

# **Replicate, Adapt, Optimize: The Three Stages of Design for Additive Manufacturing**

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## **Abstract**

A pattern is emerging among companies adopting metal-based additive manufacturing (AM). In the first stage, they use AM to replicate an existing part to understand the technology's costs and capabilities. This starts to give them insight into the process and allows them to move onto the second stage wherein they adapt their designs for AM to reap more of its benefits—leveraging the design and material freedoms that AM affords. Finally, companies will shift to optimizing for AM as they gain confidence in the process while learning how to capitalize on AM to its full potential. These three stages can be effective when designing for AM, but only if expectations are carefully managed at each stage. Automotive, aerospace, and consumer product examples from Penn State's Center for Innovative Materials Processing through Direct Digital Deposition (CIMP-3D) are presented to illustrate the benefits and drawbacks of each stage.