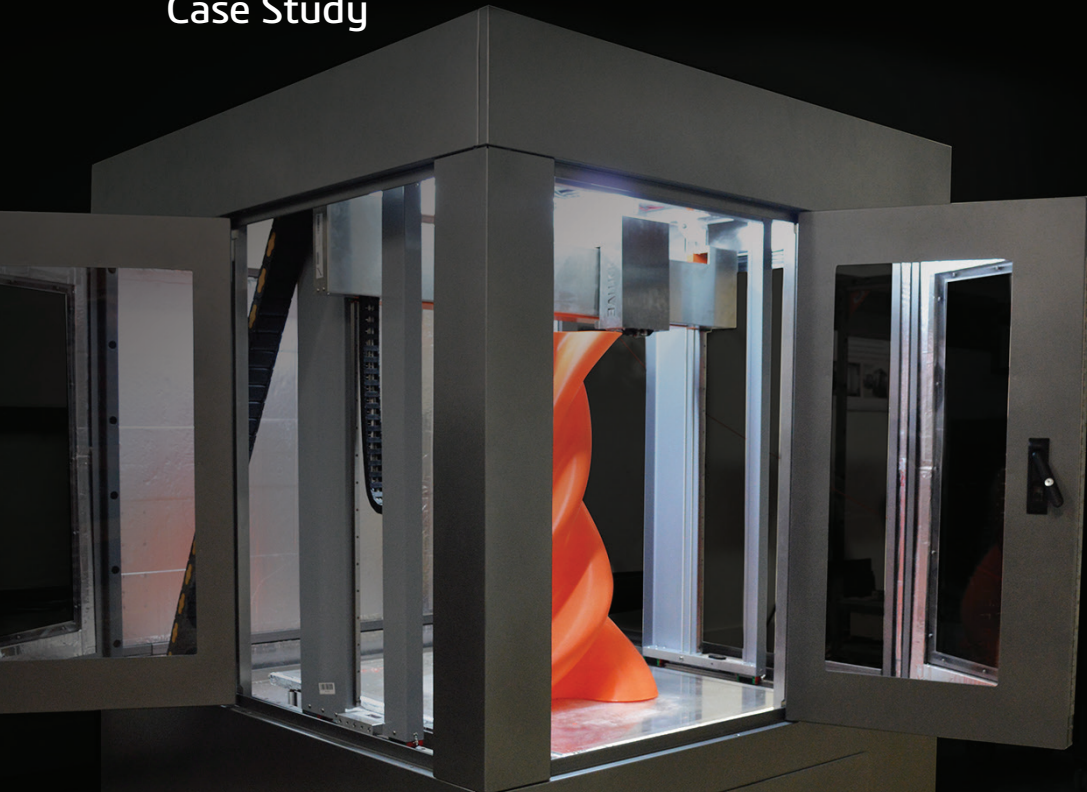# COSINE ADDITIVE, INC.
ADVANCING LARGE-FORMAT INDUSTRIAL 3D PRINTER DEVELOPMENT WITH SOLIDWORKS
Case Study

Cosine Additive relied on SOLIDWORKS design solutions to develop the AM1, the first large-format 3D printer with a big enough build envelope to fabricate highly functional components like kayaks and aircraft wings.

Challenge:

Streamline and accelerate the development of large-format, industrial-scale 3D printing and additive manufacturing systems while continually advancing, refining, and improving printer ease of use, innovative system features, and overall performance.

Solution:

Implement SOLIDWORKS design software and leverage the solution for initial and ongoing additive manufacturing system development.

Results:

- Shortened modeling time by factor of three
- Cut subassembly design time by 50 percent
- Reduced manufacturing costs
- Decreased printer time-to-build by 25 percent

Founded in 2014 in Houston, Texas, by Jason Miller and Andrew McCalip to establish the 3D printing industry's first industrial-scale additive manufacturing platform, Cosine Additive, Inc. has continued to advance its large-format 3D printing technology. The company's goal is to continue pushing and refining the development of large-scale additive manufacturing systems until they become economically competitive with and preferable to traditional production technologies for many manufacturing applications.

The first version of Cosine's AdditiveMachine1 (AM1), which was designed by a team using SOLIDWORKS® 3D design software, overcame the proprietary printing materials paradigm that was established by competitors because the large-format 3D printer is not dependent on proprietary materials. Instead, it can utilize a range of polymers and polymer/carbon fiber blends to create 3D prints. Achieving this objective was paramount for the company because it represented the first step toward extending the usefulness of 3D printing technology beyond rapid prototyping and into actual component manufacturing. Cosine's open materials, open software, and modular platform approach drastically decrease the financial barrier to industrial, large-format additive manufacturing.

Since Cosine's initial accelerated R&D effort launched the first version of the AM1 in 2015—making it the first large-format 3D printer with a big enough build envelope to fabricate highly functional components like kayaks and aircraft wings—Cosine has added and developed numerous improvements to the AM1, continuously working and experimenting to find innovative features and breakthroughs that enhance the system's utility for large-scale manufacturing. The AM1's ability to produce quality prints in a cost-effective and time-efficient manner also makes it the perfect tool for creating jigs, fixtures, and other manufacturing implements.

The company chose to use SOLIDWORKS 3D design software for initial and ongoing additive manufacturing system development because Cosine needs a highly efficient, cost-effective 3D development platform to help streamline and accelerate R&D, design, and manufacturing. After establishing that modeling is three times faster with SOLIDWORKS than with similar systems, reducing subassembly design time by 50 percent, and that SOLIDWORKS is easy to use, Cosine implemented SOLIDWORKS and continues to use the solution to advance large-format additive manufacturing system development.

> "With SOLIDWORKS, we have been able to reduce our time-to-build cycle by 25 percent. In addition to our ability to design quickly in SOLIDWORKS to rapidly incorporate custom design modifications in each machine, we've created a bunch of Visual Basic® macros to automate various tasks in SOLIDWORKS, which saves us additional time."
>
> — Jim Thompson, Lead Designer

"As our system development has advanced, Cosine has become focused on improving and customizing the AM1 machine to meet specific customer applications," explains Lead Designer Jim Thompson. "We are no longer focused on building off-the-shelf printers and leverage SOLIDWORKS to constantly update, refine, and improve our design, which is why the printers that we build today are customized to specific customer needs."

ACCELERATING PRINTER DEVELOPMENT, CUTTING PRODUCTION COSTS

Using SOLIDWORKS design software, Cosine has accelerated its ongoing printer development while simultaneously reducing production costs, because of the ease of making design modifications with SOLIDWORKS. "Now that our AM1 machine has become an engineered-to-order solution, we simply must have a development platform that enables us to create new designs, approaches, options, and enhancements as quickly as possible, so that we can continue to improve and refine large-format 3D printing technology," Thompson notes.

"For example, we've replaced all of the X- and Y-axis rail components, which used to utilize ball screws, with linear motors because it's easier and faster to assemble the machine that way without negatively impacting performance," Thompson adds. "Without SOLIDWORKS, it would take a lot longer to make wholesale changes like this."

IMPROVING EASE OF USE, PERFORMANCE

While the purpose of many of the design changes that Cosine has made to the AM1 was to bring manufacturing costs down, many others were promulgated to improve the AM1's ease of use and performance. "Every time that we build a machine, we improve it, and many of those improvements make the system easier to use, perform better, or easier to maintain," Thompson stresses.

"On the last machine that we built, we added capabilities to utilize additional materials for additive manufacturing," Thompson continues. "SOLIDWORKS allows us to make these changes quickly and cost-effectively. The primary SOLIDWORKS tools that we use are weldments, sheet metal design, and mold development tools. With SOLIDWORKS, we've been able to make these improvements while simultaneously reducing the total number of parts in the AM1, which benefits Cosine and our customers."

SLASHING PARTNER TIME-TO-BUILD CYCLES

Now that Cosine is customizing each of its machines—adopting an engineered-to-order approach to machine development instead of designing standard products—the time required to engineer and build each machine, the time-to-build cycle, has become an important metric of success and satisfying customer orders quickly. "With SOLIDWORKS, we have been able to reduce our time-to-build cycle by 25 percent," Thompson says.

"In addition to our ability to design quickly in SOLIDWORKS to rapidly incorporate custom design modifications in each machine, we've created a bunch of Visual Basic macros to automate various tasks in SOLIDWORKS, which saves us additional time. We never build the same machine twice, and SOLIDWORKS is helping us improve quality and performance with every machine that we make."
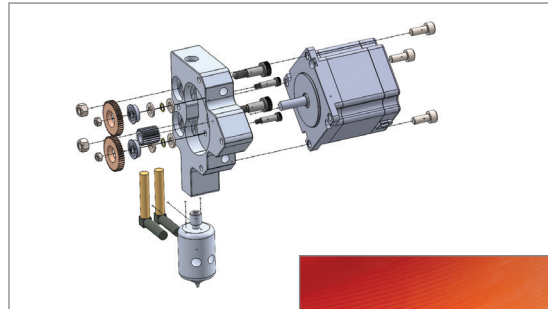
Using SOLIDWORKS design tools, Cosine Additive is improving every aspect of its large-format 3D printer, such as the extruder assembly shown at top, and customizing machines for specific client applications, such as the large threads shown in close-up below, all while reducing machine time-to-build cycles by 25 percent.

Our **3D**EXPERIENCE® platform powers our brand applications, serving 11 industries, and provides a rich portfolio of industry solution experiences.

Dassault Systèmes, the **3D**EXPERIENCE Company, is a catalyst for human progress. We provide business and people with collaborative virtual environments to imagine sustainable innovations. By creating 'virtual experience twins' of the real world with our **3D**EXPERIENCE platform and applications, our customers push the boundaries of innovation, learning and production.

Dassault Systèmes' 20,000 employees are bringing value to more than 270,000 customers of all sizes, in all industries, in more than 140 countries. For more information, visit **www.3ds.com**.

3DEXPERIENCE®

Americas
Dassault Systèmes
175 Wyman Street
Waltham, Massachusetts
02451-1223
USA

Europe/Middle East/Africa
Dassault Systèmes
10, rue Marcel Dassault
CS 40501
78946 Vélizy-Villacoublay Cedex
France

Asia-Pacific
Dassault Systèmes K.K.
ThinkPark Tower
2-1-1 Osaki, Shinagawa-ku,
Tokyo 141-6020
Japan

DS DASSAULT SYSTEMES | The **3D**EXPERIENCE® Company