The Getting of Wisdom

Professional baseball scouts use the ungrammatical but colorful adjective "toolsy" to describe players who have all the "tools," or abilities, to play the game at its highest level. "Toolsy" also serves as an accurate modifier to describe all the industrial engineering seniors who recently completed Dr. Jenna Marquard's MIE 478 capstone course. It makes them toolsy enough to ply their trade at the highest professional level. According to the official course description, MIE 478 acts as "an integration of industrial engineering/operations research principles and procedures into the design of an operating system." The "operating system," in this case, was the campus chapter of Engineers Without Borders (EWB) Amazon Project, whose goal is to bring clean drinking water to 1,400 people living in rural Brazil.

As the capstone project for one team from Dr. Marquard's class, three seniors needed to take the industrial engineering principles and procedures they'd learned in their first three years of the curriculum and use those tools to help the EWB members plan and coordinate their Amazon Project. What was the key for organizing the EWB members? Retooling, of course.

"In their other courses before taking this capstone, our seniors are taught all the various industrial engineering tools," explains Dr. Marquard. "But we don't necessarily have the opportunity during those courses to teach them when to use the tools. One of the purposes of the capstone course is to have them go into an organization and find what the needs and problems are by listening to the clients. Then they work backward by considering what tools they know how to use and which of those are going to best address this particular set of issues. In other words, this is what our students will be doing when they get into the workplace."

The community of Assis Brasil, located within the protected Chico Mendes Extractivist Reserve in the Amazon, is comprised of 280 families of rubber tappers. They live sustainability in the rainforest, but are plagued by disease and infection because of inadequate sources of clean drinking water, and they lack the proper sanitation disposal. The objective of the EWB project is to work with community members to design drinking water and sanitation systems that meet the peoples' needs and protect them from harmful diseases.

After listening carefully to the problems related by members of the Amazon Project, Dr. Marquard's team of enterprising seniors went to work. Among other issues, the EWB project needed a better way to map out its overall plan, fund this plan, and decide which kind of water treatment would optimize the water purification system and minimize the cost. But implementing all these changes couldn't be done without new tools.

First, the IE team helped EWB members systematize and manage its Amazon Project with a so-called "Gantt Chart," which listed all the steps for the project in logical sequence over its projected seven-year duration. Using that chart and other IE tools, the MIE 478 team was able to target exact annual numbers for EWB's fund-raising strategy over that time span. Then the industrial engineers helped the EWB members create an important instructional booklet, which would teach the Brazilian villagers how to construct their own pumps for accessing clean water. Finally, the IE students helped EWB address its central water treatment plan with another tool of the trade.

"We used something called Linear Programming," explains Dr. Marquard, "which in this case gives the EWB project an objective analysis of how to minimize the cost of treating water while removing the most contaminants with the best possible effectiveness under the circumstances. In other words, we want to optimize the treatment, subject to certain economic constraints."

Dr. Marquard also had two other MIE 478 teams working with the Avery Dennison Corporation at its local Chicopee plant. This arrangement was no small deal, given that Avery Dennison is a Fortune 500 Company that employs more than 30,000 individuals in over 60 countries making office products. The Chicopee plant is a 300,000 square-foot operation facility, which does $1.4 billion in annual sales and is the leading manufacturer of three-ring binders and labels in the United States.

The fact that the plant approached Dr. Marquard for help demonstrates its high regard for her students and our Industrial Engineering program. As a result, our students helped solve several very real and pressing problems at the Chicopee Plant.

One of those problems was unacceptable downtime caused by unexpected machinery failures in equipment employed to make binders and labels. Using the IE methods they'd learned, the students quickly identified a problem in one specific type of machine, which was jamming too often, much like a jamming copier, as the cardboard material for making the binders was being fed into it.

"So our students worked with a technician to design a new board feeder to create fewer jams," Dr. Marquard notes. "The plant implemented the new feeder, and initial studies seem to indicate that there is less down time, though it's still too early to know for certain yet."

A second team was looking at a weekly internal audit of each machine work station, or "cell," using a checklist of some 10 preventive measures. These audits were being done on paper forms, filled out by supervisors to make certain that the staff at each cell did regular upkeep that impacts efficiency and/or safety. Our team implemented a new electronic tool, called an "electronic dashboard," that makes it much easier for supervisors to input this information, and much easier for administrators to analyze it. In management information systems, a dashboard is comparable to a car's dashboard, providing decision makers with the input necessary to "drive" the business.

The two MIE 478 teams also helped the plant resolve other key safety and efficiency issues. For professional industrial engineers, this kind of retooling is all in a day's work. But for our industrial engineering students there was one more aspect of retooling that MIE 478 drove home. Making their clients believe in them.

"One thing I think is especially important is that, as an industrial engineer, you're often coming in as an outsider, so the people you're working with need to develop trust in what you're doing," says Dr. Marquard. "They have to understand the tools you're giving them, and they have to think they're useful. This course puts our students in a position to do that."

It also puts our students in a position to understand precisely what they'll be doing for the rest of their lives as very toolsy professional engineers. Any company that might benefit from the kind of industrial engineering retooling done in MIE 478 can please contact Dr. jenna Marquard at **jlmarquard@ecs.umass.edu**. (May 2010)