The Many Ways of Making Academic Research Pay Off

Universities are learning that commercialization means more than patents, licensing fees, and startups

THREE YEARS AGO, AHMED ELLAITHY LEFT A HIGH-TECH STARTUP in Dubai to help his alma mater, the prestigious American University in Cairo, launch one of the first offices in Egypt dedicated to turning academic research into commercial products. "I faced some very existential questions," recalls the 31-year-old engineer. "What's the point of commercialization? What are we trying to accomplish? How will we know if it's working?"

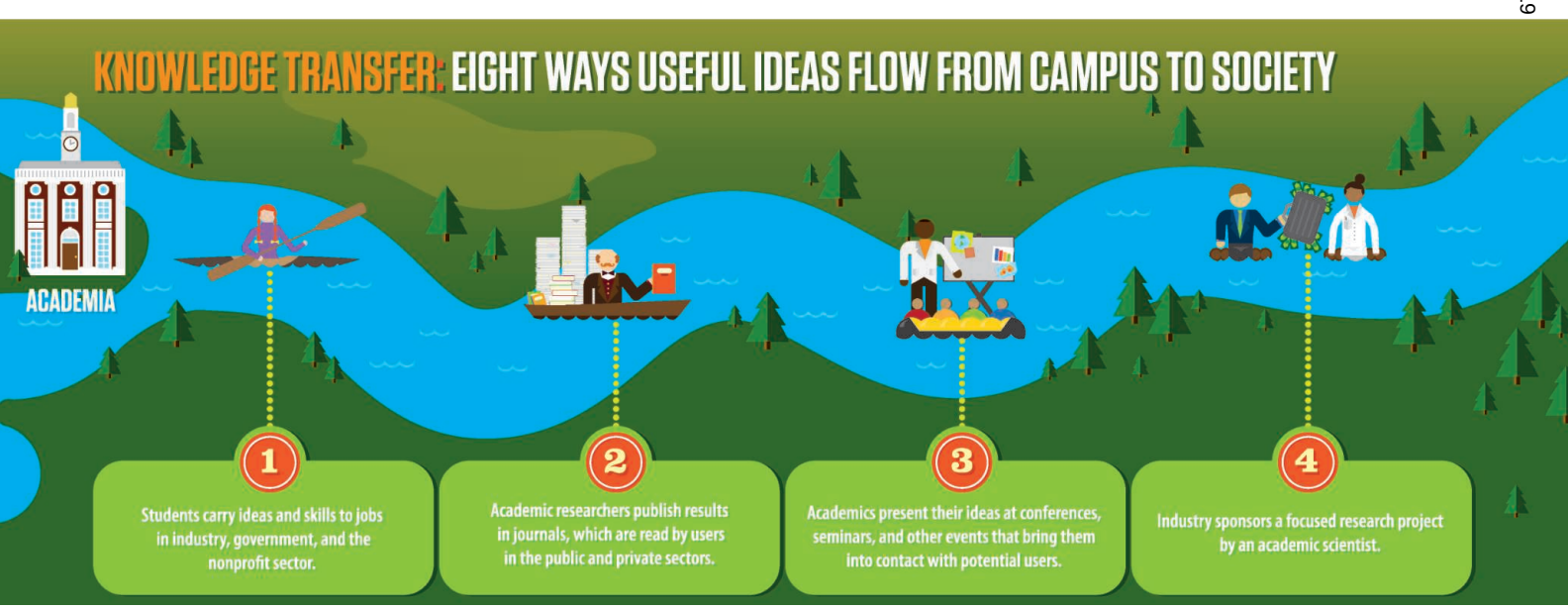
A lot of academic administrators around the world have similar questions about a suite of activities that goes by the name "technology transfer." Research universities are under growing pressure to play a more active, entrepreneurial role in commercial innovation. Intent on fueling economic growth—and dazzled by the ability of research-intensive campuses such as Stanford University in Palo Alto, California, to spawn multibillion-dollar businesses—governments are trying to encourage academic researchers to transform their discoveries into products. University leaders, in turn, increasingly regard tech transfer as a prerequisite for luring top faculty members and students, raising research funds, and potentially cashing in on lucrative inventions. "There's this growing sentiment that you can't be a strong university without having a serious plan for research commercialization," says Steven Price of Oklahoma State University (OSU), Stillwater, who helps mentor aspiring tech transfer administrators like Ellaithy.

New start. Ahmed Ellaithy is helping the American University in Cairo pioneer one of Egypt's first academic commercialization programs.

But efforts to turn universities into commercial hothouses often don't succeed: Tech transfer is a net money-loser at most universities, studies suggest, with legal and administrative costs often exceeding revenues. Indeed, a growing number of scholars warn that government and university officials too often create unrealistic expectations by overstating the potential benefits of commercialization and underestimating how hard it is to do and what it will cost. Many advise schools to focus instead on "knowledge transfer"—helping society benefit from the discoveries and skills of faculty members and students without focusing just on finances. That's the broader approach Ellaithy is taking at the American University in Cairo, at least initially.

"You are seeing a lot of reassessing, a lot of experiments," says Phyl Speser, CEO of Foresight Science & Technology, a consulting firm in Providence, and a vice president of the U.S. Association of University Technology Managers (AUTM). "People are trying to figure out the best way to do this."

Universities have a big stake in getting it right. A well-tailored tech transfer effort can bolster a school's bottom line, enhance its contribution to society, and please politicians. A flawed program, however, can become a financial drain, raise potential conflicts of interest, and interfere with an institution's mission to teach and carry out research.



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"Technology transfer has become a focus of innovation policy in many places, and there are some high expectations," says economic sociologist Martin Kenney of the University of California, Davis. The challenge, he says, is "to get the incentives aligned right, so that everyone benefits: the inventor, the university, society. And there are plenty of ways you can get them wrong."

Singles and home runs

Although the idea of commercialization seems straightforward, its implementation is not. Legal and institutional arrangements vary by nation, by university, and even by academic department and discipline, and so do strategies. "There's really no such thing as 'typical' tech transfer," says Foresight's Speser.

Some schools try to commercialize as many discoveries as possible in hopes that a few will hit it big. Others are pickier, choosing quality over quantity. Some put their own money into spinoff companies; others don't want to run the financial risk, or are prohibited from doing so. Given the vastly different budgets, cultures, and goals of modern research universities, "there cannot be a single template for technology transfer," concluded a 2010 report from the National Research Council (NRC) of the U.S. National Academies entitled *Managing University Intellectual Property in the Public Interest*.

In general, however, Egypt and most other nations are following a path blazed by the United States. In 1980, federal legislators responded to concerns that government red tape was trapping many inventions in the lab by passing the Bayh-Dole Act. The law gave U.S. universities an unambiguous right to claim ownership of promising discoveries, such as cancer-fighting molecules or better computer algorithms, even if the research was conducted with public funds. Since then, dozens of countries have adopted similar policies.

Generating good ideas is just the first step. If an invention appears to have commercial value, a university can create intellectual property (IP) by applying for a patent, copyright, or some other form of ownership that it can legally enforce. The university can then sell or license the right to use the invention to one or more companies—or assume the risks of launching its own startup. Any payments or profits are typically divided equally among the inventor, the inventor's academic department, and the university's general fund.

The Bayh-Dole system has opened the door to some eye-popping payouts. In 2005, for example, Stanford earned $336 million from selling its stake in Google, and New York University and its researchers have earned more than $650 million since the mid-2000s from the science underpinning Remicade, an arthritis drug. In 2011 alone, Northwestern University in Evanston, Illinois, earned $192 million from its tech transfer operation, topping the most recent annual chart assembled by AUTM. And a federal jury recently awarded a whopping $1.2 billion to Carnegie Mellon University in Pittsburgh, Pennsylvania, after it found that a semiconductor company had used the university's inventions without permission. (The company is appealing the verdict.)

The problem facing would-be copycats is that such windfalls are the exceptions, not the rule. "The great majority of [university] inventions generate modest revenues and many generate none," the NRC report found. "A handful of universities and a small fraction of all inventions are responsible for a large fraction of the revenues received."

In recent years, for example, analysts estimate that fewer than 15 of the roughly 100 major U.S. universities have reaped more than 50% of all commercialization revenues, which totaled $2.5 billion in 2011. And less than 1% of the thousands of academic licenses granted in the last few decades have generated more than $1 million in royalty income. (That low batting average is true even at Stanford.) Indeed, many U.S. schools earn much more from television contracts to broadcast athletic events than they do from tech transfer. Universities in Europe and Asia fare even worse, on average, using similar financial metrics.

The bottom line, the NRC report says, is that tech transfer pro-

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This is the fifth is a series of articles on global research universities. Previous stories have examined how mobility shapes an institution (7 September 2012, p. 1162), the growth of satellite laboratories (28 September, p. 1600), how France and Germany hope to strengthen a handful of elite universities (2 November, p. 596), and the problems facing the fledgling King Abdullah University of Science and Technology (7 December, p. 1276).

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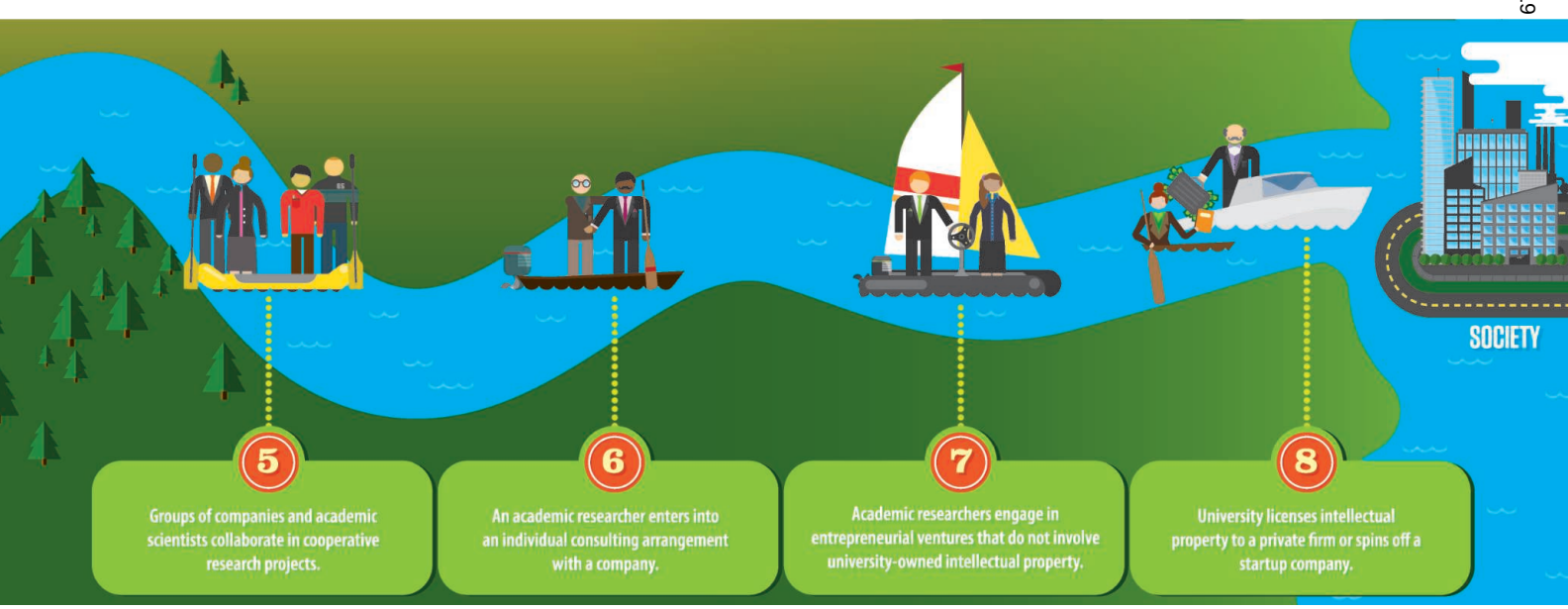

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grams "should not be predicated on the goal of raising significant revenue for the institution. The likelihood of success is small and the probability of disappointed expectations high."

A USTAR is born

Those fiscal realities haven't prevented technology transfer from becoming a powerful tool for some research universities in attracting star scientists, obtaining more funding, and moving up in the academic rankings. In Utah, for example, the state's two major public universities—the University of Utah (UU) and Utah State University—have used a high-profile commitment to commercialization to help persuade state officials to spend nearly $100 million since 2007 on the Utah Science Technology and Research Initiative (USTAR).

The program has helped the two universities build state-of-the-art laboratories, strengthen their tech transfer offices, and offer hefty startup packages to new faculty members working in a handful of fields. Those areas, including biomedicine, nanotechnology, and energy, were deemed most promising by a USTAR governing board made up of business and education leaders. In return, the universities have promised to generate new patents, licenses, and spinoff companies that would create good jobs and plenty of tax revenue (and potentially revenue for the inventor and the school).

Incubator. A new research laboratory at the University of Utah is part of a state-funded effort to attract star scientists.

CREDIT: IMAGE COURTESY OF THE UNIVERSITY OF UTAH

The link between commercialization and academic quality makes sense, outsiders say. "A good commercialization record is an outcome of having a good university, not the other way around," says economist Jerry Thursby of the Georgia Institute of Technology (Georgia Tech) in Atlanta. It didn't hurt, however, that UU already had a solid record of commercializing research and ranks among the top 20 U.S. institutions in creating startup companies and earning commercialization revenue.

So far, USTAR seems to be paying off for the two schools. The money has helped them hire about 50 scientists, who in turn have won more than $190 million in government research grants. That's definitely punching above their weight, university officials say: Although USTAR researchers represent just 1% of the total faculty at both schools, their presence has boosted extramural funding at the two schools by 5%. "USTAR was designed to allow us to aggressively recruit very productive scientists, and it is working," says USTAR chief Ted McAleer.

UU chemist Shelley Minteer is one of those scientists. "I was intrigued and impressed by how well tech transfer was integrated into the effort—the process is really valued by the university," says Minteer, who was recruited last year from Saint Louis University in Missouri. She has two technologies, including one involved in producing solar power, under review for their commercial potential, and says that tech transfer officials "make it very easy to get help with developing your ideas."

Overall, USTAR researchers have so far filed about 340 such invention disclosures that have generated more than 200 patents. Those numbers top the performance of the average faculty member, as well as USTAR's own projections.

Turning USTAR into cash and jobs, however, has proven difficult. The patents have so far produced less licensing revenue than originally forecast, and although the program has spun off nine companies, many are struggling to thrive, McAleer says. However, he cautions that it often takes 7 years for ventures to start to pay off.

The program has also experienced growing pains. The recession led to a cut in state funding, one of the new state-funded buildings has higher than expected operating costs, and officials are still tinkering with the best way to organize the USTAR teams.

Still, university officials see many advantages from USTAR. The program has created a buzz in the business community and solidified the standings of both universities in world rankings of science departments. UU, for instance, has jumped 11 slots since 2007, to 82nd in 2012, in a world ranking of research universities developed by China's Shanghai Jiao Tong University.

State politicians appear happy with the results. The governor has asked for $20 million to keep USTAR rolling in 2013, and $25 million for 2014. University administrators don't know how long that political support will hold up, however, if USTAR fails to generate long-term jobs or licensing revenue.

Going with the flow

Although many university and government officials point to USTAR as a promising commercialization model, some question the wisdom of using patenting and licensing metrics to prove its worth. Those statistics, although relatively easy to collect and present, can overshadow an array of factors that are harder to quantify, including other ways that knowledge flows from academia into the private sector. Too often, those pathways are overlooked because public discussion is "skewed by the abundance of data regarding licensing" and other financial metrics, the NRC report concluded.

In recent years, scholars have identified at least eight major pathways for "knowledge transfer" from universities—of which licensing intellectual property is just one (see graphic). The others include informal contacts between researchers and industry, private consulting contracts between university scientists and firms, and research collaborations that allow students to take jobs in industry and government. The use of a broader array of metrics would bolster the rankings of some universities that are now seen as tech transfer weaklings, researchers argue, especially in Europe, where universities often lag behind comparable U.S. campuses in traditional commercialization measures.

To capture a more complete picture, many academics and university groups are now trying to devise new metrics. The Association of Public and Land-grant Universities, a collection of 218 U.S. institutions, for example, is in the midst of a multiyear effort to quantify knowledge transfer with such metrics as the number of times local businesses seek advice from a professor or the number of student interns that a company hires.

Such interactions were very much on the mind of engineer C. Daniel Mote Jr., incoming president of the U.S. National Academy of Engineering, during his 12 years as president of the University of Maryland (UMD), College Park. When he began his tenure, in 1998, he recalls, many universities were ramping up their tech transfer offices, with some making "pretty unrealistic claims about how much money they could make." Mote preferred a knowledge transfer approach that placed less emphasis on the bottom line.

"I was much more inclined to build relationships [with industry] rather than build revenues," he says. "I wanted to create an entrepreneurial culture with lots of opportunities for interactions between

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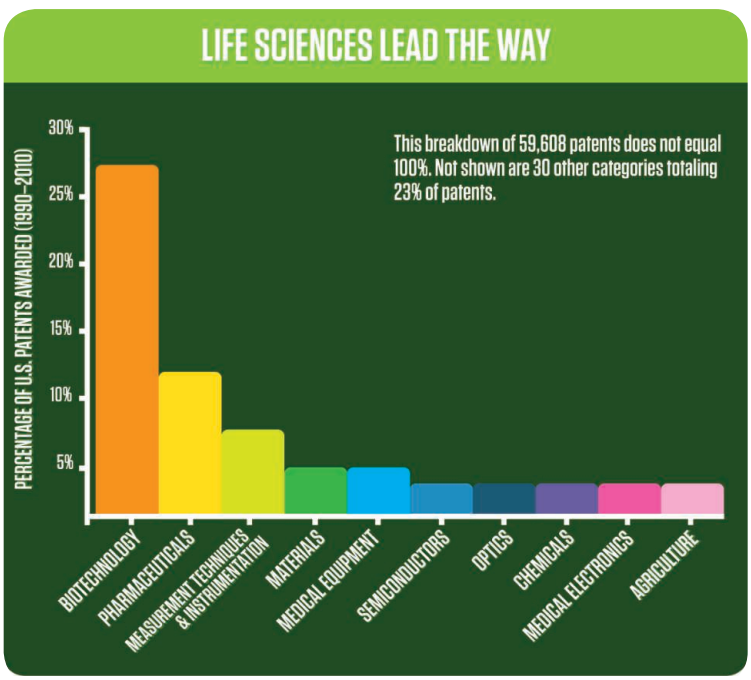
faculty, students, and companies." Students, he adds, "are basically your principal tech transfer asset; they transfer skills and enterprise to the community."

That philosophy has helped shape an array of institutional arrangements at UMD, including events intended to maximize interactions with potential industry partners. Along with a traditional patenting and licensing operation and "incubators" where entrepreneurial faculty members and students can nurture their startups, there's also a growing undergraduate entrepreneurship program and informal mixers with business leaders and local venture capitalists. The school's Maryland Technology Enterprise Institute (Mtech) also hosts regular entrepreneur hours where anyone can get advice from experts on commercializing their ideas regardless of their relationship to the university.

At one gathering last year, for instance, two UMD geneticists wondered if they could sell information about equine DNA to racehorse breeders, while a local businessman described trying to commercialize a patented recipe for converting discarded crab shells into a valuable biochemical. "We're interested in creating connections in the broader community, not just on campus," says Dean Chang, a former computer science entrepreneur who now helps lead UMD's innovation programs. Those connections are in line with the university's mission to help develop the local and national economy, Chang and other college officials say.



Intellectual property. Academic discoveries related to biotechnology and new drugs have been the top sources of patents won by U.S. universities in recent years.

UMD's approach is consistent with research showing that "innovation requires an ecosystem and experience, not just an office," says Lesa Mitchell, a vice president of the Ewing Marion Kauffman Foundation in Kansas City, Missouri, which has funded extensive studies of commercialization. "You want a rich mixing bowl where people are running into each other in all kinds of settings." Large urban campuses with diverse, well-developed economies often have an edge, she adds, because cities can provide a critical mix of skilled talent, influential contacts, and investment capital.

Many universities are also experimenting with ways to cut the red tape surrounding IP. One approach is to offer potential partners standardized online legal agreements executed with the click of a mouse. Other institutions are going further, allowing professors and students to found startups without a license from the university. Todd Sherer, the president of AUTM and head of the technology transfer office at Emory University in Atlanta, says schools taking that approach are essentially saying: "Don't worry too much about charging for this technology now; we'll get it back in donations later if the company succeeds."

Economist Marie Thursby of Georgia Tech, who has spent decades studying tech transfer, likes those approaches. "Inventions shouldn't get tied up just so the university can get its cut," she asserts.

Making an impact

In Egypt, Ellaithy has tried to draw on such advice as he builds a tech transfer office at his nearly century-old university. Although relatively small, AUC is known as one of the country's best. Roughly one-third of its approximately 5500 undergraduates and 1500 graduate students study science and engineering, and the university recently launched its first doctoral programs, starting with technical fields.

But research spending is sparse by U.S. and European standards, representing only 5% of the university's $180 million operating budget. And AUC professors often aren't eligible for government funding because of national policies favoring public institutions. "We're used to being creative and fending for ourselves," he says.

That creativity got a new outlet in 2002 when the Egyptian government rewrote intellectual property laws to make it easier for universities to take ownership of ideas developed by their scholars. In 2009, AUC and three other Egyptian universities won a grant from the European Union to set up academic commercialization offices and hired Ellaithy to lead the effort. He says he spent much of his first year "looking for approaches that might work for us."

In the end, AUC leaders opted for a version of what some call an "impact first, income later" strategy. They hope tech transfer will become a platform for building relationships with industry that might lead to collaborative research funding, jobs for graduates, and other, more personal forms of transferring technology. In the short run, new companies and licensing revenue would be icing on the cake, Ellaithy says.

One of Ellaithy's first jobs was to persuade faculty members to reveal their discoveries so his office can vet them for possible IP protection. Faculty members around the world are often reluctant to make such "disclosures," and Ellaithy notes that entrepreneurial academics in Egypt have traditionally felt entitled to own and commercialize their work.

At AUC, however, he has been pleasantly surprised by the faculty's response. Since the 2.5-person office formally opened in 2010, it has prepared a dozen patent applications and is in the process of standing up its first startup company, which is developing a quick diagnostic tool for hepatitis C invented by AUC chemist Hassan Azzazy. Ellaithy is also drafting new conflict of interest rules in a bid to head off problems. "We're sort of swamped," he admits.

Despite these early achievements, Ellaithy knows that tech transfer is a marathon—and that success isn't measured solely by monetary gains. "We might shoot ourselves in the foot if we do really well with licensing one year," he says. "People could come to expect that's the way it is always going to be."

–DAVID MALAKOFF

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