Simulated sheet metal forming operations have improved product quality, reduced body component lead time and married a more distinct, attractive design with improved manufacturability at Volvo Cars Body Components' plant in Olofström, Sweden.

Form and function

Volvo Cars' designers and engineers have allied form and function with speed and precision in the development, production and delivery of car body components - using simulation techniques to achieve their goal.

Sheet metal forming simulation

Core processes for Volvo Cars Body Components include manufacturing engineering, tooling and
the production of body components (stamping, sub assembly and material planning/logistics). The Stamping Engineering encompasses Stamping CAE, Die Process Engineering and it liaises with Strategy and Concept, Assembly Engineering, Geometry and the R&D/Design in Göteborg for new product development.

“There are forty people in Stamping Engineering,” Anders Skogsgårdh told ISMR, “and seven of us work in sheet metal forming simulation.”

Volvo Cars Body Components uses AutoForm CAE software for draw-die development/optimisation, layout of trimming and flanging tools, detection of surface defects, calculation and compensation of springback, optimisation of material usage etc. Pre-production work includes die development, simulated forming, analysis and the manufacture of the formed dies. A lot of dies are analysed to support all the new car models in production.

“From 2000, with big changes in our workload and multiple projects on hand, we made the decision to just use AutoForm software for sheet metal forming,” said Anders Skogsgårdh. AutoForm’s Incremental, DieDesigner and Sigma modules have allowed Volvo Cars Body Components to perform more accurate simulations, analyse more parameters and ensure many more loops and robustness evaluations.

“Some car manufacturers distinguish between simulation and final validation and they like to have two or three different software codes for final validation but we only use AutoForm,” commented Kristoffer Trana, senior forming analysis engineer, Volvo Car Body Components. “We found that a multi-code approach was not good enough because if we encounter problems very late in the development process, it may result in unnecessary late changes.”
“AutoForm’s tooling/tryout solution allows us to simulate more processes,” added Trana. “We need high precision and we are constantly trying different processes and simulations to find a optimum between product attributes and manufacturability. One indicator from using sheet metal forming simulation is that the quality of the try-out and the body of the first series production car is so much better than it was five years ago. Surface finish is also much improved. With increased volumes and focus on material utilisation the nesting-module has become more important.”

Trana also points out the importance of having core stamping experience and sheet metal knowledge when performing simulations.

“The same engineer who does the sheet metal forming simulation is also present at the tryout floor – this is crucial because we can learn from actual production, get vital feedback and strive for improvement,” he told ISMR. “This means that there is real liaison between all the departments.”

Skogsgårdh agrees. “Simulation is a key enabler to shorten tooling lead-time and secure manufacturing robustness. We can be assured of reliable, lean stamping production due to stable forming processes, quality assured dies before die manufacturing and better/faster tryout,” he told ISMR. “We increase our knowledge with each simulation and, in the process, gather correct CAD data for part and die, which is invaluable for future projects.”

Streamlining processes

Volvo Cars Body Components has recorded a huge increase in output since 2000, incorporating the production of the new S40/V50 (the old S/V40 was stamped at another plant) within its current press shop.

“We have made large steps in accuracy with our simulation processes,” commented Dr. Mats Sigvant, technology area leader, FE-simulation, Volvo Cars Body Components. “To be able to increase production, we needed to be better in the pre-production and simulation phase to remove as many problems as possible before the cars
come to production. We have streamlined the process and lowered tryout times. We now have very few problems with forming dies since the simulation is working well, we are saving money and the results are respected. The bottom line is that people like simulations, they see the benefit. It saves time and cost."

In the pre-study stage, Volvo Cars Body Components simulates almost everything – all line dies, transfer dies and a lot of progressive dies. Die design for simulation is done in AutoForm-DieDesigner or Catia. Volvo Cars Body Components also specifies that contracted toolmakers must use AutoForm software.

"Toolmakers send us their simulation files and we check and approve them," commented Dr. Sigvant. "We would have previously supplied our simulation model and material database to the supplier. We then discuss the best way of producing the tool. Suppliers must produce tools within safety margins for production. One of the benefits from using simulation is to get better tools from third parties. We also support R&D/Design in Göteborg with feasibility studies for new car concepts - different areas may have to be modified using simulation."

Material issues and challenges
Volvo Cars Body Components has a long history of using high strength steel and aluminum – it was one of the first carmakers to use dual phase materials in volume production and has been steadily increasing its usage of this material over the last ten years. It also uses a lot of tailored blanks but has reached a mature level of consumption for these.

"Today, we have tougher materials but also quite tough requirements," commented Kristoffer Trana. "We need to be aware of issues like springback. This means getting a pressed panel from the draw die quickly while putting the other dies on hold. In this way, we can make corrections to the draw die before we start spend time and money on the following dies. This is also an area where CAE simulation is crucial."

Anders Skogsård agrees. "Simulation allows us more time to spend on other processes and procedures. We don’t have the time to waste – we go from one model to another and there are limited timeframes, which is where good simulation tools are vital."

"With some high strength steels, we can find springback problems," commented Dr. Mats Sigvant. "Springback is a challenge and can give different results. In tryout, the physical material results can be different so it is equally hard to handle in the virtual world. Therefore, the springback problem goes hand in hand with, and is very much related to, process robustness and material properties."

"Car bodies are becoming stronger and lighter," he concluded. "We aim to develop processes with excellent manufacturability that can meet Volvo Cars’ distinctive and attractive exterior requirements, demands and core values."