

Building a silage chopper by Virginia Tech engineers sounds easy, but not if it is for Senegal

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Sept. 2, 2015 – *Editor's note: This story was updated to clarify funding issues pertaining to the students' trip to Senegal.*

BLACKSBURG, Va., Aug. 26, 2015 - A "roller coaster ride" is how one Virginia Tech mechanical engineering student described the team's attempts to travel to Senegal, Africa, to test their innovative design for improving an aspect of the agricultural industry in the country.

The seniors were "up" when they learned they would receive some \$7,000 in travel money from the U.S. Agency for International Development to meet the people they were hoping to help.

These same technical artists were "down" when their first scheduled trip to the African country was sidelined by scheduling constraints. Simultaneously, a public panic was brewing from the Ebola crisis that was happening mostly in Sierra Leone in the fall of 2014.

From their remote laboratory in Randolph Hall, where they had logged dozens of hours on developing a prototype tool they were ready to test, the students were hearing the concerns voiced by U.S. State Department and the Center for Disease Control about travel last year to the African continent.

"But the Ebola virus never once alarmed our team or put us into any uncertainty about whether or not we would be willing to travel to Senegal," said team member **Josh Booth, of Chesapeake, Virginia**, now a graduate of industrial and systems engineering.

When **Julia Jordan of Bellevue, Washington**, a mechanical engineering student also on the team, thought she would be going to Senegal in November of 2014, she was ecstatic. "I feel like the luckiest girl in the world. What an awesome opportunity for our team," she said at the time.

But then new problems set in, and the trip was put on hold..

For Jordan and her teammates, that was devastating news. But they did not give up, and in late February of 2015 they finally boarded a plane with their design called a silage chopper. They had been provided 10 days notice that they could go, but in anticipation they had made sure they were continually up to date on all medical shots and passports.

This international senior design project, before it was even tested on site, had provided the students with numerous, invaluable real world experiences well beyond the technical components.

When they landed in Sengal, their lessons in cultural differences started.

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Their faculty adviser, [Kevin Kochersberger](#)^[2], associate professor of [mechanical engineering](#)^[3], had already made two trips to Senegal in the fall of 2013 and the summer of 2014. The idea of engineers working on agricultural technology for Senegal arose through a meeting with [Ozzie Abaye](#)^[4] agronomist in the [College of Agriculture and Life Sciences](#)^[5]. As co-principal investigator on the USAID -- Education and Research in Agriculture (ERA) project, Abaye saw the benefit of including engineers in a silage production project. Senegal has a dry season that lasts nine months, and ensiled feedstock can be critical in sustaining farm animals throughout the year.

Offered as a design project option for a team of 2014 seniors, the first silage system was what Kochersberger described as a "spinning Cuisinart design." The students chose to convert a bicycle into a pedal-driven chopper to turn crop residue and grass into silage.

"I was really excited about demonstrating this technology ... but I soon found out upon my arrival in Senegal that it was very hard to find a bicycle. ... Overall, it was a grueling experience, and the Senegalese people were very blunt, saying, 'You failed.' "

"That really inspired me," Kochersberger acknowledged. "It was an unforgiving environment. I had nothing to compare it to and found it challenging." So he proposed another year of support from USAID/ERA for a new team of students to tackle the problem.

It again became a senior design project, but with some history behind the new effort. When Jordan and the rest of the team landed at the Dakar Airport in 2015, Kochersberger was with them for his second try.

Yet, with all the planning, there was a new problem.

"We interacted with farmers of the Santamba village. We found, as we anticipated in traveling to Senegal for the very first time, that we really did not fully understand their user needs," Booth said.

"We explored the weld processes used in Senegal, and we evaluated the dimensional replicability of numerous machined features," Booth added. "After each of these milestones, we still had numerous questions that were not able to be answered from 4,000 miles away, and knew very well that our trip to Senegal would only begin to answer everything we were hoping to know."

The design they brought to Senegal was the result of working first with four different drawings, each prototyped and tested. But when they unpacked it in Senegal, reassembling it the first day, they discovered the pieces did not come together well. They stayed up all night reassembling the machine. On the second day, this silage chopper worked, and the team was excited.

"Our design was great in theory, and a great idea, but then we learned it was not adequately functional," Jordan said.

As the roller coaster ride experience continued, the students soon learned that even though the prototype chopped up silage, it did not have the necessary output to make the tool successful.

"The plant material in Senegal included a much larger variety than was previously described to us as being the most typically available plant material, which was sorghum. The issue was not that the stalky sorghum-like material wasn't there in Senegal, because some of the plant material we used while in Senegal was very similar to sorghum. The issue was in the much greater variety of plant material that was being chopped. This factor was due to the season during which we arrived in Senegal being different from when the post wet-season harvest would typically occur, and when more plant material

would be available like sorghum," Booth added.

"We had good intentions. We did learn that failure can teach you and make you learn. It was an awesome opportunity to communicate with people," Booth added. "We used the failure of the device as an opportunity to finally communicate directly with the farmers, and better understand their acceptance criteria for a silage chopping device."

The truly good news was members of two Senegal universities were present for the demonstration, and met with the Virginia Tech delegation and the agricultural outreach agencies that were also in attendance. They discussed future partnerships where students would become more involved with the farmers. The students from both Virginia Tech and Senegal remain friends on Facebook.

The Senegal project is just one of about 42 overseen by Kochersberger, and maybe up to a half a dozen are international. One is the design of an intravenous delivery (IV) system that can support IV delivery in harsh environments.

Companies interested in sponsoring a senior design project can learn more about the program [here](#)^[6] or contact [Kochersberger](#)^[7].

The [College of Engineering](#)^[8] at Virginia Tech is internationally recognized for its excellence in 14 engineering disciplines and computer science. The college's 6,000 undergraduates benefit from an innovative curriculum that provides a "hands-on, minds-on" approach to engineering education, complementing classroom instruction with two unique design-and-build facilities and a strong Cooperative Education Program. With more than 50 research centers and numerous laboratories, the college offers its 2,000 graduate students opportunities in advanced fields of study such as biomedical engineering, state-of-the-art microelectronics, and nanotechnology. Virginia Tech, the most comprehensive university in Virginia, is dedicated to quality, innovation, and results to the commonwealth, the nation, and the world.



Kevin Kochersberger, associate professor of mechanical engineering at Virginia Tech, has traveled twice to Senegal prior to the students' visit in 2015. He led the senior design team in the making of a prototype to assist the African country's agricultural industry.

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