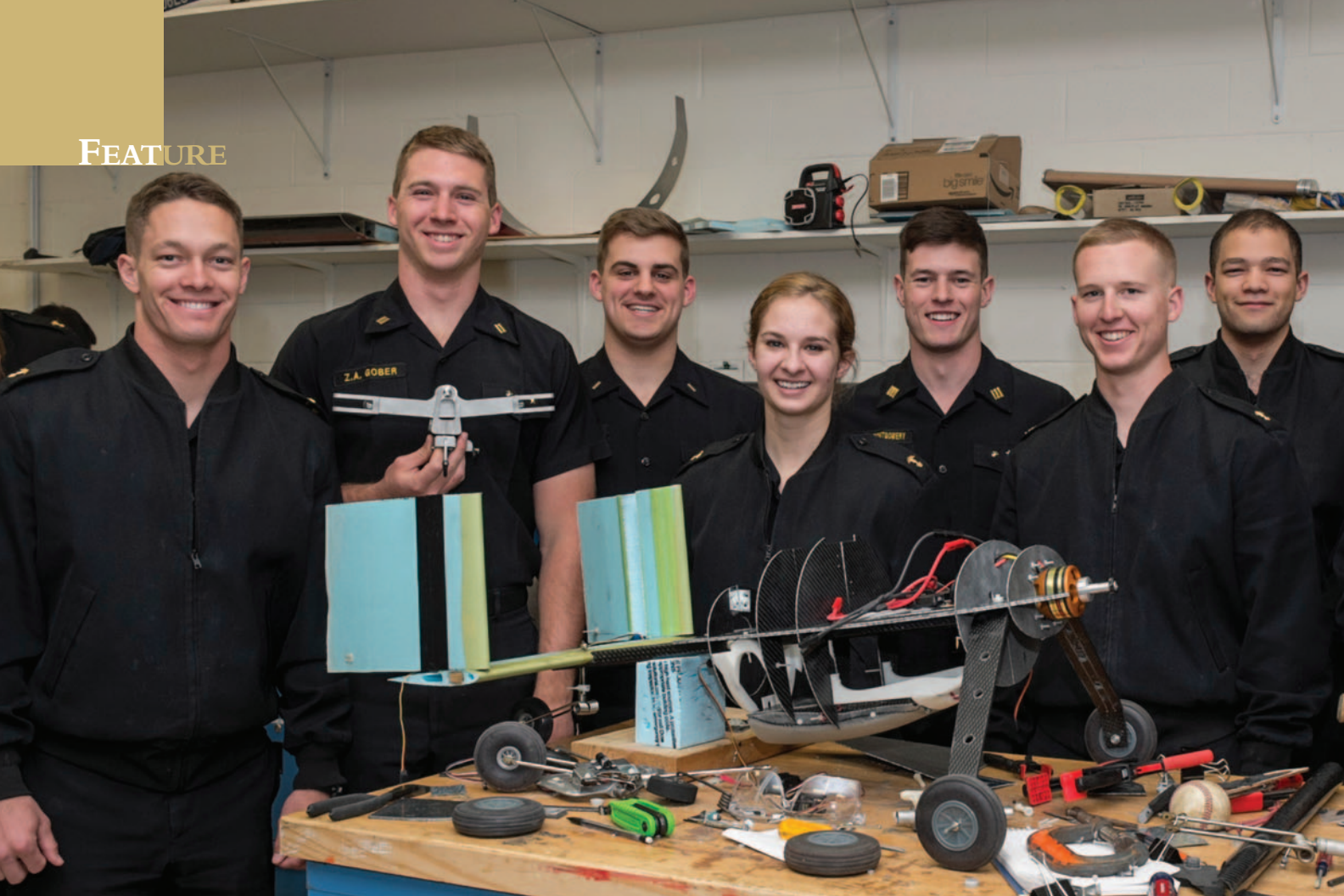




Members of the Design/Build/Fly team supported by Sikorsky with their unmanned aerial vehicle (UAV). Photo by Debbie Latta

No Substitute for Experience:

Project-Based Learning Boosted by Corporate Sponsorship

By Ellen Ratrie Ternes

WHEN ENGINEERING & WEAPONS DIVISION MAJORS BECOME FIRST CLASSMEN, MANY OF THEM SPEND THAT FINAL YEAR WORKING ON A CAPSTONE PROJECT, A PROJECT-BASED LEARNING EXPERIENCE THAT PUTS THEM TO THE TEST IN WHOLE NEW WAYS.

Taking the textbook knowledge they've developed since plebe year and honing new skills as fundamental as using a screwdriver or as detailed as preparing complex presentations, teams research and design real-world projects, many that could go on to help the Navy and Department of Defense.

"It's where the rubber hits the road," said aerospace engineering major Midshipman Spencer Marsh '15. "We have to take the theory we've learned the past three years and actually build something that flies," or moves through the water, or directs energy or creates a model for future military vehicles.

"Project-based learning is different from the classes where they've been sitting lined up, taking notes," said Eric Hallberg, Ph.D., chair of aerospace engineering department. "The midshipmen are on the lab deck, working on the computer, working with technical experts. They have to use teamwork to manage data and complexity of information, as they'll have to do in the Navy."

But these projects require funding, and in 2012, reality threw up a roadblock. Following the sequestration that cut budgets across the federal government, funding for the Academy's project-based learning program was severely cut. "Virtually every senior design project was forced to be scaled back or unable to be completed," said John Rudder '78, the Naval Academy Foundation's director of corporate and foundation relations.

"Here were all these really creative things going on with midshipmen, but they didn't have the money to fund the projects," Rudder said. That's when he and the Foundation set out to find outside sponsors to help project-based learning maintain the Academy's margin of excellence.

Less than two years later, several major corporations, including Boeing, Sikorsky and Booz Allen Hamilton, are helping to fund or supply equipment to capstone projects and other project-based learning opportunities. It's proving to be a good relationship for midshipmen and the sponsors.

The midshipmen learn what it means to work for a customer. They must make well thought-out proposals to potential sponsors, then present their results at the end of the year. They also get to interact with some of the people in the industry who are doing similar work.

"We guide the mids to make something that's useful to the customer, that meets the customer's needs," said Commander John Stevens '93, USN, a member of the electrical engineering faculty and mentor to a team sponsored by aircraft manufacturer Boeing. "Boeing has given us the resources to buy parts and components to meet their specifications."

"They want us to understand what engineering is in the real world, the time it takes to come up with a valuable project," said Midshipman Clay Petty '15, a team leader of the Boeing ACES-T capstone project.

Mick Maurer '82, senior vice president for strategic projects for United Technologies Corporation, parent company of Sikorsky, believes the company's sponsorship this year of a rotary wing research team will provide the midshipmen with valuable practical experience. "It's always good to have something removed from standard book learning, to think about how these things work and to integrate a lot of experience."

But Maurer also sees long-term benefits for Sikorsky, an aircraft manufacturer best known for its helicopters. "For us, it's a two-way exchange. We see this as a way to make a connection with the next generation of aviation leaders in the Navy and Marine Corps, to connect with some of the people who will be out in the field and whose lives depend on our equipment. It's a win-win."

On 22 April, engineering and weapons teams presented their capstone projects in Rickover Hall. Here is a glimpse of three projects.

Laser Dynamics

Objective: Beam power to a UAV to keep it airborne indefinitely
Sponsor: Booz Allen Hamilton

It might not be long before an unmanned aerial vehicle (UAV) will be able to deliver that pizza you just ordered. Companies like Amazon and Google are already working on drone delivery, but today's battery-powered UAVs can fly only limited distances. The UAV might run out of juice before it can drop your pepperoni and cheese on your doorstep.

That has this capstone team of three electrical engineering majors asking, "What if you could remotely power a UAV so it can stay airborne indefinitely?" After scouring the web and finding few people studying the question, the team decided to explore how laser power could be transmitted from ground stations to keep UAVs flying as long as necessary.

"People have proven power beaming can work," said team member Midshipman Josh Forgacs '15, "but I think we have a unique application for it—delivery using existing infrastructure like cell phone towers."

There was one big problem, said Midshipman Leo Anderle '15, the team's tech guy. "To do what we wanted required material we didn't currently have."

"It's a really challenging problem," said Commander Charles Hewgley, USN, one of the team's professors. "You have to

start out with a high-powered laser and specialized panel. It's expensive equipment."

Rudder made some contacts at Booz Allen Hamilton, who said they'd be interested in hearing about the project. The team put together their best pitch, presented it to Booz Allen, and, said Anderle, "I guess we said the right things." Booz Allen offered to provide funding and mentorship for the project, including helping the team acquire a high-powered laser they needed to test their theories.

Their capstone project has been a learning experience in more ways than the midshipmen had imagined. While their faculty advisors oversee the project, the midshipmen have to ask the questions, use the right methodology, follow a rigorous schedule of reports and presentations, and figure out how to make their team successful.

The team has learned to use each other's strengths. Forgacs calls himself the "PR guy," the one who gets on his cell phone to find what the team needs. Anderle is the go-to guy for the complicated technical stuff and Midshipman Vicki Rand '15 is the one who thinks outside the box and makes sure the team meets its obligations.

Assistant Professor Charles Nelson '96 is a laser specialist and the team's technical advisor. "My job is to ask them 'Did you think of this?' But the midshipmen have owned this project. They've made my job easy."

The midshipmen also have had the benefit of interacting with Booz Allen experts. "We have to present to them," said Anderle. "We've been able to develop contacts, to establish a back and forth,"

The team's project is too big to finish this year, but they think they've laid a great foundation for the next capstone team.

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And they think their project-based learning has given them new skills for their futures.

"It's been one of the most rewarding things I've ever done," said Anderle, who will go into submarines. "That's how it is in the real world, nobody holding your hand. You have to figure out what's going on yourself."

Forgacs, who's going into the Marine Corps, said "A lot of what I'm going to be doing for my Marines as an officer is making sure they have what they need. I'm a far more resourceful person as a result of this experience, more able to think unconventionally about something we need."

And they recognize that Booz Allen's sponsorship has been the critical factor in their project. "We literally could not have done this without formal sponsorship," said Forgacs.

Design/Build/Fly (DBF)

Objective: Build a remotely controlled rotor wing aircraft

Sponsor: Sikorsky

Sikorsky's sponsorship of a capstone team's project to build a remote-controlled rotary wing unmanned aerial vehicle (UAV) is as good a fit for Sikorsky and the Navy as it is for the midshipmen.

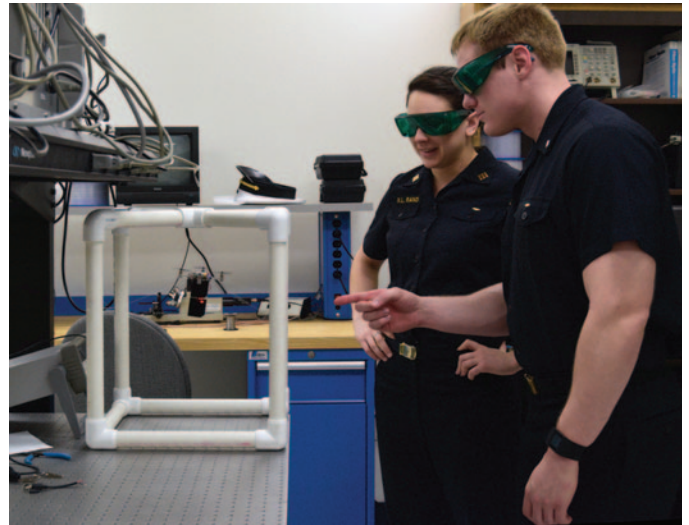
"One of the reasons we're especially interested is the prevalence of rotary wing aircraft in the Navy," said. "Fifty percent of the aviator community will be flying rotary wing."

For the past two years, Naval Academy teams have been competing in the Defense Agency Research Projects Agency (DARPA) Innovation Challenge. The Sikorsky sponsorship is helping one of this year's teams design and build an aircraft that could win the DARPA competition and give the rotating wing community some new ideas.

"The midshipmen have to pick their own mission. It has to be innovative and have impact," said Aerospace Engineering Visiting Professor Scott Davids '90, the team's faculty advisor. "They came up with the mission to build a remote-controlled vehicle that can deliver a five-pound load five miles and return."

Team leader Midshipman Spenser Marsh '15 described their vehicle as a mix of fixed wing and rotary. "It's not a helicopter, and it's not an airplane." The nine-member team, likewise, is a mix of midshipmen who have studied both kinds of aircraft. They hope to have a UAV with a six-foot diameter rotor flying by the end of April.

"This project is different from anything we've done," said Marsh, who was selected to be a Marine ground officer. "This is our first experience with real money, working with mechanical



A team supported by Booz Allen Hamilton is exploring how lasers can power a UAV

people, using the skills of the people around you to produce the best product."

The team's second-in-command, Midshipman Caitie Petrofes '15, plans to follow in her father's footsteps flying Navy jets. She said working with a team for long hours, especially when things don't go as planned, is an experience that will serve her well. "It's a different culture from Bancroft Hall and the engineering hall, a different kind of leadership. We're all peers and friends, so we have to figure out how to tell people what to do without telling them exactly what to do."

The midshipmen also work with the Academy's technical master craftsmen. "It's our first time to build something, and they are our reality check," said Marsh.

"A lot of experience with capstone is tying together technology aspects with leadership," said Petrofes. "In the fleet, I'm not going to be the technical person, but I will have to interact with the people who are working on my plane."

Sikorsky will hear the team's final presentation at Capstone Day, something they are looking forward to, said Chris VanBuiten, Sikorsky's vice president of Technology and Innovation. "The midshipmen take on the technical and build challenge in a very short time. Using cell phones to direct aircraft, it's so out of the box."

"They don't know what's not possible," said Aerospace Chair Eric Hallberg. "They find ways to do things."

Sponsorship like Sikorsky's will continue to be essential as new classes move into their capstone projects. "It's not just the funding. The level of projects is raised when midshipmen

interact with someone outside the Academy,” said Davids. “There’s pressure when you brief someone from the outside. They give mids feedback they can’t get from faculty. The whole experience is taken up a notch.”

Advanced Concept Energy System-Tactical (ACES-T) Service Academy Competition

Objective: Design renewable energy system for a 2040 combat scenario

Sponsor: Boeing

It’s 2040. You have to get power to a Forward Operating Base. You don’t know where it will be, but you have to make the energy supply resilient to physical and cyber attack. And you have to use a renewable energy other than fossil fuels as the energy source.

That’s the challenge Boeing has posed to the Naval Academy Capstone and the other service academy teams competing in its ACES-T challenge.

“Boeing has given us the criteria, the constraints and key performance requirements,” said Commander John Stevens ’93, USN, assistant professor of electrical engineering and faculty advisor to the ACES-T capstone team.

It’s up to the midshipmen to design and simulate a system that solves the challenge, then build a prototype of the critical components of their solution. “It’s the largest open-ended question I could imagine,” said Midshipman Clay Petty ’15, one of two leaders of the 16-member team, which includes midshipmen from five different engineering majors. “It took us six weeks just to bound the problem before we could decide how we would approach it.”

“They’re a really enthusiastic group,” said Stevens of the team. “They have to use imagination and creativity to project what’s going to happen in 2040. What kind of technology will mature in 2040? Where can they scrounge the power?”

“I have been awestruck by how much I’ve learned working with engineers of different backgrounds,” said Petty. “We know a little about what our roommates and friends do in their classes, but it’s entirely different to see how that knowledge comes together to work toward a common goal.”

Managing the large team has been a learning experience of its own, said Petty, who will go into submarines. “On the technical side, we have to constantly know where we are on the time line. On the people side, we’ve had to learn how to balance the workload, how it interplays with everyone on the team. It will serve me well in the fleet.”

Along with their work in the lab and workshops, the team is required to make three presentations to Boeing. The Critical Design Review they presented in February earned an “Exceptional” rating. “The interaction with the Boeing team was valuable,” Petty said. “They gave us good feedback.”

In their final presentation, the ACES-T team demonstrated their prototype to the Boeing reviewers and representatives from the Navy, Army and Air Force. “They come to realize you can’t just build something without knowing where the money is coming from,” said Stevens. “Engineers like that they can innovate, make things for people. But this shows them a design process that steers you to the right solution.”

Thanks to Boeing sponsorship, the team has had what they need to create a high-level solution. “Boeing has given us the resources to buy parts and components to meet their specifications,” said Stevens. “We couldn’t do it without them.”



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