

# THE CHRONICLE

of Higher Education

## The Maker Movement Goes to College

**Institutions gamble on open workshops as engines of entrepreneurship**



Lisa DeJong

A Case Western Reserve student (left) works with a staff member to drill a hole in a mold of a laryngoscope. The aim of the project is to measure the pressure patients feel during medical procedures.

*By Scott Carlson* APRIL 20, 2015

CLEVELAND

**T**he ghosts of a glorious American enterprise haunt the old Lincoln Storage building at the southern end of Case Western Reserve University's campus here in Cleveland. A hundred years ago, the men who built this city on invention and heavy industry stored their Oriental carpets, furniture, and furs in this ornately decorated seven-story concrete hulk. Ian

Charnas, in vintage glasses, a Carhartt jacket, and a blue hard-hat, points to new holes cut into the floors for venting and drain pipes, through nearly a foot of steel-reinforced concrete. "The floors were thick," he says, "because they wanted to pack as many Model T's in here as they could."

Soon the floors will support a different array of machinery, and hope for a new generation of inventors, entrepreneurs, and industrialists. Mr. Charnas will manage the space, known as [think\[box\]](#), guiding students, and anyone who strolls in, through the process of bringing an idea to life.

One floor will house woodworking tools and 3-D printers, another a paint shop, welding station, and water-jet cutter that can slice through metal or marble. The building will also boast machines for making circuit boards, rooms to brainstorm with paper and Popsicle sticks, incubator space for promising start-ups, and offices for lawyers and others who can help usher young entrepreneurs through the patenting process. On a tour of the construction site, Mr. Charnas stops outside a stainless-steel vault where the old industrialists kept their jewels. "This would be fun for a shark tank," he says, where entrepreneurs can pitch to investors.

Think[box], moving from an engineering-building basement, is one of many emerging campus sites open for students to come in and mess around, with the intention that they'll get creative, maybe even hit on something big. The sites go by many names — hackerspaces, innovation centers, Fab Labs — but are generally known as makerspaces. The [maker movement](#), which rose out of hacker and DIY cultures [several years ago](#), has led to open workshops elsewhere: community centers, church basements, and libraries. Advocates have hailed the spaces for their ability to liberate creative urges in a prepackaged world. A room of tools can teach young people especially about problem solving, teamwork, the virtues of failure, and independence.

As the movement migrates into higher education, engineering schools have been a natural base of operations. Now more colleges are taking a multidisciplinary approach: They say they want engineers to meet artists, musicians, ecologists, anthropologists, lawyers, and business and medical students for serendipitous exchanges of ideas. Major universities already size themselves up by the useful and lucrative inventions that come out of their academic departments and labs. Makerspaces aren't cheap, but they're a way to get everyone involved — maybe with more to show for it.

"It's a numbers game," says Shane Farritor, a mechanical-engineering professor who is planning a 17,000-square-foot makerspace at the University of Nebraska at Lincoln's Innovation Campus. Maybe two out of 100 ideas have potential, he says, so if he provides a place for Nebraskans to tinker, he'll increase the possibility that someone will invent the next Square, the mobile credit-card reader first created in a makerspace.

"We are a big agricultural state where people are handed vise grips when they are 4 years old, and we want to foster that natural ability," he says. "We are going to create an infrastructure that allows makers to make."

Nebraska's space joins a slew of others in higher education, big and small, already opened or still in the works. Wichita State University recently got [nearly \\$4 million](#) from Koch Industries and the Fred and Mary Koch Foundation to establish an 18,000-square-foot makerspace in a new engineering building opening in 2016. Arizona State University has partnered with TechShop, a private operator of makerspaces, [to open a facility](#). [Davidson College](#), [Georgia Tech](#), [Northwestern University](#), [North Carolina State University](#), [Southern Methodist University](#), and [Wheaton College](#) have established makerspaces of various sizes on their campuses. And top-tier research universities like Stanford University and the Massachusetts Institute of Technology are maintaining prominent workshops.



Lisa DeJong

Ian Charnas (left) and Malcolm Cooke are among the leaders of think[box], a seven-story tool shop and meeting space now under construction in a former storage building at Case Western Reserve U.



The rise of makerspaces in higher education is, in some sense, an attempt to hack the traditional academic environment, adapting it for contemporary inventors and manufacturers. "The Henry Ford model is broken," Mr. Farritor says. China now produces a trillion identical objects cheaper than the United States can; the resurgence of manufacturing here depends on design and customization for discerning consumers who look for specialized products on the Internet. By running makerspaces, he says, higher education can prove its relevance not only to students and families, but employers seeking new hires with practical skills.

Or this could just be the latest pedagogical fad — and a pricey one at that. Running a makerspace requires staff, materials, expensive machines, and an administration with a tolerance for risk. Some fear students messing around with powerful and sharp objects will hurt either the machines or themselves. After a Yale University student [died in 2011](#) while working with a lathe in a campus machine shop, makerspace managers and advocates have paid closer attention to safety.

But the growth may be just the beginning. In a decade, Mr. Charnas believes, most every institution will have a roomful of tools for students to tinker. A makerspace will become a standard amenity, just as students expect colleges to have a cafeteria or gym, he says. "People won't ask, 'Do you have a makerspace?' They'll say, 'Where is it?'"

W

alk through the door of the technology building at the Community College of

Baltimore County in Catonsville, Md., and you'll hear a screeching din. Students, some in blue coveralls and other factorywear, are grinding away at metal on Bridgeport and Fadal milling machines, some dating to the 1960s. It's the classic equipment of American heavy manufacturing, and students are still training for those jobs, if fewer of them, the traditional way.

But just beyond the metal shop is a brightly lit room with another set of tools, like a computerized wood router and laser and vinyl cutters. This is the college's Fab Lab, one of many campus spaces in the [Fab Lab network](#) started by Neil Gershenfeld, director for the Center for Bits and Atoms at MIT.

"It's like the Wizard of Oz, where you go from black and white to color — going from old manufacturing to new manufacturing, both of which are still relevant," says Doug Kendzierski, chair of the department of applied technology here. The college is considering a new program in digital fabrication and advanced manufacturing, he says, based on the tools available in the Fab Lab. The degree would take students from digital design to prototypes to production.

"What we envision in the rebirth of American manufacturing is this type of graduate leading that movement," he says. Employers are screaming for people who understand the

entire process. "The new manufacturing employee is technology-savvy, a creative thinker, self-motivated and self-led, and that's what we are teaching here."

A makerspace is a serious investment at a time when cash isn't exactly flowing to community colleges. This one spent \$400,000 to start its Fab Lab and will have to come up with about \$100,000 annually to cover salaries and replacement parts for machines. The college should recoup about a third of the annual costs by running "Fab Academy" courses for the general public and charging fees for on- and off-site equipment training and work-for-hire.

There's no tech-transfer agreement for people who use the lab, but campus officials hope successful inventors remember the college if they strike it rich. One recent entrepreneur is a facilities director at a local private school who used the Fab Lab to invent a camera lens-holder, called the [Cap Gorilla](#), of which 2,000 have now been sold.

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Some colleges are deliberately connecting makerspaces to entrepreneurship programs. At Case Western Reserve, an office for [Blackstone LaunchPad](#), a nonprofit entrepreneurship program originating from the University of Miami, will occupy space in the new think[box] building. "It's very difficult to divorce creativity, innovation, making or tinkering, and entrepreneurship," says Malcolm Cooke, an associate professor of mechanical engineering at Case Western Reserve and executive director of think[box]. The goal, he says, is much bigger than "just giving people some space and a 3-D printer and some hand tools."

Think[box]'s new seven-story building, bottom to top, will be "a whole ecosystem," he says. The ground floor, a community area, will lead up to brainstorming space. The third floor will hold tools for rapid prototyping, and the fourth floor will let entrepreneurs give their inventions a more permanent form. The fifth floor will provide space for project development, and the sixth and seventh, offices for patenting ideas, finding investors, and incubating the most promising projects.

The think[box] philosophy is open access — for all departments on campus and for the community at large. For Mr. Cooke, success lies in attracting creative people from all over the city and giving them room to collaborate. "We vigorously, vociferously, and constantly say that this is not just a school of engineering resource, but a campus and community resource," says Mr. Cooke. "This is for anybody who walks in the door."

Serving as a local hub or engine is one way to make a case for a campus

makerspace. These days, providing value to students may be an even stronger argument. And employers seem to be buying it.

Nick Cusick, co-founder and chief executive of Bison Inc., a sporting-goods manufacturer in Lincoln, Neb., has given money to the new makerspace at the flagship university there, and he wants to get involved. When he and a longtime friend founded their company back in the 70s, they hammered out some of their first products on metalworking equipment in the friend's backyard.

"There are plenty of kids who are entrepreneurial and like to make stuff, and they have great ideas, but they don't have a place to do that," Mr. Cusick says. That's latent talent. "If they come to the university here and they are doing the lecture-test type of studying, and even if they have the inclination to be inventive, it gets stymied by the lack of opportunity."

Students in all fields with various career aspirations will benefit, he says. Working in a makerspace will give the student in marketing or management, for example, some experience in what people are doing on the factory floor. "There is a tendency, especially in larger companies, to have silos," Mr. Cusick says. If new graduates understand different skill sets, he says, they'll be more valuable employees.



- [Now Everyone's an Entrepreneur](#)

Colleges are teaching undergraduates how to be self-starters. But what does that really mean?

John Nottingham and John Spirk, who founded the product-design firm Nottingham Spirk, are often asked what they look for in new hires. An interest in tinkering is vital, they say. Mr. Nottingham sometimes asks: "Do they work on their cars over the weekend?"

Nottingham Spirk, which holds more than 1,000 patents on products like the Dirt Devil and the Swiffer Sweeper Vac, designs and builds prototypes in [its headquarters](#), a renovated Christian Science church just up the hill from Case Western Reserve. (The structure of the new think[box], bottom to top, mimics that of the firm.)

"If we have our students not know how to use a milling machine or how to build things, you are going to leave it up to people overseas, and then all we are is a bunch of theorists," Mr. Nottingham says. Part of the reason to build on site, he explains, is to prove that products can be manufactured for under a certain cost, a factor that can make or break a product line. What's more, crucial parts of the patenting process rely on working out details through physical creation. "If you relegate it to the factory," he says, "then the intellectual property is there."

**O**n a recent afternoon at think[box]'s current home — a 4,500-square-foot room in the basement of an engineering building — Jacob Ashman, a junior, is 3-D-scanning a prototype broom head, a project for an internship at a local cleaning company. Marcus Brathwaite, a recent graduate of the Cleveland Institute of Art, is checking on one of two high-end 3-D printers. He's one of more than 20 employees who teach students how to use and maintain equipment including a circuit-board router autographed by the Apple co-founder Steve Wozniak. In his spare time, Mr. Brathwaite works on art projects for a local elementary school, like laser-cut lightboxes featuring students' silhouettes. Marshall Nill, an engineering major, is using a laser cutter to etch the Hogwarts emblem from the Harry Potter series into a piece of scrap plastic, to make a wax-seal ring. Mr. Nill, whose family is in the tool-and-die business, transferred to Case Western Reserve from Lehigh, in part, he says, because the makerspace there was accessible only to students in specific programs and classes.

"I just wanted to work on my own stuff," he says. Think[box] was a big draw, and not only for him. A survey of users found that among students who saw the makerspace before enrolling, 34 percent said it played a major role in their decision. Now all prospective students are marched past think[box] on the campus tour.

The distinction it brings may justify the university's hefty investment. Case Western Reserve spends \$750,000 a year to operate think[box] in its current location. The new building will cost \$35-million, with annual operating costs yet to be determined.

Ian Ferre, a sophomore math major, saw think[box] on his campus tour. He thought it looked fun, he says, "for Christmas ideas, like making coasters for my mom."

Last year, in a course titled "Engineering for the World's Poorest," Mr. Ferre and Samuel Crisanti, a mechanical-engineering major, learned that millions of people in the world have cellphones but no reliable access to electricity. Challenged by the instructor to come up with a solution, they used think[box] to build a prototype for a foot-powered cellphone charger. It seemed more fun, they say, than a solar panel.

The project won the two students a \$15,000 grant to build two more prototypes and study their market feasibility. They traveled to Lesotho, where they met families who walked three hours to charge a car battery, using that to charge their cellphones.

The students are now looking for investors, and Lesotho may become a test market for their charger. "If it works there," says Mr. Ferre, "we'll target 17 other countries where there are 400 million people who are in need of the product."

To counter the stereotype of left-brained male engineers using the makerspace, Mr. Charnas, the think[box] manager, has tried to encourage an atmosphere welcoming to women and artists (among student employees, more than half are women). A mix of people from a spectrum of disciplines is important to creating new things, Mr. Charnas says: a clip-on water meter for showers; an inexpensive, competition-grade yo-yo; a dress that lights up in response to movement; eco-friendly headphones; a component for superefficient jet engines; and a breathing-exercise device that has already been sold to professional sports teams.

Local reporters have compared Mr. Charnas to Max Fischer, the [eccentric hero](#) of the Wes Anderson film *Rushmore*. A Case Western Reserve graduate who traveled the world in a prior career as a web developer, Mr. Charnas has a reputation for working on unusual projects like a "[waterfall swing](#)," a swing set that stops raining water precisely at the moment someone is passing under the center pole, which was once featured on the *Today* show. He and others at Case Western Reserve are gambling on the new building's being a beacon for aspiring entrepreneurs. That could raise the profile of the university and the prospects for its graduates, while possibly contributing to local economic development. "We would love to be part of the brain gain for the region," says Mr. Charnas. Places like Silicon Valley are crowded with entrepreneurs competing for a limited pool of investment money. Here the living is cheap, and the investors are hungry. A kid with a good idea and a place to create it, says Mr. Charnas, can find a way to thrive.



# Finished Products

Dozens of creative and useful items have been developed by students and others in think[box], the "makerspace" at Case Western Reserve University. Here are a few of them.

## EveryKey

Founded by an engineering and computer-science student at Case Western Reserve, Chris Wentz, EveryKey produces bracelets that use Bluetooth technology to unlock a wearer's electronic devices and online accounts when within a certain range. The product was featured at the 2015 Consumer Electronics Show in Las Vegas.

## Plasma-Assisted Fuel Nozzle

Felipe Gómez del Campo, a mechanical- and aerospace-engineering student at Case Western Reserve, designed a superefficient fuel nozzle for jet engines.

## Furniture for the Cleveland Museum of Contemporary Art

Katelyn Petronick, a Cleveland Institute of Art student, used think[box] tools to make this piece of furniture. People can write on the clear panel dividers.

## Geometric Installation Art

Designed by an artist, Jared Akerstrom, for an urban elementary school, this installation incorporated 3,280 paper triangles made with think[box]'s laser cutter.

— Scott Carlson

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