ALTIUM DESIGNER BOOSTS SMALL SATELLITE DESIGN PRODUCTIVITY TO NEW HEIGHT

In the Student Space Programs Laboratory (SSPL) at Pennsylvania State University, undergraduate as well as graduate students get to create real, working space systems, some of which actually get launched on their missions. The hands-on projects give students the experience of working through a complete design cycle, from overall system specs to detailed board layouts and mechanical design and assembly.

" The ease of use and integration of Altium Designer allows system densities previously unachievable with our student-staffed projects. "

Tyler Boehmer, SSPL Programs Manager, Pennsylvania State University

In certain ways, supporting a student-staffed engi¬neering project can bring out the best and worst in a design tool suite. If tools are difficult to use, they not only frustrate new engineers, but also stand in the way of completing assignments within academic semesters. If the tool doesn't support an entire design cycle, students and instructors may never achieve a complete, working system. On the other hand, design tools that are easy to use and comprehensive help students to focus on the techniques and skills they need to acquire to be successful in their careers.

The design tool suite at SSPL that helps young engineers to launch their careers is Altium Designer.

The Problem

SSPL students enjoy the opportunity to design, fabricate, and integrate space systems. Their hands-on projects apply classroom knowledge to real world, interdisciplinary projects. Design auto¬mation plays a critical role in helping the predominately under-grad workforce successfully complete sophisticated assignments.

For example, the OSIRIS-3U CubeSat mission combines sytem-level, electrical and mechanical design efforts to create a com-pact satellite that will aid in the study of space weather. Once launched, OSIRIS-3U will provide in situ (immediate vicinity) and remote sensing measurements of the spatial characteristics of stimulated (heated) ionosphere to better understand variable space weather conditions and phenomena. These measurements will be correlated with ground-based measurements to further specific research interests of NASA, the US Navy, and other space weather researchers.

SSPL projects proceed under the guidance of three grad students and the contributions of nearly 70 undergrads. In prior projects, the teams used OrCAD for electronic designs."The OrCAD systems were slower and more difficult to use," explains Tyler Boehmer, the programs manager for SSPL. The usability challenges of the design software made it very difficult for incoming undergrads to learn.

Its long learning curve and non-intuitive workflow resulted in frequent errors that had to be caught and corrected by more senior engineers. So how did the OSIRIS-3U project ever make it off the ground? SSPL reached out to Altium Designer.

The Solution

"Switching to Altium was a breeze—the online tutorials are very effective, and the wiki pages are wonderful," says Boehmer. As a result, projects are completing considerably faster and the quality has improved.

With Altium Designer, new students can self-train very quickly, in many cases designing schematics within a few hours of first sitting down at the workstation. While the typical user continues to learn more and more of the tool's deep functionality, it does not overwhelm them all at once. New designers gain confidence by seeing successful results, not error messages and crashes.

The common parts library is another major reason why mistakes are down and productivity is up at SSPL. The lab has imported parts directly from suppliers such as Mouser. The

grad students have customized this capability to meet the specific system requirements of their space-borne projects.

For board design, SSPL has found Altium Designer's Footprint Wizard critical for making sure all of the physical package footprints are correct for the students. "It only takes a minute to create new footprints," says Boehmer. "For a laboratory of primarily undergraduate students that are prone to these kinds of mistakes, this has resulted in a noticeable drop in board layout errors and more time spent actually designing circuits."

The use of AltiumLive also makes it easier to support many students with a dozen seats of Altium Designer in SSPL. When a user logs into the design suite, AltiumLive automatically pulls preferences from the cloud and configures that workstation to the user. "I go online through AltiumLive and connect to our licensed server, which is very convenient," explains Boehmer. "It's great having all my preferences in the cloud."

When electrical designs are complete, integration of all the design tools in Altium Designer further accelerates the design process. For ex¬ample, the Footprint Wizard also creates 3D models that have made mechanical fit checks significantly easier. Cou¬pled with this wizard, the Supplier Links function helps to ensure that the inexperienced users are using and ordering the correct approved parts. Boehmer has also added a custom BOM template that takes into consideration the varying component costs due to quantity; saving time in projects in which SSPL must track costs. Students can also easily apply simulation for signal integrity analysis, and export 3D designs for mechanical design using SolidWorks.

The Results

Helping the students to spend more time designing, and less time chasing down and correcting mistakes, is "allowing system densities previously unachievable," reports Boehmer.

After successfully building and testing a prototype, SSPL is well on its way to completing the engineering models for the OSIRIS-3U satellite. They are confident that its on-orbit operation will be adaptable and flexible, designed to cap¬ture emergent phenomena under control of a command uplink, and to coordinate with ground-based stations doing related measurements. In fact, SSPL has submitted a proposal to NASA for a flight opportunity for OSIRIS-3U in 2015.

With the success of the OSIRIS-3U project, SSPL meets two important objectives of NASA. By simulating the energy of solar events connecting with the Earth's atmosphere, it addresses NASA's Strategic Goal 2.2 "Understand the Sun and its interactions with Earth and the solar system." Additionally, the heavy involve¬ment of students throughout the project directly supports NASA's Education Outcome and Objective Hierarchy Objectives 1.1–1.3.

By helping the students of SSPL meet these objectives, the project proves that Altium Designer's ease of use and integration are really out of this world.

Product Information

The OSIRIS-3U CubeSat project uses a customdesigned small satellite working in collaboration with ground stations to study space weather. Its on-orbit operation is adaptable and flexible because the OSIRIS-3U satellite can be commanded, via com-mand uplink, to focus on emergent phenomena and facility ca¬pabilities. OSIRIS-3U data will be coordinated with ground-based stations doing measurements such as incoherent scatter radar. OSIRIS-3U has been proposed for a flight opportunity in 2015.

About the University

The Student Space Programs Laboratory (SSPL) at Pennsylvania State University allows undergraduate and graduate students the opportunity to design, fabricate, and integrate space systems. SSPL provides the students hands-on projects to apply classroom knowledge to real world, interdisciplinary settings. SSPL students experience working through a complete design cycle and must develop a systems engineering mind-set in addition to their component-level experience.

Altium