stratasys direct

WHITE PAPER
DFAM

Unlocking the True Potential of 3D Printing: Why DFAM is No Longer Optional

Introduction

Additive manufacturing (AM) has matured beyond rapid prototyping into a viable production technology across aerospace, medical, industrial, and consumer sectors. As organizations move from isolated builds into repeatable manufacturing programs, design decisions carry operational consequences.

Traditional design-for-manufacturing (DFM) methods were built around tooling constraints, draft angles, and assembly requirements. Additive manufacturing changes those rules—but it does not eliminate the need for discipline.

Design for Additive Manufacturing (DFAM) ensures that geometry, material behavior, build orientation, and finishing requirements are aligned from the outset. Without DFAM, parts may print—but they often do so inefficiently, inconsistently, or with unnecessary downstream cost.

In production environments, DFAM is not an optimization exercise—it is a stability strategy. It reduces variability, minimizes support dependency, improves structural performance, and prepares designs for scalable, repeatable additive manufacturing. This whitepaper outlines a structured approach to DFAM that supports not only better parts, but production ready outcomes. This whitepaper explores:

- What DFAM really means and why it matters now more than ever
- Practical ways to optimize for polymer additive technologies
- How DFAM can reduce cost, time, and risk
- What it looks like to design with success in mind—from concept to production

The Additive Shift—and the Design Disconnect

For decades, engineers optimized parts for injection molding, CNC machining, casting, and other subtractive or tooling-based processes. These methods shaped assumptions about manufacturability — draft angles, uniform wall thickness, part segmentation, tooling access, and assembly constraints.

Additive manufacturing operates under a different set of physical realities.

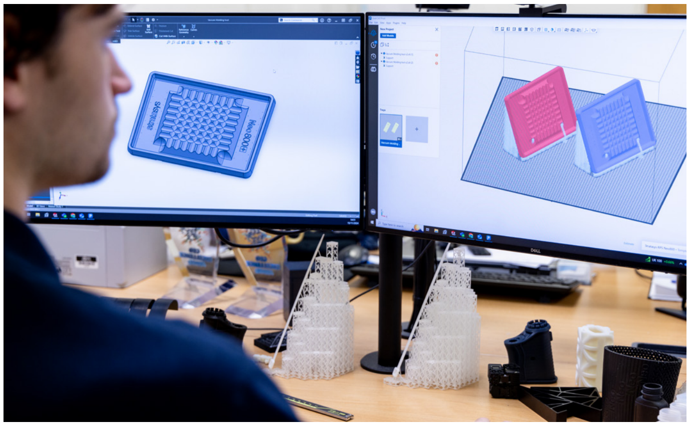
Layer-by-layer fabrication reduces many geometric constraints and enables internal channels, lattice structures, and part consolidation that would be impractical using traditional methods. It also makes low-volume and distributed production more viable.

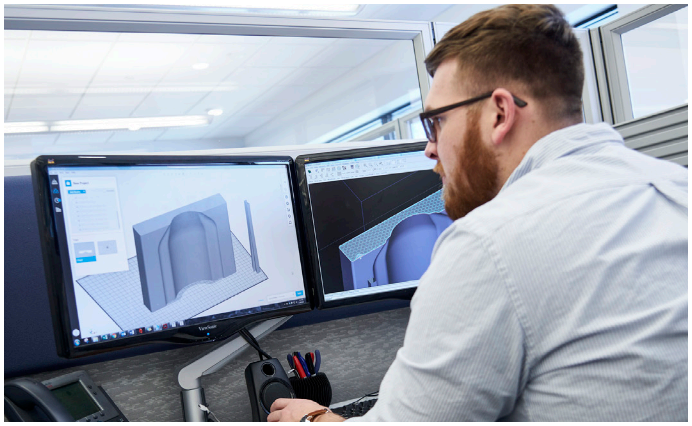
Yet the shift in process capability has not always been matched by a shift in design approach. When legacy DFAM assumptions are carried into additive workflows, the result is often inefficiency:

- Excessive supports that increase labor and cost
- Poor build orientation leading to anisotropic weaknesses
- Overbuilt geometry that negates material savings
- Missed opportunities for consolidation or weight reduction

In production environments, these inefficiencies scale.

Design for Additive Manufacturing (DFAM) addresses this disconnect by aligning geometry, material behavior, and process capability from the outset — treating additive not as a fallback manufacturing option, but as a primary production strategy.





What is DFAM?

What is DFAM?

Design for Additive Manufacturing (DFAM) is the practice of designing parts specifically for additive processes—with full awareness of material behavior, build orientation, support requirements, and post-processing implications.

It goes beyond exporting a CAD model to a printer. DFAM rethinks geometry, structure, and function to:

- Minimize support material and print time
- Improve part strength and performance
- Optimize for layer-by-layer fabrication
- Enable consolidation and weight reduction

Like any manufacturing method, additive performs best when the design is aligned with the process. DFAM ensures that parts are not only printable—but efficient, durable, and ready for real-world use.

At Stratasys Direct, we specialize in polymer additive technologies, which each come with unique DFAM considerations. From fused deposition modeling (FDM) and stereolithography (SLA) to powder bed fusion and photopolymers, DFAM practices help extract the most from each platform.

Below is a reference guide for each technology:

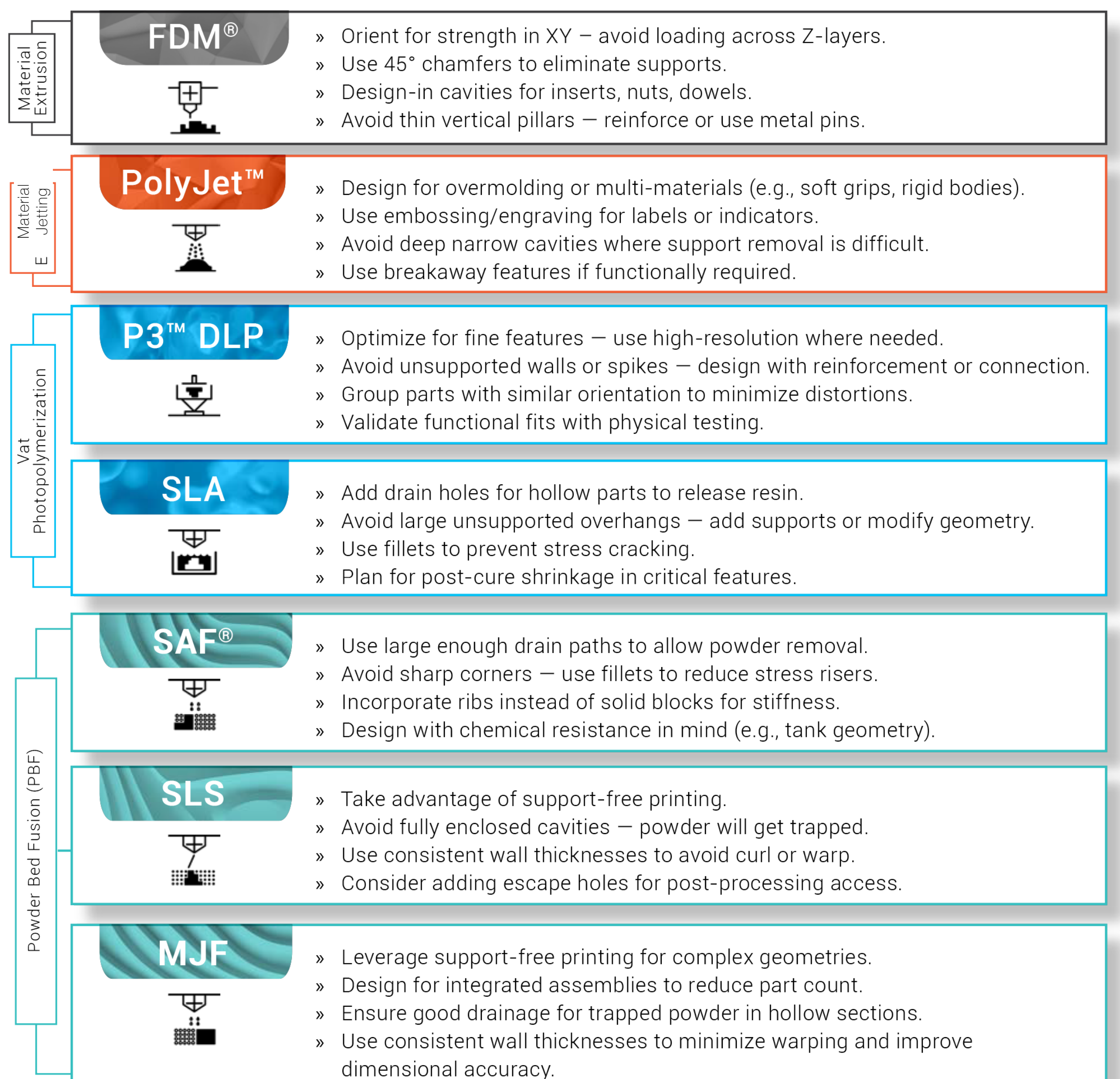


Figure 1: Breakdown of DFAM principles for each 3D printing technology available at Stratasys Direct

Why DFAM is No Longer Optional

Adopting additive manufacturing without DFAM is like using a CNC mill but skipping the CAM setup. The machine may run but the results are inconsistent, inefficient, and difficult to scale.

Without DFAM, 3D printed parts are:

1. More expensive than necessary
2. More prone to build faitures or warping
3. Over-reliant on support structures
4. Structurally underperforming due to poor orientation

In isolated prototype builds, these issues may appear manageable. In production environments, they multiply.

Design inefficiencies increase material consumption, extend build times, complicate post-processing, and introduce dimensional variability. As volume increases, these variables impact cost stability, throughput, and repeatability.

Conversely, parts that are designed with additive in mind typically:

- Print faster and with less material
- Require minimal support structures
- Exhibit improved mechanical consistency
- Transition more smoothly into repeatable production workflows

And for production parts, DFAM isn't just helpful—it's essential. It enables:

- Part consolidation that reduces assembly steps
- Customization without tooling investment
- Weight reduction for performance and energy savings
- More predictable unit costs as volume increases

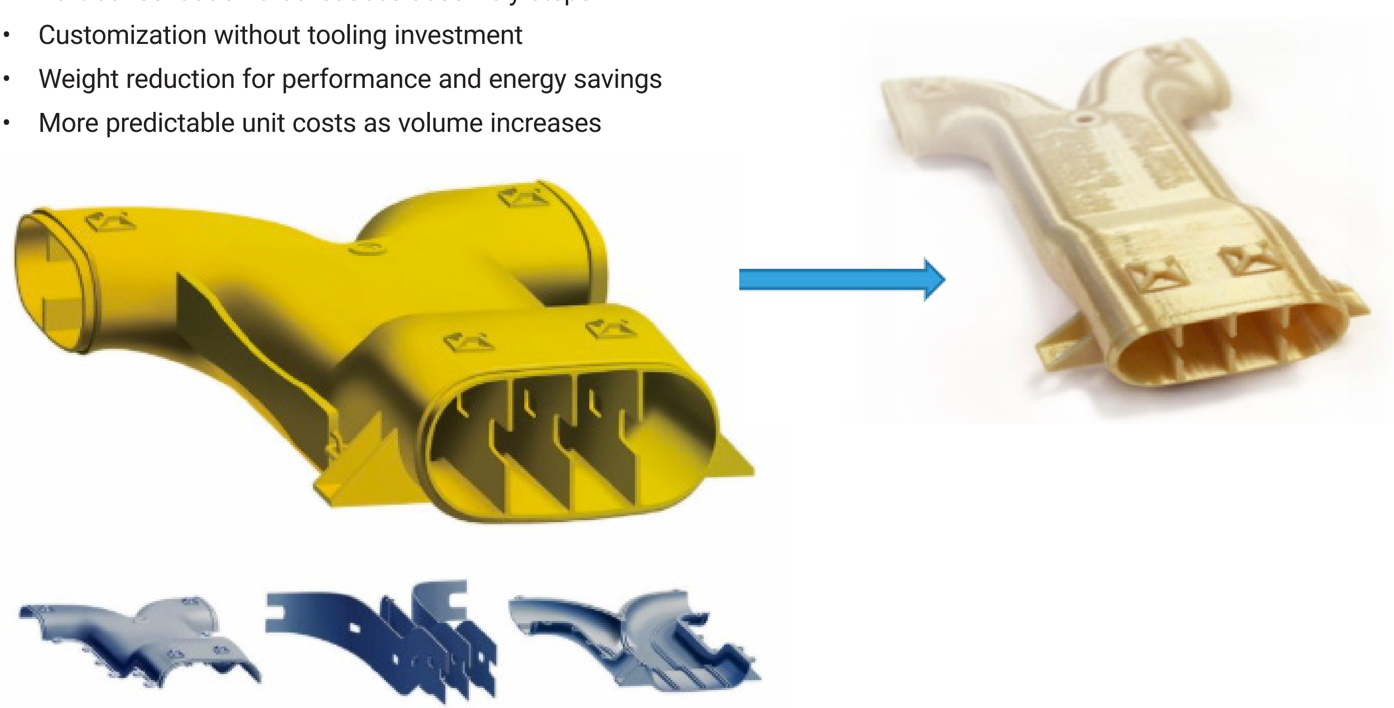
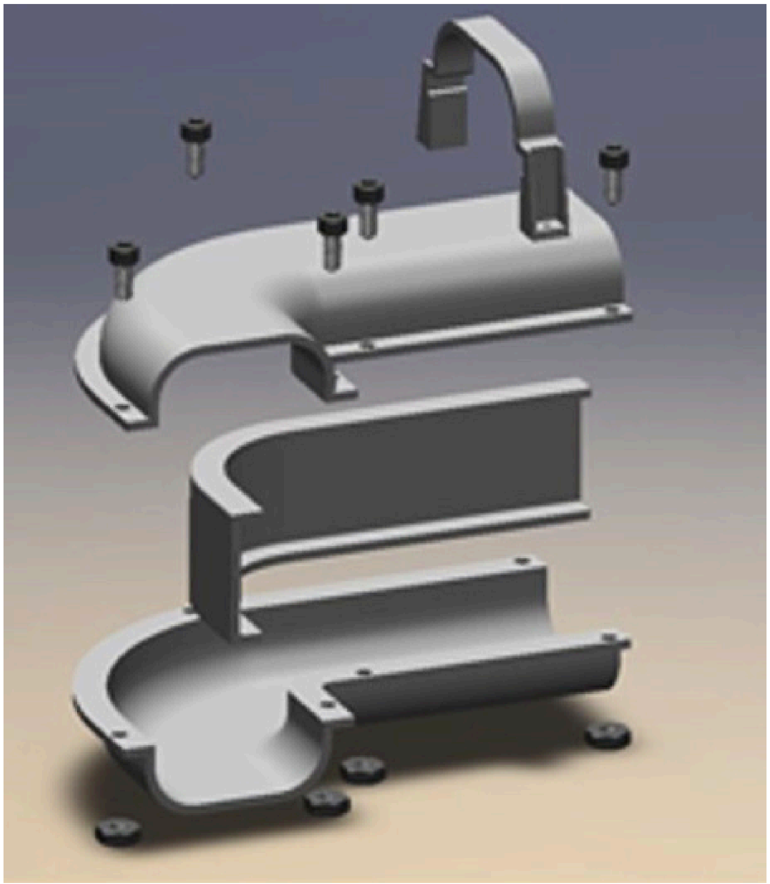


Figure 2: Idea 1

Designs can be easily simplified through consolidation of solid bodies/parts when design intent allows.

- Reduces number of componets
- Minimizes operator risk during assembly
- Eliminates some post-processing steps
- Increases design freedom
- Integrates fastening features



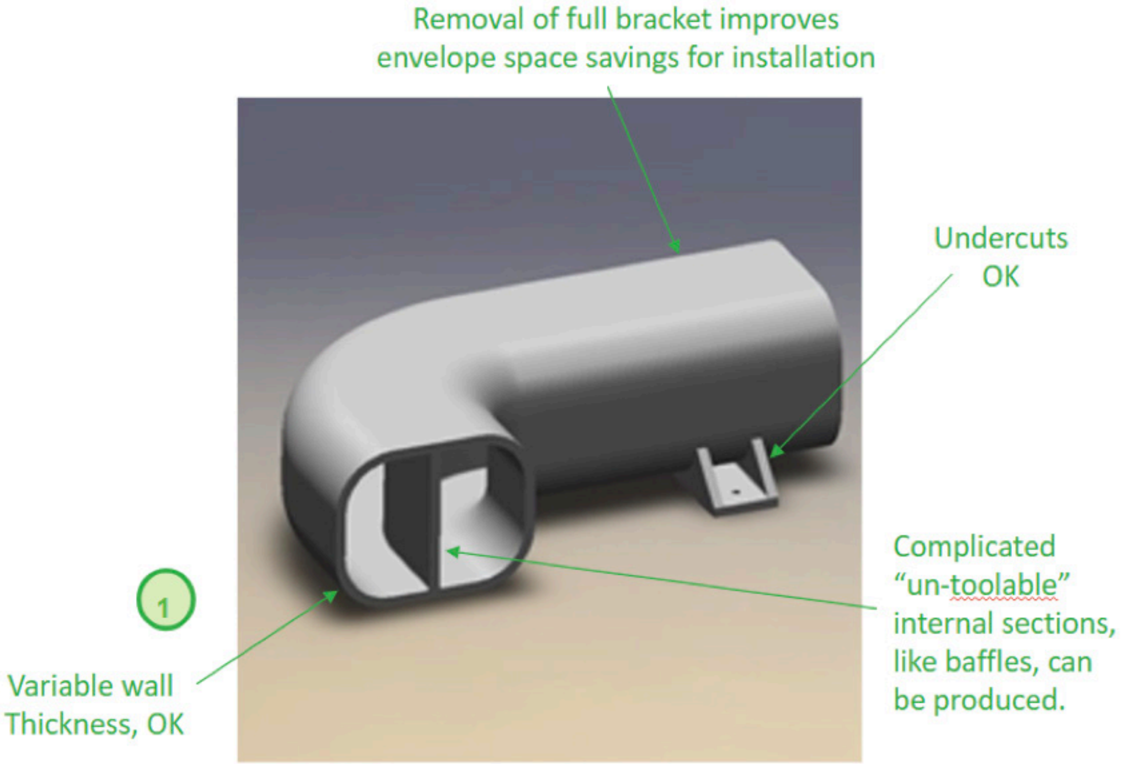
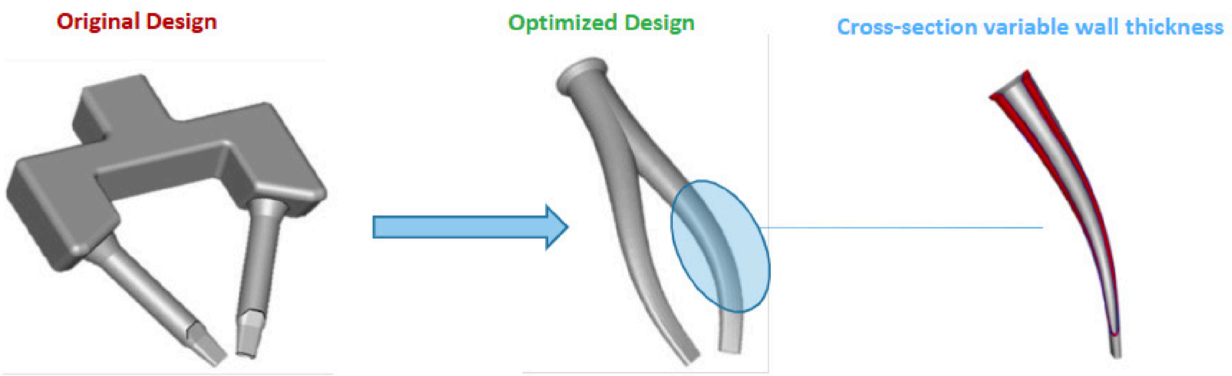


Figure 2: Idea 2

Ergonomic One-for-One Design

Material Type	Original Design	Optimized Design
PolyJet Gray	115 grams	24 grams
FullCure 705 (Support material)	73 grams	37 grams
Build Time	3.4 hours	1.3 hours



The example below shows a drill guide where part volume is reduced using a lattice. The part volume is reduced by 35%

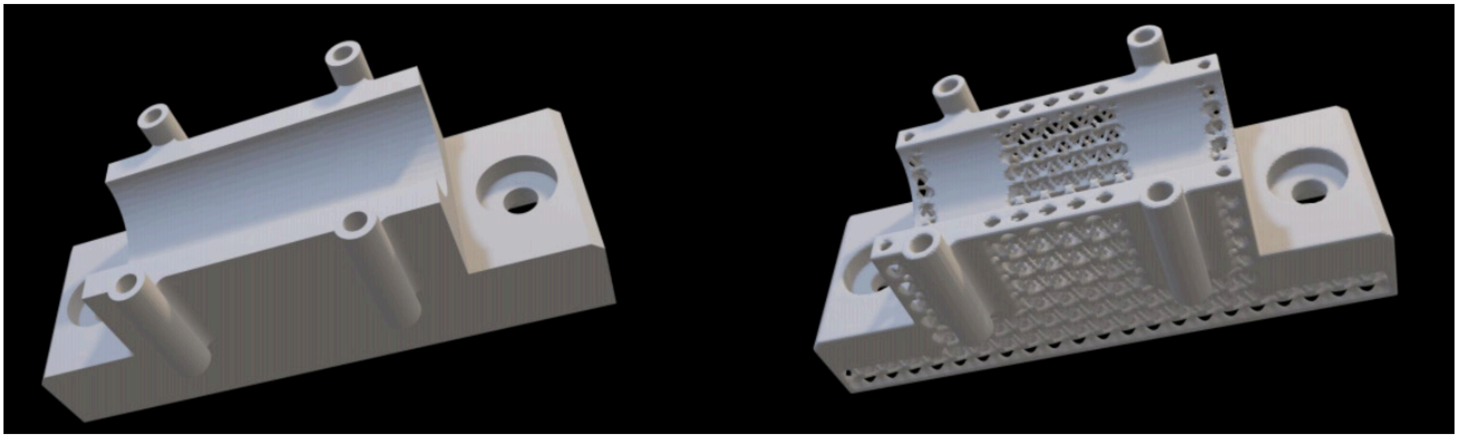


Figure 4: Idea 4

Applying DFAM in Practice: From Optimization to Operational Stability

The value of DFAM extends beyond creative geometry. In production environments, it functions as a discipline — aligning design intent with process capability to reduce variability and downstream inefficiencies. Effective DFAM strategies focus on practical, measurable outcomes:

1. **Designing for Mechanical Consistency**

   Build orientation, wall thickness, and feature placement directly affect strength and dimensional performance. Designing with layer behavior in mind improves structural reliability and reduces rework.

2. **Reducing Support Dependency**

   Strategic orientation and geometry refinement minimize support structures, shortening build time and simplifying post-processing.

3. **Consolidating Components**

   Additive enables the integration of multiple parts into single assemblies. This reduces fasteners, tolerance stack-up, and potential failure points — particularly valuable in aerospace and industrial applications.

4. **Optimizing for Post-Processing**

   Design decisions influence finishing effort. Accounting for machining allowances, surface requirements, and vapor smoothing effects early prevents costly redesigns.

5. **Enabling Scalable Builds**

   Parts optimized for additive tend to build more consistently across batches. This consistency supports stable cost-per-part modeling and smoother transition from prototype to production

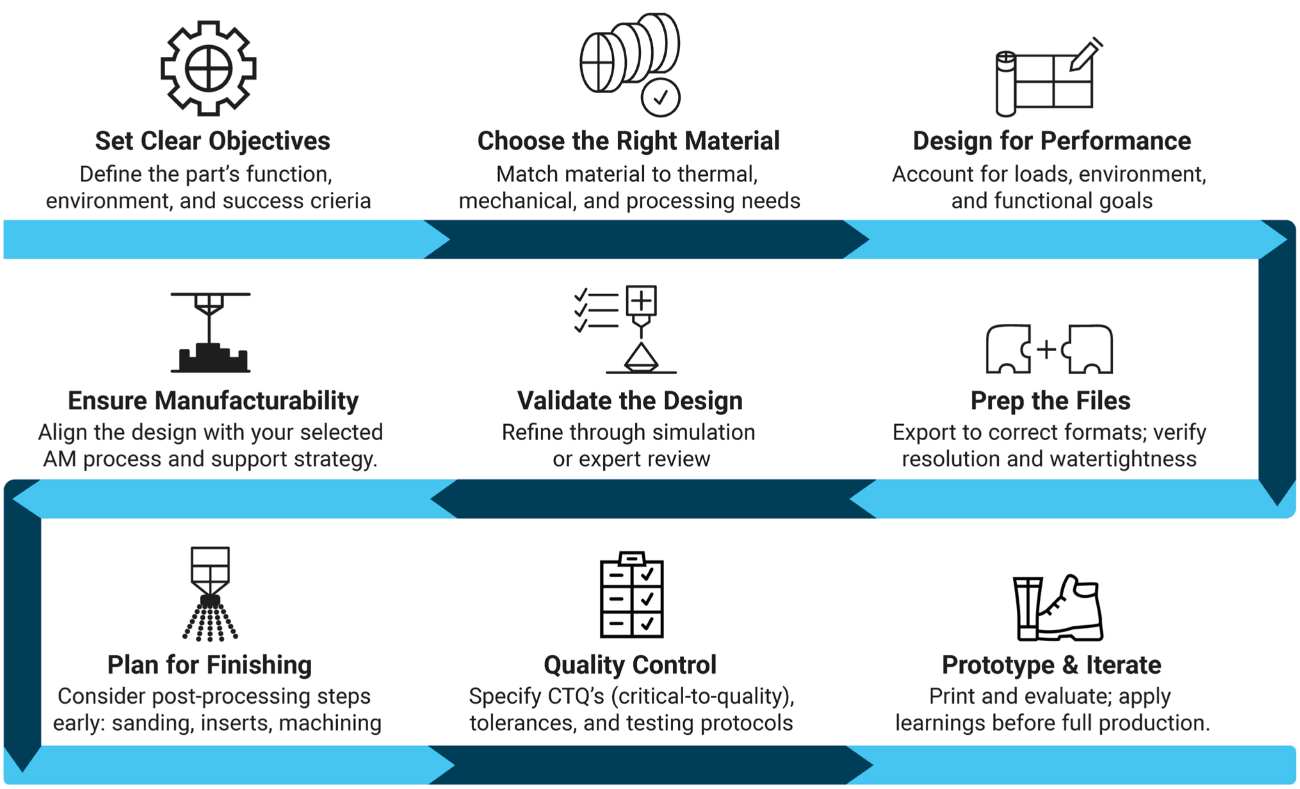
When applied systematically, DFAM improves more than part performance—it stabilizes additive workflows and prepares programs for repeatable manufacturing.

DFAM Roadmap: Step by Step to Success

DFAM is most effective when applied systematically rather than reactively. A structured approach reduces design variability, aligns engineering intent with process capability, and supports smoother transitions from prototype to production.

The roadmap below outlines a disciplined framework for integrating DFAM into additive workflows — ensuring that design, material selection, finishing considerations, and quality planning are aligned early in the development cycle.

When implemented within a controlled manufacturing environment, this approach supports repeatable builds, predictable cost modeling, and scalable additive production programs.



In regulated or high-requirement applications, elements of this roadmap may align with formal validation protocols such as First Article Inspection (FAI), PPAP, or IQ/OQ/PQ activities, depending on program requirements.

DFAM in Practice at Stratasys Direct

With more than 30 years of additive manufacturing experience, Stratasys Direct supports customers from early-stage design through regulated production environments.

Our DFAM engagement typically includes:

- Cross-technology evaluation to align geometry with the most appropriate additive process
- Material selection based on mechanical performance, environmental exposure, and application requirements
- Orientation and support optimization to improve repeatability and reduce post-processing variability
- Finishing-aware design refinement to ensure cosmetic and functional requirements are met
- Alignment with documentation and quality systems in regulated environments

This structured approach allows design intent to transition more smoothly into scalable additive manufacturing.

Headlight

Made of Three Parts

Build Time	FDM 1 day, 15 hours, 2 minutes
Material	ABS/ASA
Cost to Print	Material cost - $15 Material plus running cost* - $167
CNC Cost	$2,076
Savings	92%

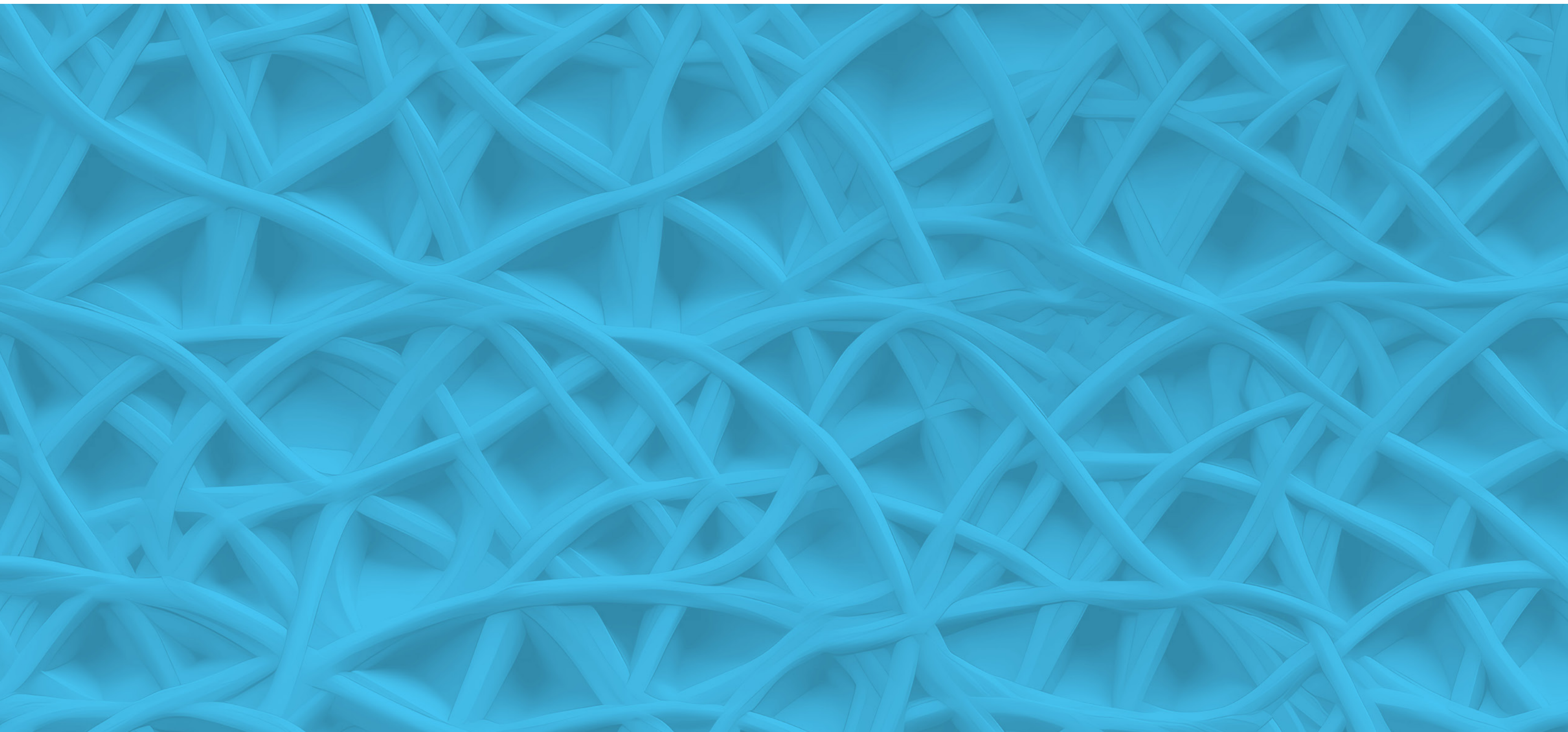
*Includes printer depreciation plus annual service contract. Labor cost is excluded.

DFAM in Practice at Stratasys Direct

Ergonomic Hand Braces

- Traditional: CNC + molding = 5-week lead time
- Additive: Custom braces printed on demand
- Bonus: Digital inventory, same-day customization

Build Time	FDM 1.5 days
Material	ABS-M30™
Cost to Print	$176
CNC Cost	$420
Savings	58%



From Profitability to Peformance

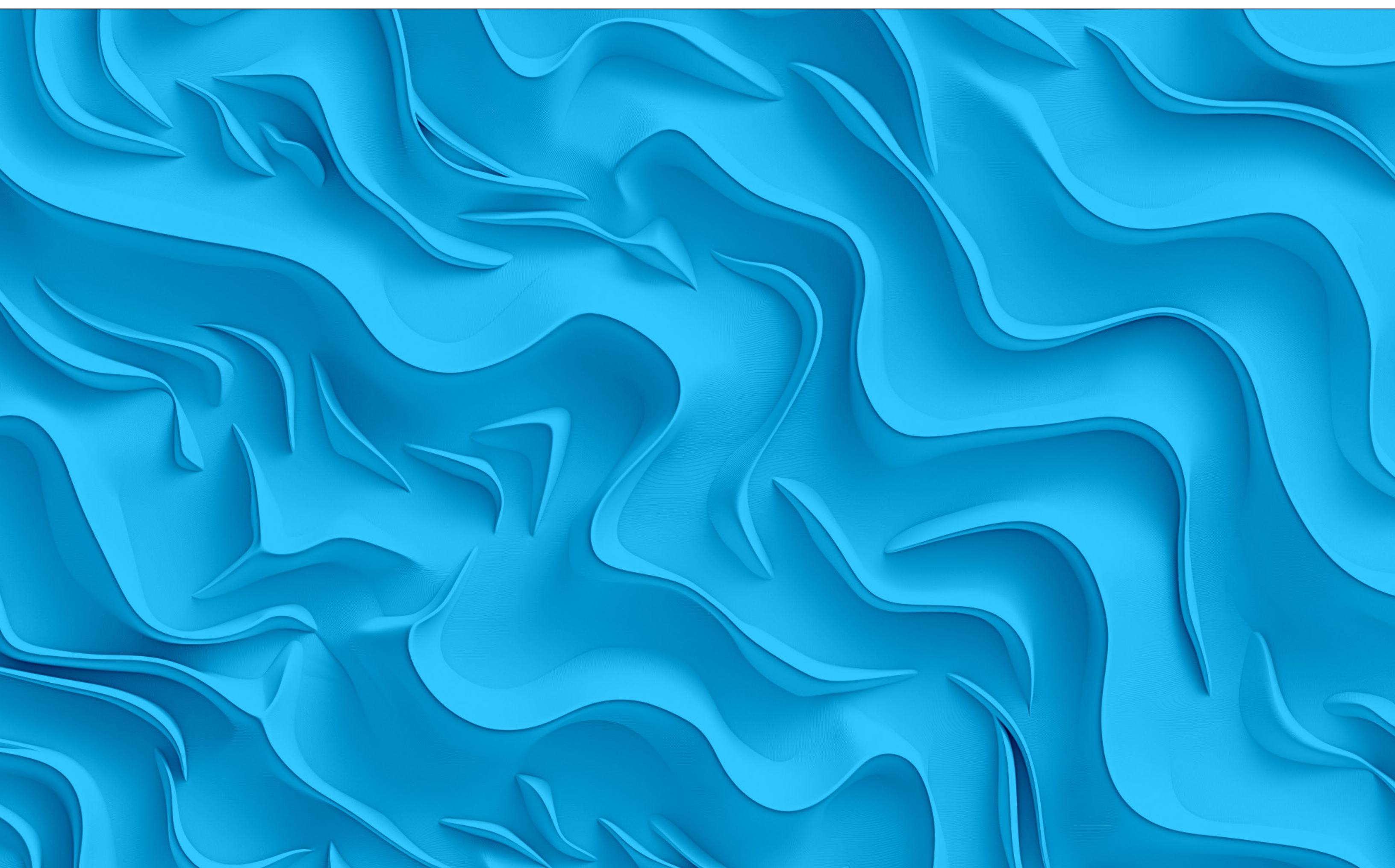
Additive manufacturing allows parts to be produced without tooling — but that flexibility does not eliminate the need for disciplined design.

Whether developing early prototypes or preparing for production, DFAM ensures that geometry, material behavior, orientation, and finishing considerations are aligned from the outset.

When applied consistently, DFAM reduces inefficiency, improves mechanical reliability, and supports smoother transitions as programs evolve.

Additive manufacturing performs best when design and process are treated as a unified system.

To explore how structured DFAM can support your additive initiatives, contact us.



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