (see info box for more on the company).

“We always use simulation to investigate and improve the designs, as we work on them. This enables us to uncover any remaining issues and find and test creative ways to solve them,” explains **Philipp Beckel**, project manager at Gollmer. “In this example, our CADMOULD simulations showed that thanks to the great preparatory work by PLASTON, the part and the early mold were well-designed. But one thing

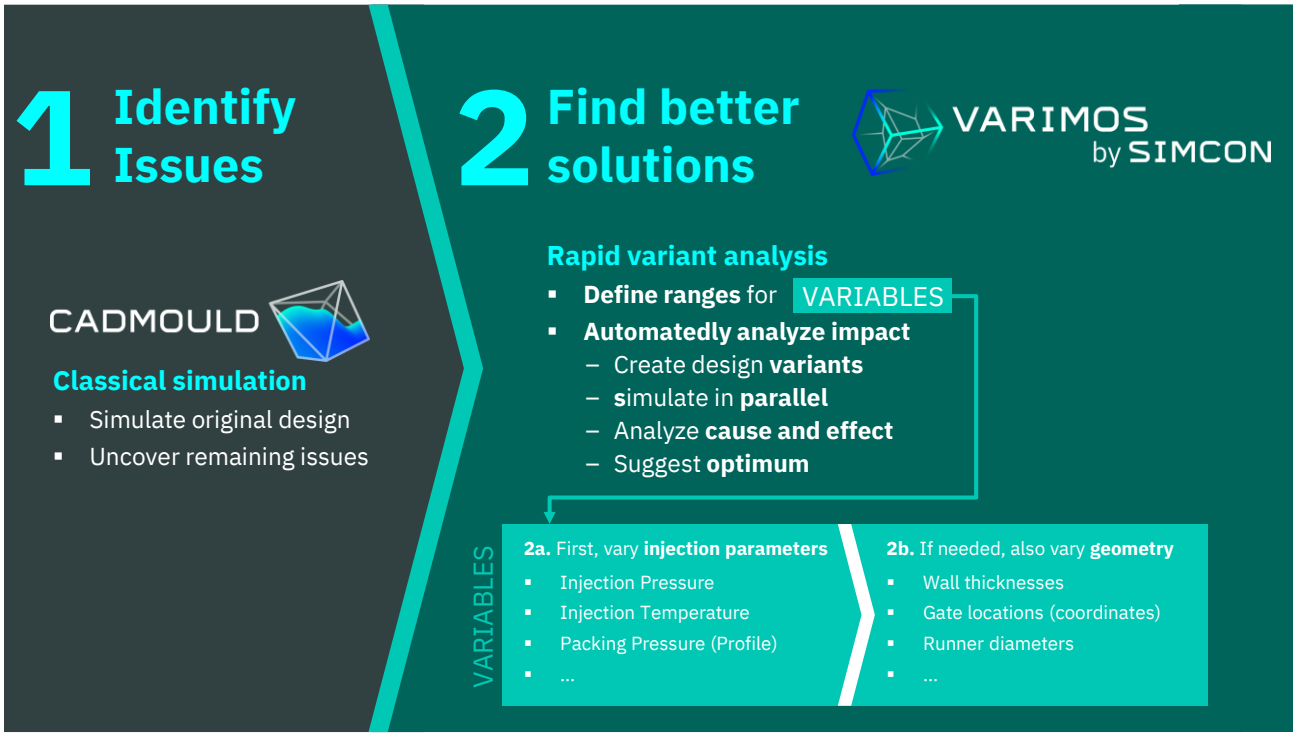

Figure 3: A modern way of working uses simulation to uncover issues, and then deploys rapid variant analysis to explore the entire solution space, instead of classical "trial and error" solution-seeking. SIMCON offers a uniquely fast and convenient solution for rapid variant analysis, called VARIMOS.

that we did uncover was some warpage that occurred in an edge area of the part. So we went in and explored what could be done."

First parameters, then geometry

To solve this issue, Gollmer decided to proceed in two steps, first checking whether injection parameters alone could solve the issue, and only if that is not the case, escalating to subtle geometric modifications. "We always check first whether the problem can be fixed by modifying only the injection parameters, like temperatures and pressures. Because that's just the easiest thing to get approved, since you're not touching part or mold geometry.", explains **Philipp Beckel.** "And if we can prove that that isn't enough, then we've shown that it's worth discussing whether to make some subtle adjustments to geometry. The key to having a constructive discussion about that, of course, is that you've done your homework and really checked all possible combinations of parameters. Not just one or two. Otherwise the customer will rightly tell you to go back and try other settings."

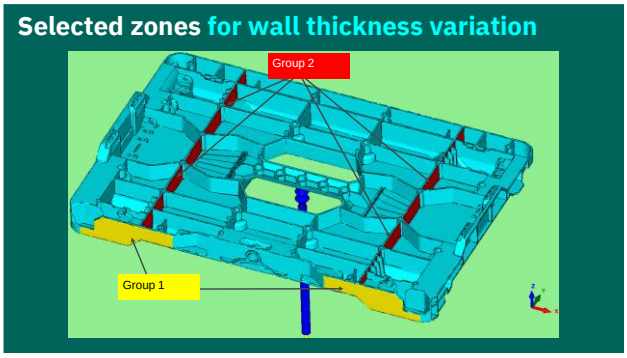

Figure 2.: Two areas (groups 1 and 2) were defined, in which wall thickness could be varied. Since changing wall thicknesses changes both the flow of material through the part, as well as the mechanical properties of the resulting part, it can have a large impact on warpage. GOLLMER used the thickness of these two areas as variables in the second round of VARIMOS variant analysis.

An exhaustive but efficient search for solutions

"We've found that there is a a slow way, and a faster way to explore a large number of alternatives," explains **Alexander Dangel**, CEO of Gollmer. "The slow way would be to run trial and error simulations, one by one. Change something, simulate, look at the results, rinse and repeat. But that's an ineffective, slow way of working, because you're setting up, running and interpreting simulations one by one. So

we've decided to use a faster, more systematic way. We parallelize the process by using rapid variant analysis."

A faster way to explore many possible solutions

In order to explore entire solution spaces thoroughly, but also quickly, Gollmer uses a tool called VARIMOS, which is a rapid variant analysis layer for SIMCON's injection molding simulation CADMOULD.

Angela Kriescher, head of product management at SIMCON, explains: "In VARIMOS, you don't need to set up simulation by simulation yourself. Once you've got your baseline simulation set up, all you need to do is tell the system what variables to vary, and by how much."

VARIMOS will then set up a suitable number of simulations to explore these variations. It will then use powerful parallelization to run multiple simulations at once, instead of one after the other. Finally, an inbuilt AI will look at the simulation results to learn cause and effect. As a result, the user gets an interactive display that lets them explore the impact of changes onto results, in realtime. They can do what-if analysis, without having to run more simulations. And the system will generate suggestions for optimal configurations, which can serve as a starting point for discussion.

First, vary parameters…

"For the Hybrid Adapter Plate, we first told VARIMOS to vary pressures and temperatures for injection and packing by a certain percentage, around the baseline design we already had," explains **Philipp Beckel**. "We then ran the simulations, had the AI analyze results, and looked at a summary. The result was that while injection parameters could indeed be adjusted to generate a small improvement, the improvement was not big enough, even at optimal settings. So we knew that we needed something more than just injection parameters, to fix the issue."

…and then if needed, vary geometry

As a result, Gollmer decided to investigate whether the issue could be resoved by varying

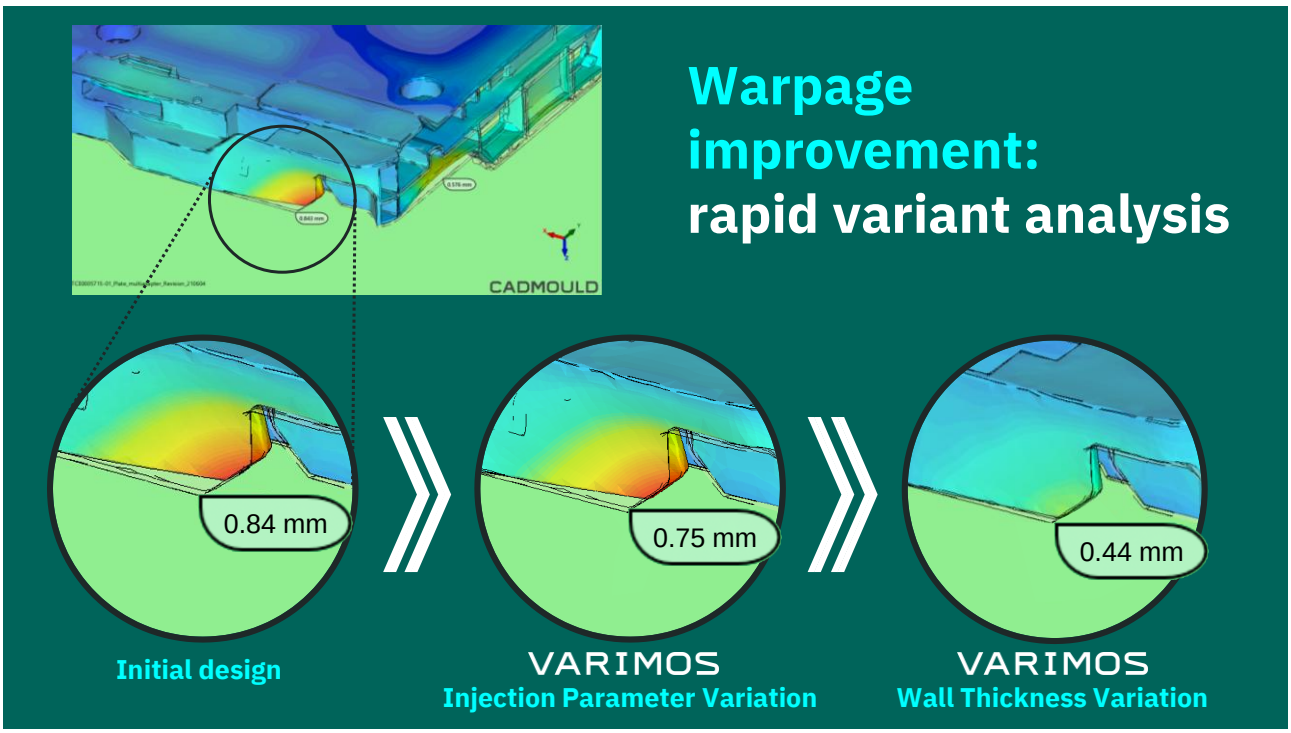

Figure 4: (Left) A simulation of the initial design revealed significant warpage near a corner of the part. (Center) Gollmer then used VARIMOS rapid variant analysis functionality to first explore, whether the result could be improved by varying only injection parameters. The achievable improvement, however, was small. (Right) So, they also selected certain walls of the part that could freely be modified in thickness, and set up a second VARIMOS analysis using these wall thicknesses as variables. This brought a significant improvement in warpage – achieving a reduction of almost 50%.

some subtle aspects of geometry. Specifically, they reasoned that perhaps subtle changes in the thickness of some of the ribs could change the flow characteristics in the mold, leading to better warpage results.

"And so, we told VARIMOS **which walls** could be **changed in thickness**, and in what range. Again it set up a collection of new simulation variants, computed and analyzed them, to model cause and effect, and then optimize. And for this part, it really made a big difference. We were able to improve warpage by almost 50%", explains **Phillipp Beckel**.

Sampling with confidence

Having optimized the part and mold using simulation and rapid variant analysis, Gollmer and PLASTON proceeded to build the physical mold. Mold tryouts showed that the simulation analysis had really paid off: only minimal corrections were needed in the three molds. They could be delivered to Plaston after a quickly completed optimization loop including pilot series production.

The result: Flawless serial production, fast time to market

The subsequent start-up of series production was flawless. The components could be produced as predicted by the simulations, accurately, without significant warpage and within the required component tolerance, in the process window provided by the customer.

What it takes

CEO **Alexander Dangel** explains that the impressive speed and accuracy achieved by PLASTON and Gollmer could not have been achieved without three important factors in place, which are core to Gollmer's value proposition: "First, you need a **trust-based relationship** with your customer. Unless you've got that, it's really hard to talk to the customer about potential changes that bring improvements. Second, you need the **right way of working**. This means that you not only need the competency to design, run and interpret simulations and know what to do. You also need the ability to parallelize that process, so that you don't take forever when you explore alternative solutions. And third, you need **the right technology** to support that way of working. We use CADMOULD and VARIMOS not only because of its industry-leading accuracy, but also because of its order-of-magnitude speed advantage. Without this, it would be impossible to parallelize solution exploration in practice. Because if it takes a week to get back your results (which can happen, with other simulation solutions), that's not really an acceleration."

About the Authors

Alexander Dangel is the CEO of GOLLMER Formen.

Philipp Beckel is a project manager at GOLLMER Formen and runs operational simulations.

Dr. Bastiaan Oud is head of strategy at SIMCON.

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gollmer.
Gollmer Formen GmbH
www.gollmer-formen.de

anfrage@gollmer-formen.de

https://www.gollmer-formen.de/en/

SIMCON

solution@simcon.com

https://www.simcon.com/contact

PLASTON
SWITZERLAND

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