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CASE STUDY
FDM + SAF

Creating a One-of-a-Kind Car

Making low-volume auto production possible with 3D printing.

In 1914, a buyer of Henry Ford's Model T automobile could choose any color they wanted – as long as it was black. Ford's reason for a single-color, cookie-cutter car probably had a lot to do with the efficiency of mass-producing a product with few options.

But not everyone wants the same car as their next-door neighbor. That's where CALLUM, a UK design house, comes in. Founded by Ian Callum CBE, former Director of design for Jaguar Cars, CALLUM designs and engineers highly specialized autos, the likes of which you probably won't see in your local supermarket parking lot.

Exclusivity and Intrigue

The highly unique and exotic cars made by CALLUM and other specialty automakers cater to a particular clientele. They pay a premium for these vehicles, often having a direct say in how they're crafted. However, despite a client's ability to pay high prices, there are limits, and the carmaker still has boundaries on cost and lead time.

In fact, the challenge facing low-volume specialty car makers like CALLUM and others is meeting the customer's requirements while managing costs. They don't have the luxury of mass-produced, high-volume products that benefit from economies of scale, justifying the high initial capital outlay required to produce them. The tooling to make these cars often reflects a sizeable investment. But when it's needed for only a few vehicles, it's a cost not quickly recovered by the manufacturer.

One of CALLUM's latest projects involved a car steeped in exclusivity and intrigue. The C-X75 was previously used as a stunt car in a premier spy thriller movie, with only several being produced. CALLUM's client wanted the car to be brought up to more comfortable driving standards, which meant a complete interior retrofit. Doing that in a reasonable amount of time, without breaking the bank, meant considering alternatives to conventional manufacturing.

The finished interior of the C-X75.

Finding the Answer With Additive Manufacturing

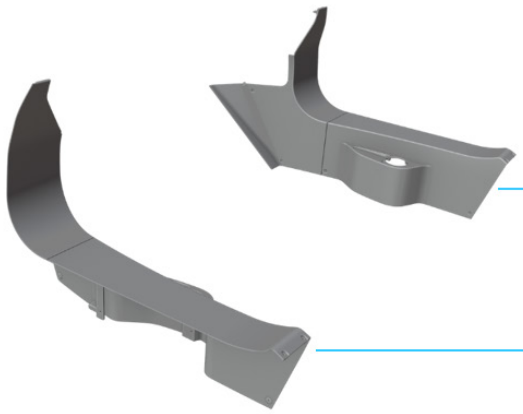
Interior parts printed using SAF technology.

It was clear to CALLUM engineer Charlie Stamp that relying on conventional tooling wasn't a viable option to meet cost and timeline goals. The traditional way would involve making parts with composite lay-up, and each unique part would need its own fabrication tool. All of this would drive cost and consume time.

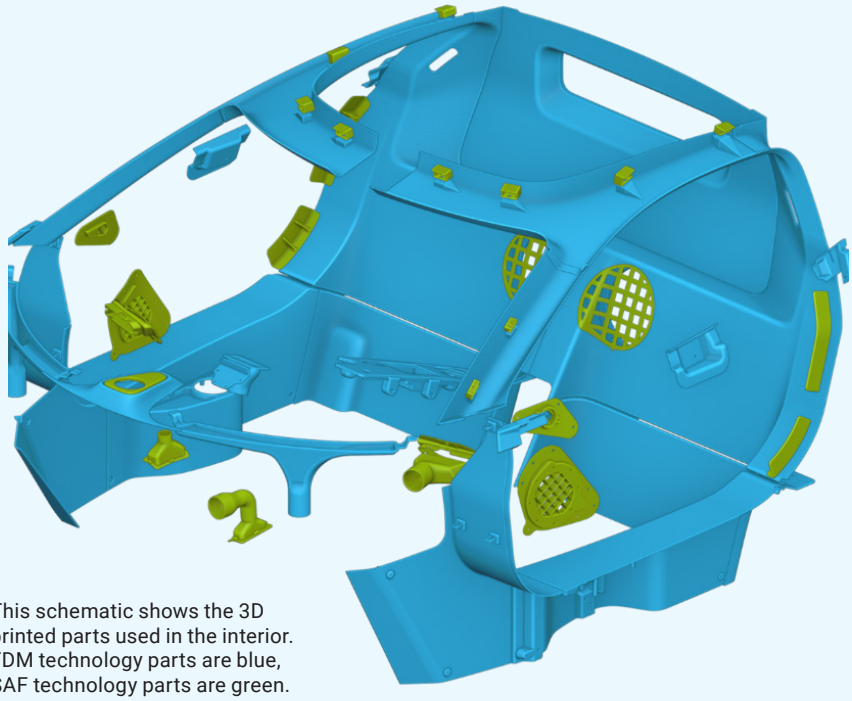
Stamp had prior experience with 3D printing through earlier projects, although on a relatively limited scale. "We had experimented with 3D printing to some extent, primarily producing basic ABS components," Stamp explains. However, the C-X75 project – engineered specifically for the demands of cinematic stunt work – presented a more complex challenge. A key design priority was to ensure that the interior enhancements were both lightweight and structurally robust.

Had Stamp chosen a conventional approach using composite materials, it would have required the creation of additional B-surface components to mount and secure the interior elements within the vehicle. These parts would have added unnecessary weight, increased production time, and escalated costs. This prompted Stamp to fully embrace 3D printing, challenging conventional methods by asking, "How can we change the process—how can we do things differently, and how far can we push this?"

His solution was to leverage the design flexibility of additive manufacturing alongside the lightweight, high-strength capabilities of FDM® and SAF® (Selective Absorption Fusion®) technologies. "With 3D printing, we were able to incorporate intricate design elements into the interior that would have been far more complex and time-consuming using traditional machining and layout methods," Stamp explains.



Lower door sills printed using FDM technology.



This schematic shows the 3D printed parts used in the interior. FDM technology parts are blue, SAF technology parts are green.

Hidden 3D printed parts in the C-X75's interior. Blue indicates FDM technology and green shows the parts made with SAF technology.

Leveraging the Benefits of FDM and SAF Technologies

One particular C-X75 3D printing application Stamp highlights was accommodating the customer's wish for a premium audio system. The sound system of choice included two large subwoofers. The question for Stamp was how to mount them in the car while providing the right design envelope to optimize their performance.

Stamp picks up the story, "We didn't know how to mount these subwoofers and give them the box envelope they need to perform as they should. We ended up 3D printing the mounting box for them, which is great, because we could pick up a lot of fixing points to get the fitment correct."

These boxes are usually made from wood to achieve the proper amplification. However, Stamp felt FDM® Nylon 12CF, a carbon-fiber material, had the lightweight but high-strength properties needed to support the heavy subwoofers. In the end, that bit of creativity proved successful, allowing the speakers to perform as advertised with no adverse sound feedback. "The box has been great. There's no reduction in the performance of the subwoofers. They've been absolutely brilliant," says Stamp.

In addition to using FDM technology, all the B-surface engineering mounts for the car's dash components were printed using SAF technology. This powder-bed process provided a good solution for the complex geometries of the clips and other mounting features used to assemble the dash panels. "The reason for [using] SAF on that was the complexity of the shape. The towers were all slightly formed to reach around certain corners," says Stamp, adding that the SAF parts had the necessary structural rigidity to maintain the required shapes, thanks to SAF technology's excellent isotropic properties.

A speaker surround made with FDM technology.

"With [3D] printing, you just change the design, click print, and you're good. It's very adaptable."

Charlie Stamp
CALLUM engineer

Simply a Better Approach for Custom Auto Production

Would the customer still have bought the C-X75 had it been upgraded using conventional means? Maybe. But when you're a specialty automaker competing in a small, niche market, you do whatever you can to accommodate your customer – including managing cost and delivering on time. And to achieve those goals, there's really no other solution than additive manufacturing.

3D printing's efficiency advantages result from several factors, and one that shouldn't be overlooked is design freedom. If tooling needs modification because the parts don't fit quite right, difficulties arise. 3D printing, on the other hand, offers time-saving flexibility. Stamp agrees, "With [3D] printing, you just change the design, click print, and you're good. It's very adaptable," he says. 3D printing's cost savings compared to traditional manufacturing for this application are also a boon.

"It's certainly a cheaper process in terms of the limited production runs and a quicker process, without a doubt," Stamp adds.

When asked if the team will continue to use additive manufacturing, Stamp quickly replies in the affirmative. "Certainly, we're already doing it again – 100%. And the more we can do it, and with more confidence that the part's going to last, the more we'll jump on board. It suits us perfectly," says Stamp.

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