New Era of Reverse Engineering Fuels Growth of Design Services Firm

by Anna Turnage

It's every entrepreneur's dream: Growing a customer base ten-fold over the course of a decade, going from three to 13 employees, and progressing from a regional to an international firm. That's the story of Advanced Design Concepts (ADC), the Pewaukee, Wisc., engineering design firm owned and operated by Mark Schaefer.

Schaefer says he owes much of his success to reverse engineering. No, not the reverse engineering that was once the bane of the U.S. electronics industry; the process of disassembling a stereo or TV to see how it works, then figuring out a way to make it faster and cheaper in mass quantities. Nor is it reverse engineering software that is difficult to use, often provides inaccurate results, and takes highly trained professionals to operate.

The new wave of reverse engineering, sometimes called 3D photography, entails scanning a 3D object and automatically processing it into a watertight surface that can be transferred into a CAD/CAM package or sent straight into a CNC machine or other type of manufacturing device. The software that enables the process is Geomagic Studio from Raindrop Geomagic in Research Triangle Park, N.C.

Less Time and Money

Schaefer's firm started out 10 years ago as a regional CAD/CAM service bureau using Pro/ENGINEER software. The three-person firm attracted some major clients, including Briggs & Stratton, Mercury Marine and Harley-Davidson

"We weren't doing any reverse engineering when we started," says Schaefer. "And the CAD business was doing well. But since that time there's been such a huge revolution in computer and software technology. It has opened up a whole new world of possibilities for us in reverse engineering."

Schaefer's first experience with reverse engineering software was hardly encouraging. "It's really hard to grow your business with that type of software," he says. "It was difficult to use. It took days to get a model right, and even then the accuracy wasn't as good as I would have liked."

That all changed after Schaefer discovered Geomagic Studio software during a web search. "It was two-thirds the cost of the other software we were using for reverse engineering," he says. "And it was incredibly easy to use and learn. In fact, I hired a

high school student to run the software. That's a lot of the reason we can grow. It has changed the recipe for the type of people we need."

The software automated the reverse engineering process so much that Schaefer was able to charge less for some services. "In some cases this software has allowed us to finish a project 10 times faster," he says. "Now I can call customers and quote them a price that they can live with. Before, I might have had to quote them $10,000 for one project because it would have taken days in production time. But now I can quote $1,000 or so for the same project because we can do it in hours."

A Small Business Takes Off

ADC can now offer services to help small business people such as Jay Sadowski get their businesses off the ground. Literally, in the case of Sadowski.

A former Milwaukee art teacher and avid ultra-light pilot, Sadowski makes hand-carved foam airplanes in the shape of animals. He discovered the formula for his product, called Creature Gliders, while working with students in an art class. He decided to start selling the airplanes on Internet toy stores. He received a contract to sell Creature Gliders to a promotional advertising company, which meant he had to be able to produce more of them in less time.

"The shape of the gliders is very hard to reproduce," Sadowski says. "They have to be perfectly symmetric on each side to be aerodynamically correct."

ADC took a handmade model of one of the gliders and scanned one side with an ATOS white-light scanner. Surfaces for the resulting point-cloud data were generated in Geomagic Studio and exported as a standardized IGES NURBS model that came within a thousandth of an inch of the original model.

"We never even went to a traditional CAD program to make this model," Schaefer says. "We could get what Jay needed right in the Geomagic program. Jay can make his Creature Gliders from that file without the trial and error that used to be required to get both sides exactly symmetrical."

Sadowski sends the Geomagic surface file to a CNC milling machine to carve out the metal cavity of the gliders. The foam is then pumped into the cavity to complete the model. In addition to saving time, the process helps Sadowski avoid wasted materials from trying to match the two sides by hand.

"This is the first time I've ever had an exact match for both sides," he says. "Of course, if both sides aren't symmetrical the glider won't fly. So, the old process would often lead to product failure."

Sadowski has made 300 gliders in one month using this method, compared to the 50 or so he was able to make by hand in the same amount of time. He says the surface created in Raindrop will help him duplicate his toy airplanes more quickly for the promotional advertising company. He also eventually wants to start shipping the gliders to toy stores across the country.

One-of-a-Kind Electric Guitars

Precision is crucial in Joe Driskill's business. Driskill makes all of his electric guitars by hand. Before hooking up with ADC, it often took days of sanding and cutting expensive wood to ensure each guitar had the exact shape, sound and quality his customers expect. He needed a way to cut the errors out of the process to get his guitars finished in time to deliver to his clients, many of whom are well-known rock musicians.

Driskill turned to ADC to create computer surface models of the deceptively complex guitar bodies. Geomagic Studio made it possible for ADC engineers to take output from the scanned 3D data of an original guitar, capture the texture and shape, and process the data as an IGES file that can be used over and over again. With the file, Driskill is able to manipulate the angles and measurements in a CAD program and cut the guitar bodies in a vertical mill machine with great precision.

"The resulting data output was accurate to 0.005 inches, whereas the traditional method we used would have resulted in an accuracy rate of 0.20 to 0.30 inches," Schaefer says. That accuracy pays dividends throughout the production process according to Driskill.

"I can determine the exact angle of where the neck needs to be," he says. "This is an all-important angle because it determines the string height and playability of the guitar. I can also measure exactly where the bridge needs to be. This is a critical distance as it determines the intonation (how well it stays in tune)."

Beyond accuracy, the software saved Schaefer's staff several days in production time. "Using Geomagic, the process was condensed from three or four days to four hours," Schaefer says.

Duplicating a Legacy

It's not just new clients that benefit from ADC's new process. ADC has also been able to use this new generation of reverse engineering for one of its oldest clients – Harley-Davidson motorcycles.

ADC's early surfacing efforts helped streamline the production process for Harley's Dyna Wide Glide gas tank, but it was still tedious work to get the models within the accuracy range required by Harley-Davidson. Geomagic Studio enabled ADC to deliver the CAD integration, accuracy and flexibility that Harley-Davidson has been seeking for its legacy parts.

The process starts with Harley-Davidson sending Schaefer an assembly-ready Dyna Wide gas tank. It takes two days to prepare the tank and scan it with the ATOS scanner. The 3D point cloud data is brought into Geomagic Studio, converted to a polygonal model, then a NURBS model, and exported as a watertight IGES surface for manufacturing. The process takes a few hours, compared to three or four days with ADC's previous surfacing tool.

In the final step, Pro/ENGINEER is used to add parametric features such as mounting brackets to the model. The entire process takes four days. The surface accuracy of the model comes within 0.003-inch of the original gas tank. It's the level of quality that Schaefer has sought since he first began working with Harley-Davidson.

Besides saving time and money, ADC's work has given industrial engineers such as those at Harley the freedom to go back to what they do best.

"These guys are used to working with clay to make models," says Schaefer. "Geomagic is allowing them to go back to doing that instead of learning how to manipulate a difficult CAD program, which they're generally not as good at doing."

The New Way to Reverse Engineer

Whether it is seen as a new form of reverse engineering or 3D photography – the process by which you "photograph" a 3D object and automatically process it digitally as one would film from a camera – this new technology clearly has the potential to generate new businesses and transform traditional ones.

At ADC, the growth continues without the traditional pain often associated with it. Schaefer recently added five full-time employees dedicated to using Geomagic Studio software.

"The new evolution in reverse engineering is going to change the way a lot of companies do business," he says. "It has certainly changed the way I run mine for the better."

###

Anna Turnage is a writer specializing in computer graphics and other technology issues. She works for Cramblitt & Company in Cary, N.C.