



CASE STUDY

DMG MORI and Sigma Labs

*Improving Additive
Manufacturing Quality*



Additive manufacturing (AM) plays a critical role in multiple advanced industries and its current and potential applications are extensive. From more simplistic uses such as small-scale component manufacturing to high-stakes applications in medical devices, aerospace, automotive and oil and gas, AM is a driving force in the innovation of the manufacturing industry.

However, with so much on the line, companies that use AM have little room for error in the quality of their final product, even as they are pressured to innovate more and deliver faster. This case study explores how two industry leaders, Sigma Labs and DMG MORI, have teamed up to enhance quality control in the AM process.



Company Overview

Sigma Labs Inc. is a leading provider of in-process quality assurance (IPQA®) software to the additive manufacturing industry under the PrintRite3D® brand. Sigma specializes in the development and commercialization of real-time monitoring solutions for 3D metal advanced manufacturing technologies enabling cost-savings and production efficiencies.

DMG MORI is a global leader and major supplier of machine tools with about 12,000 machine tools produced annually. Their additive manufacturing division boasts six AM Excellence Centers in America, Europe and Asia, each with a focus on the industrialization of AM. Their portfolio includes four complete, individualized process chains that leverage powder nozzle or powder bed technologies.

DMG MORI accomplishes this by combining the company's LASERTEC SLM models and the LASERTEC DED series with the machining centers from its broadly diversified machine portfolio.

Background

DMG MORI seeks to elevate and industrialize the AM process while simultaneously focusing on consistent quality and reliability in all parts produced. The company utilizes a full-circle strategy that begins with the design and programming process utilizing proprietary software. They horizontally integrate the additive process with the machining process using standardized interfaces and the integration of the digital process chain.

The Challenge

DMG MORI serves a variety of industries in which quality control is instrumental in the reliability of the final product including aerospace, medical, mechanical engineering, die and mold, energy and gas, and automotive. In these industries, failure of the final product is simply not an option. Even the most minor inconsistencies in small parts can create dire consequences for end users. For example, a poorly made acetabular cup used in a hip arthroplasty could result in the catastrophic failure of the replacement and extreme pain and suffering for the patient. In the manufacturing of parts for aerospace or automotive, the consequence of poor quality control could result in lives lost.

DMG MORI has been meticulous in its dedication to perfection in the QA process. However, the company wanted a QA solution that would allow the operator to have more control during the AM process. While post-process quality control is beneficial in catching errors before they go to end-users, that is really all it can do. Inspection is important but usually too late to address and prevent problems. Additionally, post-process QA is:

- ▶ Time-consuming — Adjusting or remaking parts after the process is completed takes up an enormous amount of valuable time that could be spent on producing new parts.
- ▶ Expensive — More resources are expended when parts must be adjusted, remade or scrapped altogether.
- ▶ Destructive — Too often, post-process errors are irreparable, resulting in the destruction of the part in its entirety.

DMG MORI sought an in-process QA tool that would allow their customers to adapt and overcome problems before the final product was complete, saving time and resources while continuing to uphold the company's standards for helping its users manufacture reliable, safe parts.

“If you’re constantly monitoring your melt pool, you can essentially monitor each individual part without destroying it.”

Nils Niemeyer, Manager – Sales & Service, DMG MORI Advanced Solutions, Inc.

The Solution

DMG MORI worked with Sigma Labs to qualify Sigma's in-process quality assurance (IPQA®) software PrintRite3D® and begin preparing its AM machines factory supplied as "PrintRite3D Ready". Specifically, a number of melt pool issues were identified and detected, including lack of fusion and keyhole anomalies using the TEP and TED metrics in conjunction with machine learning models to register and map post process CT data. As Fred Carter, Lead Engineer at DMG MORI Advanced Solutions, stated: "This information is really good for making in-process decisions that can eliminate problem parts before they start to affect other parts on the build plate."

PrintRite3D® offered many benefits that enhance DMG MORI's QA in-process monitoring, including:

- ▶ Faster product development
- ▶ Reduced trial and error
- ▶ Minimized waste
- ▶ Minimized machine time
- ▶ Reduced post-production processing costs

In addition to these benefits, DMG MORI found Sigma's innovative melt pool monitoring to be instrumental in achieving their QA goals. Effective melt pool monitoring has allowed the company to accomplish:

- ▶ 100% batch size, non-destructive testing — the ability to monitor development without destroying the part
- ▶ Increased process reliability
- ▶ Enhanced anomaly detection — to stop bad builds in-process
- ▶ Direct information on the part rather than indirect
- ▶ Rich data output
- ▶ Advanced material development capabilities

Not only do these benefits allow DMG MORI to save its customers' time and resources while reducing damaged parts, they support the company's dedication to helping provide trusted, reliable parts their customers — and their customers' end users — can count on.

You can learn more about how DMG MORI validated the Sigma Labs' PrintRite3D technology by viewing this [on-demand webinar](#).