

ENGINEERING FOR THE BOTTOM OF THE PYRAMID

At first, it was just a class project. When seniors Rudy Roy and Ben Sexson took Product Design for the Developing World (E/ME 105), they didn't think their idea of turning bicycles into wheelchairs for the poor and disabled in Guatemala would go beyond the classroom. But during the fall quarter of 2006, as they designed and built a prototype chair, learned how to make a business plan, and held videoconferences with students in Guatemala, the project became a passion. "The problem became personal," Sexson says. "We really wanted to do something good." They carried on with the project after the term ended, and upon graduation teamed up with Charlie Pyott, a student at the Art Center College of Design, to form a new nonprofit organization called Intelligent

Mobility International, with Roy as the chief executive officer, Sexson as the chief financial officer, and Pyott as the chief technical officer.

The class, taught by Visiting Professor of Mechanical Engineering Ken Pickar, introduces students to developmental engineering. This emerging field is about finding cheap, technological solutions to some of the most basic needs of the poorest people on the planet. The solutions must also generate income, in the proverbial way of giving a man a fishing pole instead of a fish. The class focuses on rural Guatemala and includes close collaboration with students at Rafael Landivar University to gain crucial insight into the people's culture, daily lives, and needs. Once the students identify a problem, they find a solution, and form a business plan to market and

manufacture their product.

Reliable statistics are scarce, but the number of disabled in Guatemala is estimated to be at least in the many tens of thousands, as a result of decades of civil war and violence. Without the means to get around, getting a job or an education is nearly impossible. Imported wheelchairs are too expensive, so Sexson and Roy decided to build them from ready-made bicycle parts. Not only are bicycles—and local bicycle manufacturers—common in Guatemala, but this design uses mountain bikes, resulting in an off-road wheelchair capable of negotiating the rural terrain. These durable wheelchairs could last up to 10 years, Sexson says. A standard chair wouldn't come close.

The key innovation is a standardized and simplified manufacturing process. The

team has designed a special workbench on which you place the bicycle. The workbench acts as a template, telling you exactly where and how to take the bicycle apart and to reassemble it into half a wheelchair—each wheelchair is made from two bicycles. Because of the process's ease and efficiency, you don't need a lot of training or education, which is essential because the designers hope to employ the same people the chairs are designed for: the poor and disabled.

Developmental engineering is about developing local economies and empowering people, says Mario Blanco, director of process simulation and design collaboration in the Materials and Process Simulation Center in the Beckman Institute. "That empowerment allows them to get a better life for them-



selves,” he says. Blanco, who is from Guatemala, has been involved with the course since its inception three years ago.

“Technology for the developing world needs to be designed and built from the ground up,” says Blanco. “Because of cost constraints and socio-cultural issues, first-world technology rarely ‘trickles down’ successfully to the 2.8 billion people living on less than two dollars per day—a level of poverty often referred to as the ‘Bottom of the Pyramid.’”

Developing a product cheaply to address the basic needs of the poor may not be as difficult as building robots to send to Mars, Blanco says, “but if you have a problem with tremendous constraints on cost, you make it an impossible problem. Caltech students like to focus on just this kind of problem!”

To solve these impossible problems, this summer Blanco and Pickar helped run the first annual International Development Design Summit at the Massachusetts Institute of Technology. Run by Caltech, MIT, and Olin College, the meeting involved nearly 50 students, engineers, and academics from 15 countries, and from all walks of life, including one participant who had never before left his village in Tanzania. In the same spirit as Pickar’s class, the participants divided into teams to design products that address the needs of the developing world. At the end of the month-long summit, in which participants lived, worked, and played together, they produced 10 prototypes. Designs included a refrigerator that keeps food cool using only evaporating water, and a device that tests water safety.

By detecting microbes in the water with an incubator, the device would cost less than \$50 instead of the thousands needed for a conventional instrument. The goal, of course, is to turn these ideas into real products, much like what Sexson and Roy have been doing with their wheelchairs.

Intelligent Mobility International is still in the research and development stage, but the team continues to push the project forward. They have just started a campus club, Intelligent Mobility, to involve more students. Additionally, they plan to continue their collaboration with the Art Center, to recruit help with design aspects of the project, such as creating a website. “A little bit of work can go a long way,” Sexson says. “It doesn’t take much to make a big difference. If we keep plodding along and

keep moving, we can accomplish something.” They hope to finish the third prototype by October, and are talking with Bicicletas Corsario—El Salvador’s largest bicycle company, which has branched out to Guatemala—to provide the bicycles. They plan to roll out 500 wheelchairs in the first year of operation. Meanwhile, they hold down other full-time, paying jobs, although they continue to meet a few days a week.

Roy says the experience has shown them what they can achieve as engineers, going beyond academics. “How many times do you get an opportunity in college to make a big impact in the world?” he says. □—MW

Presto, chair-o: Starting with the far left photo, Ben Sexson (in suit; after all, he is the CFO), and Charlie Pyott steady a mountain bike frame in one of the template’s holders as Rudy Roy prepares to make the first saw cut. Then the frame is flipped over to position it in another holder for the second cut, and so on. The graphics at right, drawn by Pyott, continue the transformation.

