One day this summer, a faculty member in cardiovascular surgery at the University of Minnesota called up Arthur Erdman with an idea for a catheter system. Did Erdman, director of the new Medical Devices Center at the U, have a few minutes to talk? “Ten minutes later he was in the center meeting with me and some of the fellows, and a week later we had a prototype for him,” Erdman says. “That was a highly unlikely scenario before we had a center like this.”

A center like this—an 8,000-square-foot space with labs, workshops, state-of-the-art technology and equipment, and conference rooms—is what Erdman, a professor of mechanical engineering, envisioned when he became director in 2006. It opened this spring, moving from cramped quarters across campus to the Mayo Building, at a high-foot-traffic crossroads in the health sciences complex.

“I can guarantee you there is no physician here who doesn’t have four or five ideas for something new that can improve patients’ lives,” Erdman says. A place to connect engineers and scientists, clinical physicians, and surgeons has been missing, he says. “This facility takes down all the barriers from not only having the idea, but taking the next many steps after that.”

Nearly every health sciences faculty member or student hurriedly passes through the Mayo corridor every day. Now, they’re stopping in their tracks, peering through the Medical Devices Center’s wall of windows, and frequently venturing inside, drawn in by the giant “M” on the floor of the foyer, where glass cases show off U medical device inventions.

“In 1958, a visionary physician named C. Walton Lillehei (B.S. ’39, M.D. ’41) teamed up with a very creative engineer named Earl Bakken (B.E.E. ’48) and created, at the time, the smallest implantable pacemaker. That was exactly one floor below us,” says Saurav Paul (M.S. ’02, Ph.D. ’02), director of the U’s Innovation Center.

Brilliant minds and the entrepreneurial spirit are the lifeblood of the University’s new Medical Devices Center.
Erdman points to a large box tightly wrapped in plastic. It’s a 3D printer that can produce variable materials. “I can print out a heart with a device in it, where the heart is soft and the device is hard,” he says. It was provided by Stratasys at a deep discount.

He points to where machines donated by Bose and Boston Scientific to test devices and fatigue of materials will be set up. In the hallway is a wall of shelves and wire baskets containing materials that would make Martha Stewart giddy if she were an engineer. Lab supervisor Darrin Beekman, a mechanical engineering graduate student, keeps these baskets well stocked with the tubes, syringes, electrodes, and other materials inventors may plumb for fashioning models of physiological systems and their ideas for medical devices.

One of the most impressive technologies involves virtual prototyping. Beekman demonstrates by stepping in front of a large wall-mounted screen and a touch-screen table. He dons a pair of 3D glasses with insect-like antennae poking out from the bows. They are wireless sensors receiving signals that allow him to control and manipulate the image on the screen.

He moves his fingertips across the surface of the touch-screen table, sliding software tools and rotating graphics that display an enormous 3D image—made up of scans taken at 1-millimeter intervals—of a human heart from the U.S. National Library of Medicine’s Visible Human Project. University of Minnesota computer engineers developed software that allows the user to visually get inside the heart.

“We can push our way through the anatomy and zoom in on different portions,” says Beekman, plunging through the walls and chambers of the heart while visitors behind him, bug-eyed behind their 3D glasses, gasp. Then he draws a pink line to represent a catheter and its pathway, bending it and changing its length and diameter. He could also pull up the image of a brain or other body parts, as well as prototype medical devices to test them virtually before they go to animal or human trials.

One of the most difficult aspects of medical device development is where it meets anatomy, says Erdman. “There we need highly complex computational tools,” he says. “But those tools are available. We’re working with the Minnesota Supercomputing Institute at the U, where we can literally call up 8,000 processors at a time. Something that might have taken a day for analysis we can bring down to minutes. That changes the whole scenario. We can experiment with hundreds or thousands of designs in this environment. We can do almost everything here,” he continues. “We don’t have to send it out or even walk across campus.”

This is key, because speed is critical to innovation. Delays can be costly and missed opportunities can leave an institution in the dust.

Saurav Paul, who worked at St. Jude Medical (where he developed around 200 patents) before coming to the University,
University of Minnesota alumni are on the rise, starting movements, curing diseases and solving world problems. Destination—the top.
beams when he talks about the new center. “But buildings don’t create innovation, people do. In that sense, the Innovation Fellows are the crown jewels of the center. They’re the ones who make things happen, and we are here to support that.”

The Innovation Fellows Program, now in its fifth year, is an intensive medical device development training program for midcareer professionals in medicine, science, and engineering. Only a few such programs exist in the United States. This past year, eight fellows were accepted and worked in teams on a dozen medical device ideas. Previous years’ fellows had more than 50 patents and over 100 innovation disclosures. Three startup companies have come from the center.

“This is innovation on steroids back here,” Erdman says of the space where the fellows office, the cubicle walls filled with their sketched-out charts, ideas, and pictures—most of it proprietary information.

Laura Paulsen, an Innovation Fellow with degrees in biomedical engineering from Duke University and Johns Hopkins University, plans to start up her own medical device company. For the past year she’s been working on two main projects: a new diagnostic tool for lower urinary tract dysfunction and a new treatment for postoperative ileus in patients who’ve had an abdominal procedure. “It’s a big deal. Patients can be in the hospital for 9, 11, 20 days after surgery, only waiting for their bowels to start moving again,” she says.

Before the most recent group of fellows launched into their projects, they studied the text Biodesign: The Process of Innovating Medical Technologies, which covers needs identification, market analysis, regulatory basics, funding sources, and more. To identify needs, the fellows shadowed surgeons, physicians, and nurses; observed surgeries; and went on rounds to see patients. Getting a list of identified needs down to a handful wasn’t easy.

“It’s a recursive process,” Paulsen says. “You’re always modifying. You might change your need because you came up with a solution for a different need. Or you hear feedback from a doctor and it’s, ‘Aw, shucks! That just shot down our need because it’s not even a need at all.’ Or you just did a market assessment and the market is only going to be a million dollars, and you need a billion-dollar market for a medical device.”

And sometimes it was tense. After one fellow spent countless hours developing a proposal, the other fellows questioned its viability to the point that the project clearly couldn’t move forward. “The fellow didn’t take it that well,” Paulsen recalls. “That kind of woke everyone up to like, ‘Wow, we’re going to put a lot of work into this and we always have to be prepared [to] fail.’ With this work you have to stay slightly disconnected.”

A partnership with Minnesota-based LifeScience Alley is allowing the Innovation Fellows Program to add a second-year stage for some of the fellows, so Paulsen will stay on, working with a new team of innovators and advancing her projects.

Meanwhile, Erdman is fielding increasing numbers of calls and visits from people who are just discovering the center, including a university and industry group from Costa Rica that learned about it through a Google search. “We’re almost more popular internationally than we are locally,” he says, noting that since 2009 the center has hosted 20 groups from Japan and currently has a resident engineer from there.

Erdman envisions international interest in the center mushrooming. “At the moment we’re trying to control growth,” he says, weary but pleased. “The potential is more immense than our resources.”

Shelly Fling is editor of Minnesota. Phil Steider, a communications student at the University of Minnesota, contributed to this article. Go to www.MinnesotaAlumni.org/MDC to watch a virtual prototyping video. To learn more about the Medical Devices Center and the Innovation Fellows Program, visit www.mdc.umn.edu.
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– Tiffany Elton, ’00