Figure 1. Sheet Metal Forming on the Factory Floor

ROLLING OUT A BETTER PROCESS

DIGITAL TWIN SLASHES WASTE 15% AND RUNTIME HOURS TO SECONDS

About the Customer

Patrone and Mongiello is a leading tier-one automotive supplier based in Tito, Potenza, Italy. Since its founding in 1985, the company has seen its turnover grow yearly and has invested in premier industrial technologies to best support its automotive, agricultural, and general mechanical, cold-metal-forming manufacturing business.

Their Challenge

Patrone and Mongiello wanted a solution to better monitor and control its sheet metal forming process so it could improve product quality and reduce production waste. The solution needed

> A comprehensive digital twin is inevitable. It is simply the most effective approach to understand the impact of multiple parameters on the forming process and based on this improve the quality of the final product.
>
> Antonio Del Prete,
> Associate Professor,
> Manufacturing Technologies and Production Systems,
> University of Salento,
> Lecce, Italy

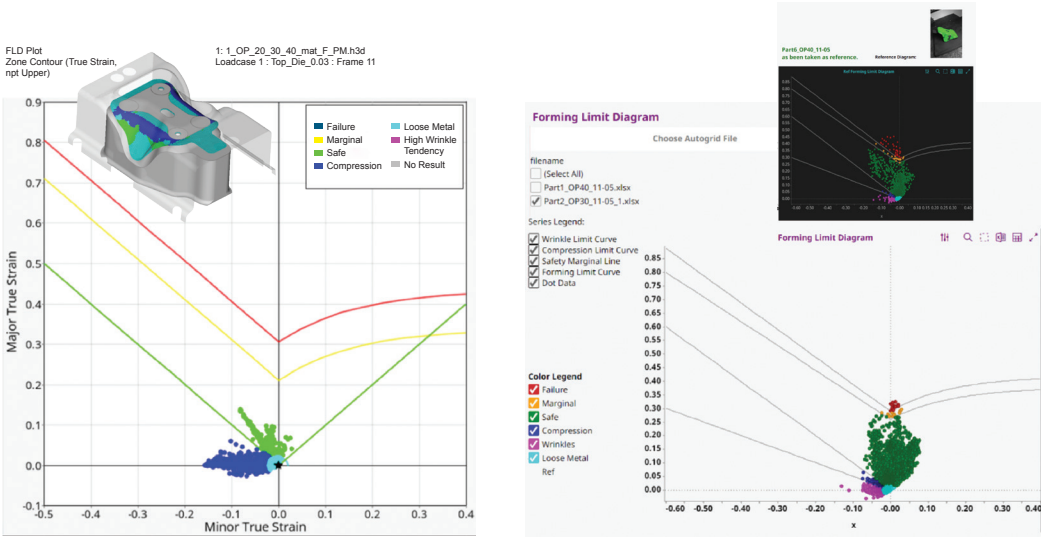

Figure 2. Simulation Results with FLD (left) and Dashboard Comparing KPIs to Real Sensor Measurements

to account for sheet metal properties such as stress, strain, and elasticity and cover equipment operating conditions such as pad force and die friction.

Our Solution

The company selected Altair's digital twin solution to achieve their goal and turned to Advanced Engineering (AE) Solutions, an Altair partner, to implement it. AE Solutions is based in Nardò, Lecce, Italy, and specializes in product and process optimization and development in the fields of CAD/CAM, CAE, process automation, business intelligence, and research and development. Altair and AE Solutions addressed Patrone and Mongiello's challenges by creating a comprehensive digital twin that simulated the company's existing sheet metal forming process including the machine press (Fig. 1) and sheet-metal behavior, system variables, and operating conditions. This virtual counterpart featured "smart" use of both simulated data and real data from accelerometers and AutoGrid sensors on the physical machine press.

Altair produced the simulated data through finite element analysis (FEA) with Altair® Inspire™ Form (Fig. 3). They also ran design-of-experiment (DoE) studies with Altair® HyperStudy® to reveal the effect of the sheet-metal properties and equipment-operation settings on the forming process performance. To leverage this data in a real-time scenario, the team used Altair® romAI™ to create efficient reduced-order models (ROMs) that support artificial intelligence (AI) and enable very fast simulation runtime. The ROMs revealed parameter variation effects such as Young's modulus, yield stress, sheet thickness, and machine-die friction on the forming process's end-product quality. Accounting for the parameter variation, the team then used romAI to train machine learning models with simulated data. With this method, the team was able to compare the simulated data models to actual data models in a real-time digital twin environment hosted in Altair Activate®.

The team deployed all data models through Altair® Panopticon™, a cloud-based dashboard where forming press operators could visually monitor actual sensor data against expected behavior for key performance indicators (KPIs) and deploy corrective actions throughout the sheet metal forming process (Fig. 2). The solution and dashboard were deployed from Altair's open and integrated software environment, which enables collaboration and accommodation to future process changes and requirements.

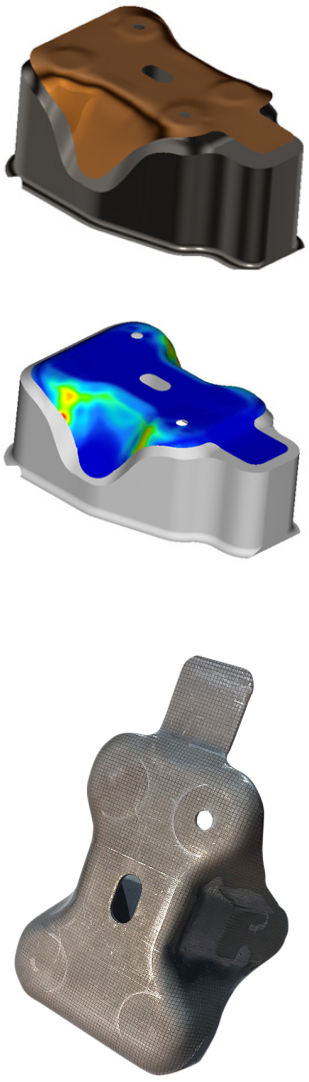

Figure 3. Virtual Part (top), Simulation Results (middle), Real Part Produced (bottom)

Results

Altair's digital twin solution gave Patrone and Mongiello the means to monitor quality and make corrections during all stages of its sheet metal forming process with respect to varying sheet metal material properties and equipment operating conditions. The ability to monitor and correct the process helped the company reduce production waste by more than 15% and as result reduce material usage, which is a major sustainability goal. The solution also leveraged efficient parameter variation that reduced simulation time—from hours to seconds—and enabled teams to monitor the process in a real-time environment. The company was able to immediately leverage the new process to supply axle attachment brackets (Fig. 3) to a leading automotive manufacturer.

To learn more, please visit altair.com/one-total-twin/manufacturing

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