Engineers CROSSING *borders*

PENN STATE ENGINEERING LEADERSHIP STUDENTS TEAM UP WITH MOROCCANS FOR UNIQUE EFFORT

BY CURTIS CHAN

Photo credit: Curtis Chan

Penn State engineering leadership students teamed up with their engineering counterparts in Morocco on a series of projects that may benefit the kingdom.

A RECENT TRIP TO MOROCCO ALLOWED PENN STATE ENGINEERING LEADERSHIP STUDENTS to put theory into practice as they engaged in a cross-cultural collaboration with engineering students from Ecole Mohammadia d'Ingenueurs (EMI).

The students were a part of the capstone class for the Engineering Leadership Development Minor, Leadership Innovation and Global Resource Challenges, taught by **Rick Schuhmann**, the former Walter L. Robb Director of Engineering Leadership Development.

The American-Moroccan teams, with support by the America-Mideast Educational and Training Services (AMIDEAST), Morocco's Office National Eau Potable (ONEP), and Philadelphia-based Roberts Filter Group, were tasked with two major projects involving water resources and technology transfer.

Bill Finney, a civil engineering student, says, "The water resources project that the class worked on in Morocco consisted of three sections: chlorination, wastewater management, and erosion."

A combined group of 30 Penn State and EMI students traveled to the tiny village of Assoul, several hours' drive north of Rabat, the country's capital and home to EMI.

There, the teams fanned out to study soil erosion in the hills surrounding Assoul, water contamination in a central village well, and the need to efficiently disinfect the water supply to prevent illness. The issues faced by Assoul are emblematic of villages throughout the kingdom.

Finney says, "Erosion throughout Morocco is causing the siltation of rivers and reservoirs, the eutrophication of water bodies, and infrastructure damage due to flooding."

Photo credit: Gopal Nadadur

Penn State and EMI students traveled to the village of Assoul to study soil erosion, water contamination, and how to efficiently disinfect the water supply.

In addition to the Assoul site visit, the engineers performed extensive research, benchmarking, and idea generation and analysis.

In its report to ONEP, the Penn State-EMI team made three recommendations for Assoul. The engineers proposed using vetiver grass, a tropical grass with deep roots, to stem erosion in the hills surrounding Assoul.

The students also recommended vetiver be planted around septic tanks, which were suspected of contaminating the village's well water. The plant's roots have proven effective elsewhere in removing impurities from wastewater and lowering the concentration of waste entering groundwater.

The team's final suggestion was installing a flow-dependent chlorine injector to disinfect the water. Employing inexpensive and easily purchased parts, the engineers designed and built a prototype chlorine injector as a proof of concept.

"Our goal was to prove to ONEP that the solution we recommended would result in fuller reservoirs and a lower operating cost of treating water for drinking," Finney said. "The system will also help transform mountainous land into agricultural land that is more easily farmed."

He continued, "If ONEP implements our recommendations, we believe that it will help provide the kingdom of Morocco with both food and water security."

ONEP senior scientist Mustapha Hajji said of the students' efforts, "The building of the venturi chlorinator is in our sense a real contribution to the improvement of sanitary condition of people living in the rural areas of Morocco, about 48 percent of the total population. The benefits are tremendous and cannot be quantified."

ONEP scientists are currently conducting performance testing on the chlorinator, and plans are to begin testing in villages soon after.

Photo credit: Gopal Nadadur

After visiting Assoul, the U.S.-Moroccan team made a number of recommendations to the kingdom's Office National Eau Potable to the soil erosion and water problems plaguing the village.

"Working with government agencies in developing world countries on issues as fundamentally important as potable water is critical," Schuhmann says. "Our students must follow the same professional ethical guidelines that we do: practice within our area of expertise and hold paramount the health and safety of the public—the health of the Moroccan public is as important as that of the U.S. public."

The second project involved developing a Moroccan version of a machine designed by Penn State students to more efficiently process baobab, a sub-Saharan African fruit traditionally processed by hand and exported to Europe for food and drink (see cover story, page 12).

The project was supported by a $7,000 grant from Procter & Gamble (P&G), and the Penn State students worked in a virtual team with **Paula Eckert** ('92 ME), an engineer at P&G's Mehoopany, PA, facility, on a design for manufacturability, modification, and maintenance.

The baobab, about the size and shape of a football, is split open like a coconut. Its innards are gouged out by hand and the pulp is crushed with an oversized mortar and pestle. The resulting powder is then sifted to remove seeds and any remaining debris before being packed for export.

Over the course of a year, **Matt Zellers**, a mechanical engineering senior, led a student team that devised and refined a baobab processing machine. He and his team worked closely with a baobab cooperative in the village of Natatingou, Benin, to perfect the machine's design and operation and engaged their Moroccan counterparts several weeks prior to their travel through virtual teaming.

For Zellers and the rest of the engineers, the goal was to replicate the Penn State machine using EMI's facilities and materials.

"With this phase of the baobab project, we were aiming to recreate our prototype that was designed and built in the U.S. using only Moroccan parts and tools," explains **Erick Froede**, a mechanical engineering graduate student. "The team and I had to adapt both our entire design and notion of fabrication techniques in order to accommodate local supplies and machinery. Essentially, the aim was to 'Africanize' it and empower those who can implement and most directly benefit from the technology."

Doing so, however, was easier said than done, according to **Tyler Pritz**, a civil engineering student. "The most challenging part of the project was adapting to the different process of getting work done in Morocco."

Froede says, "A prominent example of this was the lack of computer-aided tools like the water jet, which allowed us to cut relatively complicated parts with ease. In Morocco, everything had to be done by hand, so even creating a simple circle within a piece of sheet metal became an arduous task."

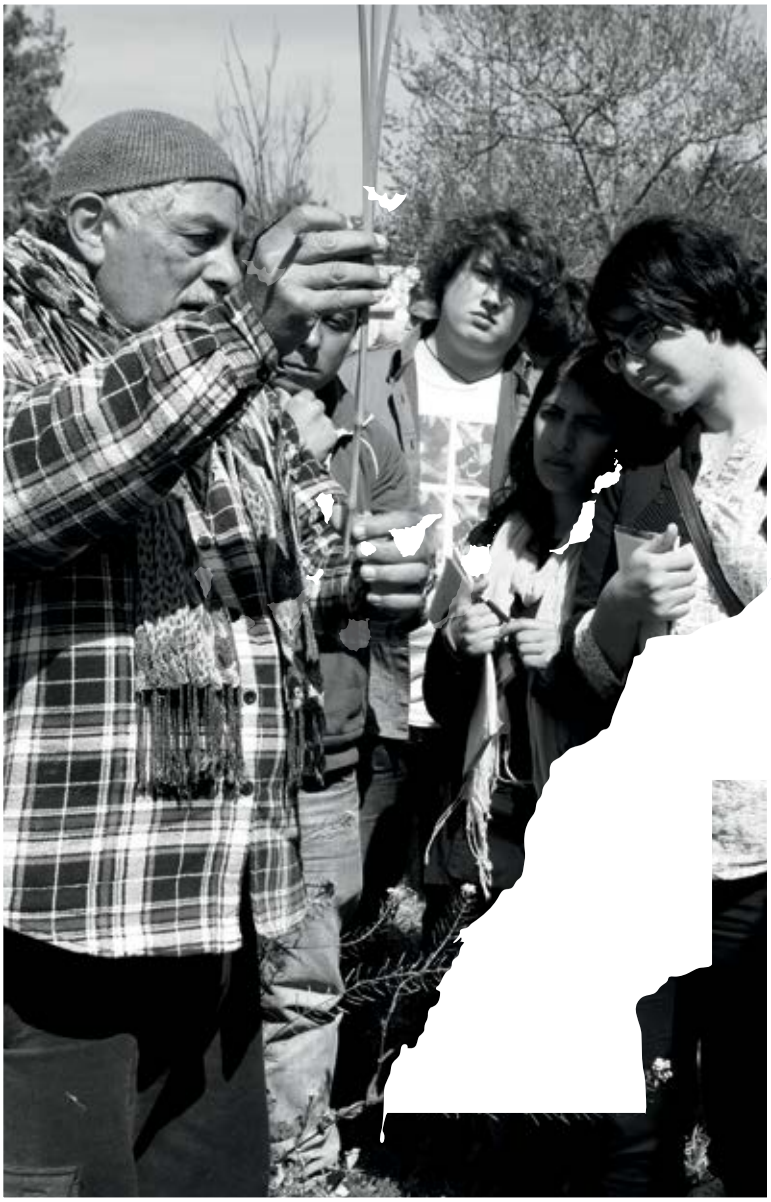
Despite the technical challenges and language barrier, the U.S.-Moroccan team was able to fabricate a working African version of the baobab machine during the Penn State students' week-long stay in Rabat.

"I thought we wouldn't make it," says Sara Boulan, a second-year mechanical engineering student at EMI. "It is hard to have all the materials in one place. We were very stressed by the fact that we might not be able to have the machine finished."

Zellers says the hope was that Moroccan-built versions of the machine could be built and sold at an affordable price to small cooperatives and enterprises through sub-Saharan Africa, boosting baobab production at the village level and providing increased revenues to rural Africans.

For students on both sides of the Atlantic, the experience was much more than completing an engineering project.

"I tried to avoid any expectations or preconceptions before heading to Morocco. Working with the Moroccans was an awesome experience," Froede says.



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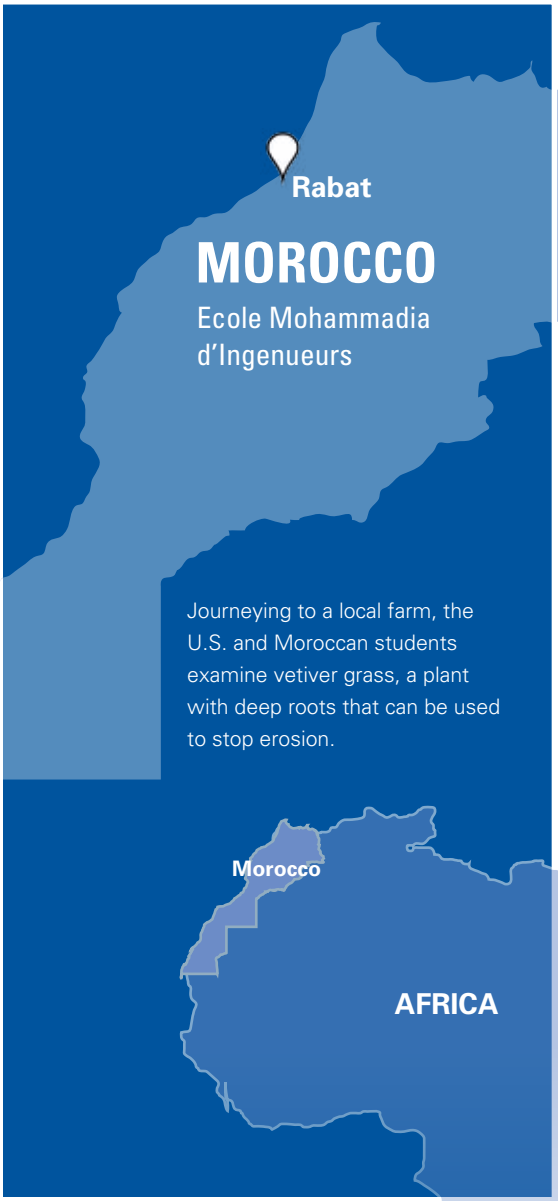

Pritz agreed, adding, "We hit it off with our teammates immediately and formed strong bonds quickly. By the end of the week, none of us Americans wanted to leave."

Houda Bentahar, a second-year mineral engineering student at EMI who had never worked with foreigners before, found the experience life-changing as well. "The whole experience is really amazing. I learned about cultural differences."

The Rabat native said working with the American students opened her up to new possibilities. "I'd like to go for another cultural experience. Before this experience, I wasn't considering a Ph.D., but now I am."

"I can't help but feel a sense of disbelief that I actually lived for a week in North Africa, running through the old walled city and using Darija on a daily basis," Froede says. "In a way, it was one of the most real and visceral experiences I have ever had. It's a feeling only someone that has done something similar can identify with, but I'm a different person now than I was before I went." ■

A video of the trip can be found at YouTube at www.youtube.com/watch?v=lgtVq7louu8&feature=plcp