



# The Sky's the Limit

PHOENIX ANALYSIS & DESIGN TECHNOLOGIES HELPS STUDENTS  
AIM HIGHER AT EMBRY-RIDDLE AERONAUTICAL UNIVERSITY

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*– Chris Smith, Embry-Riddle  
Aeronautical University*

## CASE STUDY



Embry-Riddle Aeronautical University student technician Kyle Bauer shows off the Dimension 3D Printers in the school's rapid prototyping lab.

## ENGINEERING TAKES FLIGHT

Nothing inspires human ingenuity quite like aviation, and Embry-Riddle Aeronautical University (ERAU), is where dreams of the “wild blue yonder” take flight for thousands of students each year. With more than 33 undergraduate degree programs – including mechanical engineering, aerospace engineering and electrical engineering – ERAU is considered one of the premier applied engineering schools in the U.S.

One crucial aspect of aerospace engineering is wind tunnel testing, to determine an object's stability and aerodynamic properties while in flight. While the computer aided design (CAD) process for creating wind tunnel models has changed little in the past 20 years, typically third-party fabricators had made 3D-designed models by hand. This extra step added days to project timelines and denied students the valuable experience of translating their designs into 3D models.

“We have been teaching CAD drawing and mechanical drawing for years, but until recently had no way to produce a model using those digital files,” said Chris Smith, laboratory manager for the College of Engineering at Embry-Riddle Aeronautical University. “We’ve been designing tools, parts and vehicles on computers for more than two decades, but we want students to go further than the design stage.”

With nearly all engineering designs now created by computer, Smith didn’t think it would make sense to keep hand-tooling templates and models. Yet, the fabrication process needed to be simple enough for engineering students – who are not skilled machinists or welders – to create on campus in a timely fashion. Learning how a CAD design translates into a manufactured part is an important “teachable moment” for students, helping them understand how tolerances and fit are crucial to making aeronautical parts.

“We had been carving wind tunnel models by hand from mahogany wood, but we soon realized we needed our own machine so we could do it quickly and inexpensively,” said Smith.

### Precision and Durability

Smith and his team first purchased a different 3D printer, but soon discovered the limitations of working with a less-than-durable output material, designed for use in displays and architectural models rather than manufactured parts.

“We purchased a machining device that used an inexpensive plaster-type material for its models,” Smith said. “But we realized it wasn’t ideal for what we wanted to do – the rough surface finish wouldn’t work for accurate wind tunnel testing, and the material itself was too flimsy for making functional parts.”

Smith began investigating a variety of other 3D printing solutions and learned about the Dimension 3D Printer through Phoenix Analysis and Design Technologies (PADT), a local specialist in mechanical engineering services and rapid prototyping solutions. Smith and his team sent several CAD files to the company, which produced samples using durable acrylonitrile butadiene styrene – or ABS plastic and brought them to a meeting at ERAU. ABS material is often used in industrial applications because of its superior hardness, gloss, toughness and electrical insulation properties compared to other types of plastic.

“We place a heavy emphasis on the need for precision when we design parts for aircraft and spacecraft,” said Smith, “and how every piece we create needs to maintain the tightest tolerances in order to fit and function properly. ABS material is ideal for this sort of precision because making adjustments or finishing touches doesn’t involve machine tools or metallurgy.”

Just a few months after purchasing the Dimension, Smith and his staff purchased a second Dimension 3D Printer – a 1200es – not only because the original machine was being used 24/7, but also because ERAU must stay up-to-date on the most advanced technology in all areas of instruction. Smith is a third Dimension 3D Printer to his department, in order to keep up with demand.



Embry-Riddle Aeronautical University students use Dimension 3D Printers to build scale models for wind tunnel testing, like this model aircraft.

The Dimension 3D Printers remain one of the most popular “attractions” in the engineering department, fascinating prospective students and campus visitors alike. The machines are so popular that Smith has had to limit student use to “essential” projects.

“3D printing is an essential part of our design capstone coursework in aerospace engineering, and the technology stimulates students to draw and design in CAD much more effectively,” Smith said. “While it’s pretty tempting to make some fun things, we don’t allow people to use the Dimension 3D Printers for anything but prototyping and model-building. We want to keep it our secret or every department at the University would be clamoring to use it.”



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