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UNIVERSITY TECH TRANSFER: HAVE I GOT A BUSINESS IDEA FOR YOU

DISTRICT UNIVERSITIES STRIVE TO LICENSE TECHNOLOGY TO INDUSTRY,
BUT THEIR EFFORTS MAY NOT YIELD THE DESIRED RESULTS

By PHIL DAVIES
Senior Writer

The University of Minnesota plays in the big leagues of technology transfer. Over the years, the state's flagship institution of higher learning has patented hundreds of inventions by its researchers and licensed their use to companies across the continent and around the world. In 2006, the university pulled in \$56.2 million in licensing fees and royalties, placing it fourth among U.S. universities ranked by licensing income.

But for all its success, the university believes that it can do even better at converting scientific discovery into intellectual property that can be patented and licensed to private enterprise. Over the past two years, the university has revamped its tech transfer operations in a bid to boost the commercial potential of patents and licenses, and to launch more startup firms.

The university's research arm wants to bring in more revenue from industry to make up for anti-

pated reductions in federal research funding. And state government and business groups have urged the university to strive harder to deliver the output of university labs to the marketplace. "Obviously the state expects a lot from us, our corporate partners felt that we could do a better job, and we ourselves felt we could do a better job," said R. Timothy Mulcahy, the university's vice president for research.

Since 2006, Mulcahy, recruited from the University of Wisconsin-Madison (an archrival in tech transfer), has reorganized the university's tech transfer operation and focused it on patenting and licensing inventions with the best chance of commercial success. "Technology strategy managers" work with researchers to assess discoveries, then hand off the most promising ones to other staffers, who market them aggressively to potential licensees. An expanded entrepreneurial program aims to increase the number of new companies launched from the university by providing mentoring and financial assistance to licensed startups.

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Tech transfer from page 1

The U of M isn't the only research institution in the Ninth District devoting significant resources to tech transfer, specifically patenting and licensing activities carried out by tech transfer offices, or TTOs. The Wisconsin Alumni Research Foundation (WARF), a nonprofit organization that serves as UW-Madison's tech transfer arm, has increased its patenting and licensing staff from 30 to 40 in the past five years. (Madison lies outside the district, but Wisconsin's top research institution exerts its influence throughout the state and beyond.)

Likewise, much smaller research universities have expanded their TTOs or taken steps to increase their licensing output in recent years. Montana State University (MSU) in Bozeman has doubled its patenting and licensing staff to four since 2003, when the university ended an outsourcing arrangement and established an internal TTO. South Dakota State University (SDSU) in Brookings plans to open a TTO this year.

This intense interest in tech transfer by district universities is part of a national trend toward increased patenting and licensing of academic research in the past 20 years.

The pressure to commercialize stems partly from a law that encourages universities to make discoveries resulting from taxpayer-funded research available to industry in order to foster prosperity and improve the lives of all Americans. Universities also see the marketing of academic innovation as a driver of regional and local economic develop-

ment, the high-tech path to wealth creation and job growth.

But an examination of university patenting and licensing in the district suggests that this entrenched, increasingly popular model of tech transfer isn't as sharp a spur to technological progress and regional economic development as universities and their stakeholders believe. There's scant evidence that university licensing has resulted in greater technological advances than would have occurred if university discoveries had been made freely available to companies through published research. Licensing, while a lucrative enterprise for some institutions, has limited impact on regional and local economies, because most of the licenses issued by district universities go to firms outside their home states. And TTOs aren't very good at launching startups, key generators of innovation and growth in the technology sector.

This doesn't mean that academic research has no effect on technological progress, the national economy or regional competitiveness. A stream of inventions based on university discoveries over the past century—CT scanning, taconite processing, the Internet—testifies to the immense scientific and economic impact of university research. But licensing isn't the only way for businesses to tap into the wellspring of basic research flowing from university labs, and it's probably not the best way.

The high-profile activities of TTOs have "led to the assumption that tech

transfer means licensing of university intellectual property," said Richard Lester, director of the Industrial Performance Center, a think tank at the Massachusetts Institute of Technology (MIT) that studies trends in industry. "It doesn't. It partly means that, but it means a lot of other things too."

From lab to market

Unlike General Mills or 3M, a university can't take new technologies directly from the lab to the marketplace. To convert the discoveries of researchers into marketable products, it must make them available to companies with the interest and means to invest in them further and put them on the market. Since the mid 1980s, more and more universities have turned to patenting and licensing to accomplish this transfer of technological know-how.

The Bayh-Dole Act of 1980 created a uniform policy for allowing universities to claim legal rights to inventions resulting from federally funded research and license their use to firms. The purpose of the law, passed by Congress at a time of concern about U.S. global competitiveness, was to ensure that inventions paid for with public funds were commercialized not only to boost business, but also to promote the general welfare. Advances in medicine, information technology, agriculture and other fields benefit private firms that profit from increased sales; but the public benefits as well from economic growth and enhanced quality of life.

In the tech transfer system that Bayh-Dole codified, the mechanism that transforms lab breakthroughs into market value is the licensing of intellectual property. Universities have a financial incentive to patent discoveries and license their use to companies in return for a cut of future sales.

The bulk of university licenses issued to companies are exclusive, giving only one company the right to profit from a patent. The reasoning behind this exclusivity—contested by many economists—is that without it firms would not invest in costly further development of early-stage university inventions. Introducing a new drug can cost over \$1 billion in research and development.

"When you make something publicly available, you almost ensure that it will not be commercialized," said Jay Schrankler, executive director of the U

of M's Office for Technology Commercialization (OTC). "If everyone has access to the same technology, who will commercialize it?"

University inventions follow a fairly standard path toward commercialization, often running into diversions and dead ends. Most institutions require faculty, students and staff to disclose their discoveries to the TTO, which handles the process of laying claim to an invention on behalf of the university and—if the opportunity arises—licensing it to a company. Nationwide, about one in four disclosures results in a university patent. (Some inventions, such as software and medical protocols, are copyrighted rather than patented.) Instead of committing to a license, a firm may take out an option on the technology that provides for an evaluation period.

In a common scenario, TTO staffers try to identify and negotiate with a company willing to license the technology before applying for a patent, which can cost tens of thousands of dollars in filing and attorney's fees. If the TTO can't work out a deal with an established firm—or if the inventor burns with entrepreneurial zeal—it may lend a hand in forming a new company to license the discovery. Often the university takes an equity position in the startup.

Commercially successful licenses yield royalties that are split between the inventor and various units of the university. Faculty, staff or student inventors at the U of M receive one-third of net royalty revenue after TTO expenses. At MSU, the inventor's cut is half of net revenues; WARF pays inventors 20 percent of gross royalties. Depending on university policy, the balance can be distributed in any number of ways among the graduate school and the inventor's academic department and college to fund research and student support.

Go forth and license

Since the 1990s, academic patenting and licensing has surged across the country. According to data compiled by the Association of University Technology Managers (AUTM), between 1997 and 2006, the number of patent applications filed annually by U.S. universities more than tripled, and the number of licenses and options executed increased 155 percent.

A survey of the district's research uni-

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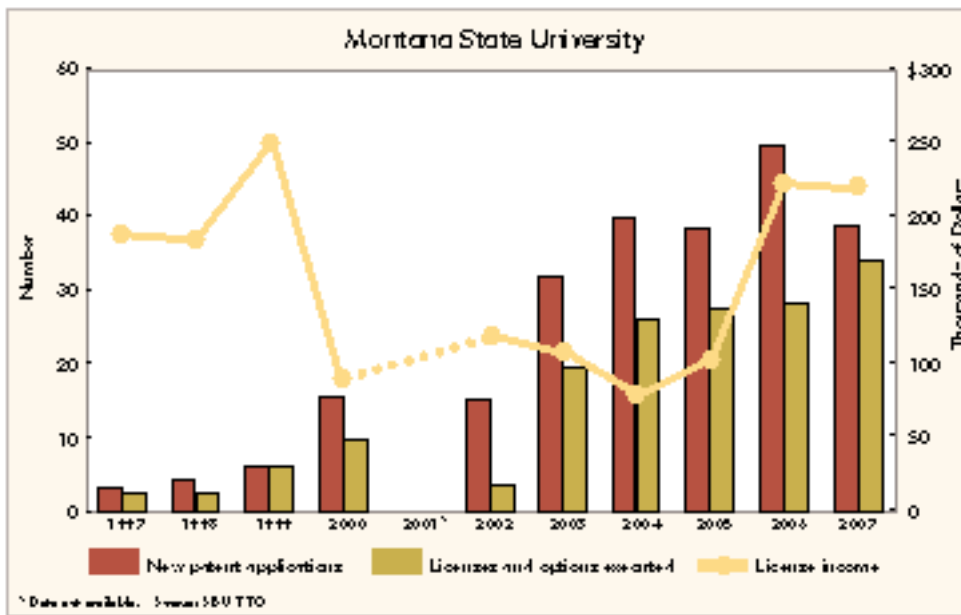
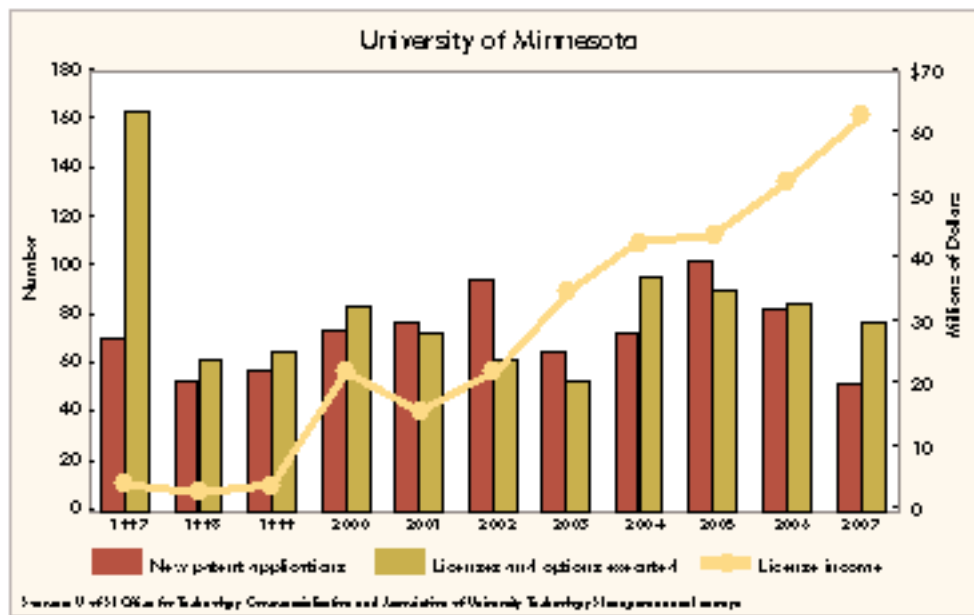
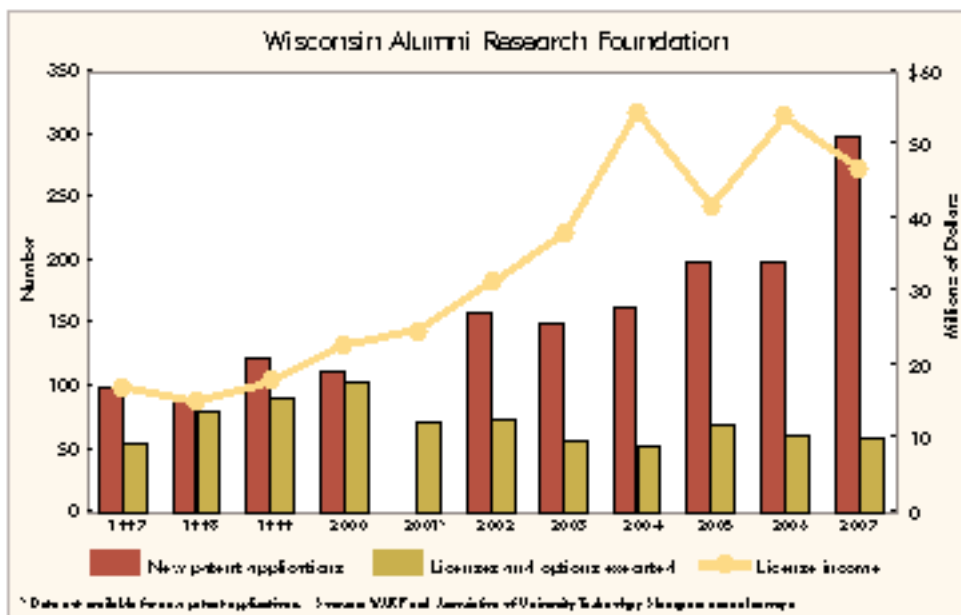
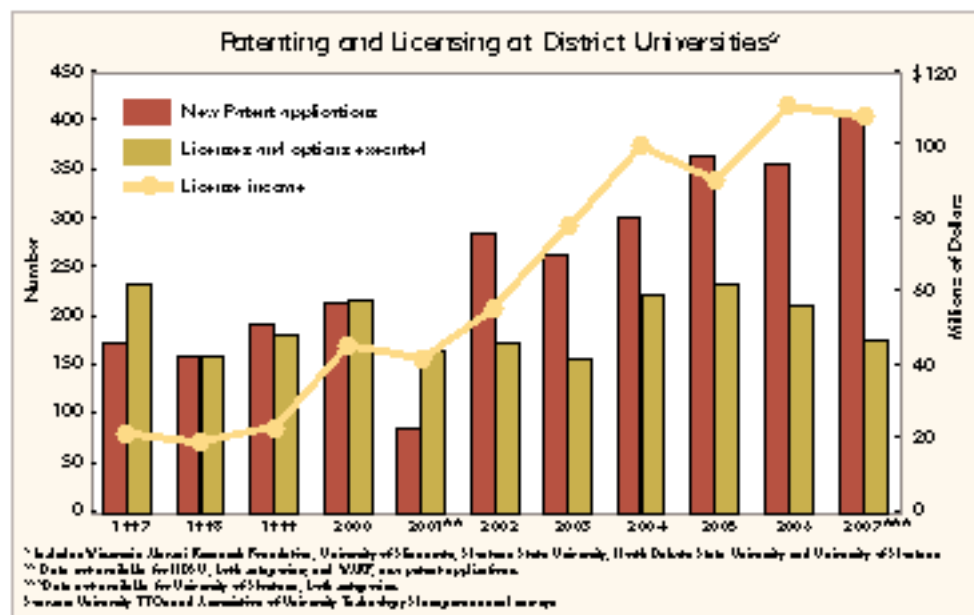
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One of the Minneapolis Fed's congressionally mandated responsibilities is to gather information on the Ninth District economy. The *fedgazette* is published bimonthly to share that information with the district, which includes Montana, North and South Dakota, Minnesota, northwestern Wisconsin and the Upper Peninsula of Michigan.

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The university's research arm wants to bring in more revenue from industry to make up for anticipated reductions in federal research funding. And state government and business groups have urged the university to strive harder to deliver the output of university labs to the marketplace.



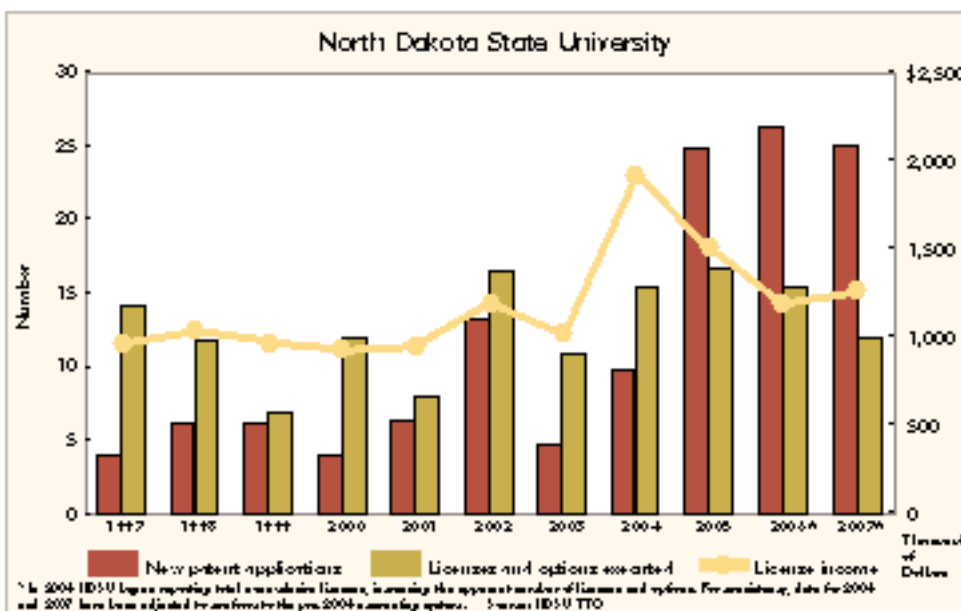
universities shows that they too have increased their patenting activity over the past decade. The aggregate number of new patent applications by the schools more than doubled between 1997 and 2006, although this jump in patent filings hasn't resulted in a commensurate increase in licensing output. Total licensing revenue has mushroomed (see chart above).

A major impetus for this heightened tech transfer activity—aside from the desire to draw upon an alternative source of research funding—is the conviction that patenting and licensing by universities contributes to economic growth through technology creation. Licensing discoveries to industry is seen as benefiting the national economy and having an even greater salutary effect on the econ-

omy of a university's "home" state or city.

Made available to the private sector through licensing to startups or established firms, the U of M's research has a "differential impact" regionally, Mulcahy said, strengthening and diversifying industry through technological innovation. Many business and community leaders share this view of university licensing to firms as a boon to state and local economies. One influential voice that urged Mulcahy to upgrade the U of M's tech transfer programs was the Itasca Project, a group of Twin Cities CEOs and civic leaders dedicated to economic progress in the metro area.

So how are district universities doing in meeting the goals of tech transfer—the first, the explicit intent of Bayh-Dole



Each university's share of licensing revenues far exceeds its tech transfer operating costs. The OTC's budget was \$6 million last year—less than 10 percent of the U of M's gross licensing revenue. "If you looked at this as a [profit and loss statement], you would think it was the most incredible thing you've ever seen." —Jay Schrankler, University of Minnesota

Tech transfer from page 3

and the second, an implicit expectation by universities and their sponsors? How well do TTOs disperse the fruits of university research for the public good, and to what extent does licensing contribute to the economic growth of the region and individual communities?

The answers to these questions depend on how you measure performance.

Heavyweights and lightweights

One way to measure success in tech transfer is by counting patents, licenses and licensing revenue. By that yardstick, some research institutions in the district score high against national benchmarks in commercializing their discoveries. Others are much less active in patenting and licensing, but doing quite well considering the size of their research budgets.

The U of M and UW-Madison are the district's tech transfer heavyweights, befitting their ranking in the top 10 of U.S. research universities based on annual research expenditures. Generally speaking, the higher a university's research expenditures, the more disclosures, patents and licenses it produces. The U of M spent \$595 million on research in 2006, according to the National Science Foundation. Its border rival spent \$832 million that year, second only to Johns Hopkins University.

While neither institution can match the patenting and licensing output of technology powerhouses such as MIT (121 license and option agreements in 2006) and the University of California System, their performance is on par with similarly sized public research universities. They account for the lion's share of patenting and licensing activity in the district, although their individual production fluctuates from year to year (see charts on page 3).

WARF applied for 299 patents last year and has executed an average of 70 commercial licenses and options annually since 2002. The U of M's OTC filed 51 patent applications in 2007 and has averaged 80 licenses and options annually over the past six years.

The district's heavy hitters also excel at earning licensing revenue, seen by many university administrators as a crucial source of research funding in an era of slackening government support.

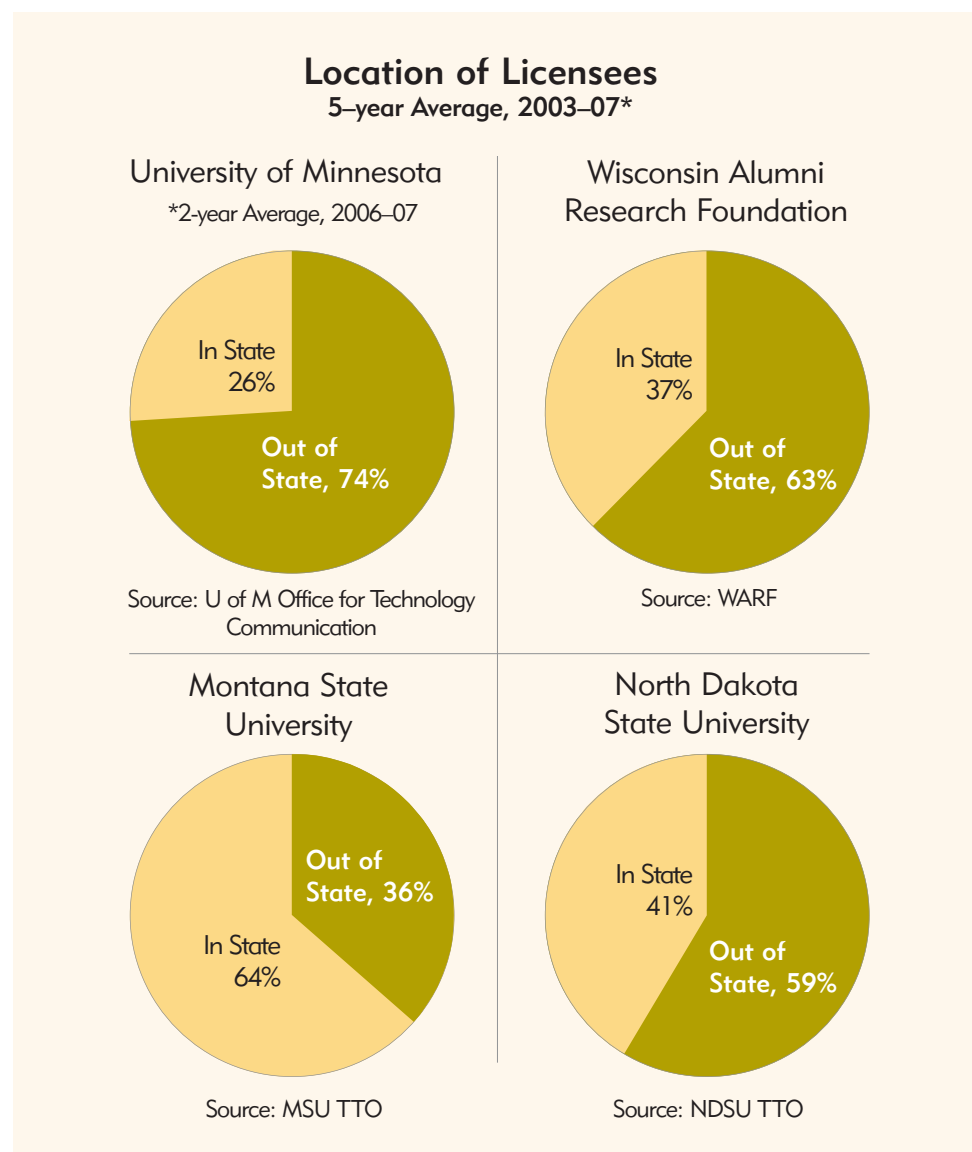
University licensing income tends to grow over time, and WARF and the U of M are old hands at tech transfer. (WARF, the nation's oldest tech transfer organization, was established in 1925.) In this decade, annual licensing income reported by both schools has steadily risen along with the cumulative total of active licenses. WARF licenses earned \$46.7 million in licensing revenue in fiscal 2007, a 45 percent increase since 2002. The U of M's \$63.5 million in licensing revenues last year more than doubled its 2002 income figure.

Each university's share of licensing revenues far exceeds its tech transfer operating costs. The OTC's budget was \$6 million last year—less than 10 percent of the U of M's gross licensing revenue. "If you looked at this as a [profit and loss statement], you would think it was the most incredible thing you've ever seen," Schrankler said.

Compared with the district leaders, MSU and North Dakota State University in Fargo are bantamweights in the tech transfer game. MSU filed 39 patent applications and completed 34 license and option agreements last year. NDSU made 25 new patent applications and executed roughly half that number of licenses. The size of the two universities' research budgets explains the disparity; both conducted just over \$100 million in research in 2006, about one-sixth of the U of M's research expenditures.

But the licensing volume of the smaller schools is equal to or higher than that of universities around the country with comparable research budgets, and that output is increasing. MSU's 2007 license production represents a 62 percent increase in four years. "I think we're right in the flow of things," said Rebecca Mahurin, director of the university's TTO. "We've set a record for license and option agreements every year since we've had it back in house." Patent and licensing activity at NDSU has been up and down since the school founded its TTO in 1995, but in the past four years, it has trended upward.

Like many small research universities that have gotten involved in tech transfer relatively recently, MSU and NDSU lose money on patenting and licensing; neither school generates enough licensing revenue to pay its TTO's expenses. In Mahurin's office, \$220,000 in licensing revenue last year didn't cover



patenting costs, let alone salaries, marketing and administrative overhead.

Other research universities in the district have sparse track records in tech transfer. They have small research budgets and lack either medical or engineering schools that typically generate a lot of patents and licenses. SDSU, the University of South Dakota in Vermillion and the University of Montana in Missoula have each executed fewer than five licenses annually this decade. (No data were available on patenting and licensing at the University of North Dakota in Grand Forks.)

Neither SDSU nor USD has a TTO, but both want to get more involved in patenting and licensing. In March, SDSU Vice President for Research Kevin Kephart was looking for a director for the university's new TTO, which he hoped could begin operations this spring.

On the market or on the shelf?

Patenting and licensing statistics, closely watched by university TTO directors and research chiefs, permit quantitative comparisons among tech transfer programs—who's topping the charts in patent applications and revenue earned, who's licensing above or below their weight class in research expenditures. But these metrics don't indicate how well universities are carrying out the primary mission of tech transfer: getting inventions into the marketplace for the public good as well as for private gain. Nor do they tell the whole story about the role of academic licensing in regional and local economic development.

"I think it's a mistake to look at overall patenting and licensing numbers and use those as a proxy for the value of

But these metrics don't indicate how well universities are carrying out the primary mission of tech transfer: getting inventions into the marketplace for the public good as well as for private gain. Nor do they tell the whole story about the role of academic licensing in regional and local economic development.

technology transfer," said Bhaven Sampat, an economist at Columbia University who has studied tech transfer by universities.

The national surge in academic patenting and licensing over the past 15 years has coincided with an increased flow of technology from universities to corporate labs. Various studies have shown that the proportion of industry patents that cite a university patent as an inventive source has increased significantly since the 1980s.

But such studies don't reveal how many of the cited university patents were licensed to a company. And just because a firm takes out a license on a university invention doesn't mean that it will lead to a new marketable product or service. Some technologies are destined to sit on the shelf, and this is particularly true of early-stage university discoveries that require further research and development investment to become commercially viable. A 2001 study of tech transfer at major universities found that only 12 percent of university inventions were ready for commercial use when initially licensed.

Reliable data are scarce on long-term economic outcomes of academic patenting and licensing—how tech transfer activity translates into new products, increased company sales, bigger payrolls and rising incomes.

It's standard practice to require licensees to report on progress toward commercialization; in some cases, a firm must hit specified development milestones in order to maintain its license. But as a rule TTOs don't track the aggregate performance of their license portfolios—what proportion of licenses has achieved a measure of commercial success five, 10 or 15 years after licensing. At the U of M, where such followup has long been lacking, Schrankler has instituted a monitoring and auditing process for licensing.

High licensing revenue isn't an indicator of market penetration, either, because at many research universities the bulk of licensing income comes from a handful of "blockbuster," lucrative licenses. The rainmaker at the U of M is Ziagen, an HIV treatment licensed to GlaxoSmithKline Inc. Royalties paid on drug sales since 1999 bring in about \$45 million annually, 70 percent of total

university licensing income. WARF doesn't disclose revenue figures for individual licenses, but Managing Director Carl Gulbrandsen said that Zemplar, a synthetic form of vitamin D, is the foundation's biggest moneymaker, earning "tens of millions" of dollars annually in royalties.

A telling revenue statistic: Less than 1 percent of active licenses held by U.S. universities in 2001 yielded \$1 million or more in annual revenue, according to AUTM. The vast majority of licensed inventions gain little traction in the market.

Without solid data on the market impact of tech transfer, it's impossible to say whether patenting and licensing has likely resulted in more commercialization than would have occurred if university discoveries had entered the public domain through graduate education, articles in academic journals, conferences and other traditional channels for disseminating knowledge.

Sampat, among other economists, rejects the notion voiced by Schrankler that university inventions must be licensed exclusively if they are to stand a chance of being commercialized. He said that this idea, the justification for university licensing under Bayh-Dole, stems from the pharmaceutical industry, in which new chemical compounds often have narrow and obvious applications in medicine. Exclusive licensing may be called for to keep competitors at bay while a company makes the necessary investment to refine the compound and steer it through clinical trials.

But in other industries—electronics and information technology, for example—a university discovery may lead to different lines of industry research, each with the potential to yield an array of patentable processes and products. In such instances, Sampat said, granting one firm sole use of an invention may hinder, rather than spur, technological progress. "The Bayh-Dole model may work for embryonic pharmaceuticals, but the whole world is not embryonic pharmaceuticals," he said.

I'll take that to go

Gulbrandsen is well aware of the political value of licensing to Wisconsin companies. Licensing to state firms shows lawmakers in Madison that the university is doing what it's supposed to as part

of its land-grant mission—promote technological and economic progress in the state by sharing its knowledge with local industry. That fosters goodwill at the Legislature, he said, helping to garner support for day-to-day operations. "This is a state university, and if we were licensing all of the technology out of state, that ultimately would damage the image of the university when dealing with the Legislature at budget time."

But this perception of technology licensing as an engine of regional economic development is overblown, and not just at UW-Madison. The benefit of university licensing to regional and local economies in the district is less than that implied by licensing totals, because the bulk of licenses go to companies outside each school's home state (see charts on page 4). Last year, 62 percent of licenses and options executed by WARF went to firms headquartered outside Wisconsin. (The five-year average is 63 percent.) Two-thirds of U of M licensees in 2007 were based outside Minnesota, and NDSU's out-of-state percentage has averaged 59 percent in recent years.

The only district university with an active TTO that regularly executes more than half of its licensing agreements with in-state companies is MSU; last year, 53 percent of its licensees were Montana firms.

Why do the majority of licenses granted by district universities go to firms outside the school's home state? Schrankler of the U of M cites the "massive diversity" of intellectual property at the university eligible for licensing. Most in-state licenses are for medical devices, new chemical compounds and discoveries in biology and food science—all strengths of Minnesota industry. Finding a local niche for other types of inventions is more difficult, Schrankler said. New drugs, for example, are much more likely to be licensed by large pharmaceutical companies on the East Coast.

Dale Zetocha, director of NDSU's TTO, has his work cut out licensing any technology that doesn't go in the ground to in-state firms. Over 80 percent of NDSU license and option agreements with North Dakota firms are for agricultural innovations—novel varieties of wheat and barley or new herbicides. In a state with little high-tech industry, licenses for software, electronics, advanced

polymer coatings and other non-ag inventions often go begging. "For some technologies there may not be a particular firm [in the state] that would have the capabilities to license that type of technology," Zetocha said. "Sometimes you have to look around the country to try to find any kind of company that might be a good fit."

MSU's relatively high proportion of in-state licensing may be due to the presence of more than 50 high-tech firms in Bozeman, including several laser optics firms that have benefited from the university's cutting-edge research in electro-optics. About a third of the area's high-tech firms hold active MSU licenses, Mahurin said.

Some licenses go to out-of-state firms with local manufacturing or sales facilities (WARF licensee General Electric operates a health care division in the Milwaukee area). Nevertheless, when companies outside the region leverage university technology, the economic benefits of that technology—assuming it reaches the marketplace—are dispersed. Some "knowledge spillovers" trickle down to the university's home state and city, but not as much as would accrue if locally owned firms made use of those licenses.

Another factor lessening the impact of licensing on state and local economies is universities' modest success at starting new companies to exploit licensed technology. Startups are crucial to the development of local high-tech economies because they create new wealth and employment that increase exponentially as young companies grow and spin off more startups. But the number of licensed startups spawned annually by TTOs is low compared with the number of unlicensed startups that are either affiliated with a research university in some other way or have no academic connection at all (see "The few, the risky," page 8).

Costs vs. benefits

All this is not to say that patenting and licensing by TTOs hasn't contributed to the flow of innovation from universities to industry. It's likely that some drugs, medical devices and other products wouldn't have reached the market without the intellectual property protection

This perception of technology licensing as an engine of regional economic development is overblown, and not just at UW-Madison. The benefit of university licensing to regional and local economies in the district is less than that implied by licensing totals, because the bulk of licenses go to companies outside each school's home state.

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afforded their developers by exclusive licensing. It's also possible that diligent marketing by TTOs has helped to push worthy technologies into the marketplace that otherwise would have died on the vine.

But there's ample evidence that what many universities view as the primary mode of technology transfer is not the most important pathway taken by university discoveries en route to industry labs and commercial success. Alternative channels prized by businesses themselves include published research, university-industry cooperative projects and learning that students transfer to the workplace upon graduation (see "Old-fashioned tech transfer," at right).

The limitations of licensing as a driver of U.S. technological innovation and regional and local economic growth puts the onus upon district universities to carefully weigh the costs and benefits of this approach to technology transfer. Devoting resources to direct commercialization leaves fewer resources available for other university functions, including basic research and education.

Licensing technology may be profitable at some universities, supplementing government support for research. (Last year, U of M licensing revenue applied to research amounted to about 7 percent of all research funding from external sources.) But it's debatable whether such activity serves the original purpose of Bayh-Dole or significantly boosts state and local economies. There's the risk that the pursuit of more licensing revenue to fund research can become an end in itself, impeding rather than facilitating the flow of ideas between campus and industry labs.

Most TTO managers downplay generating income as a goal of their programs. "We certainly want to get good money for our technology, but our more important issue is to see that the technology gets used," said Gulbrandsen of WARF. Yet biotech firms have criticized the organization for charging high licensing fees for the use of its stem cell patents, thereby discouraging further research.

Assessing costs and benefits is especially called for at universities such as MSU and NDSU that currently lose money on their tech transfer opera-

tions. These programs may become self-supporting as the number of active, revenue-producing licenses in their portfolios increases. Or they may continue to be financial sinks.

Sustaining losses may be justified if piping intellectual fuel to technology companies stimulates regional and local economic growth. But as NDSU has found, licensing discoveries in your own backyard can be a tall order in small markets without large concentrations of industry. And university licensing is rarely the main factor in the development of local high-tech "clusters"—concentrations of firms in related industries. An important ingredient of Bozeman's success as a technology mini-hub is its mountain setting that has attracted entrepreneurs who have founded companies with or without an MSU license.

Lester of MIT advises universities to adapt their tech transfer strategies to the economic realities of their home states or communities. Licensing university inventions may indeed promote growth in state and local economies if sufficient demand exists for those nascent technologies. If not, a better approach might be to give technology companies seeking to improve their processes and launch new products what they've always sought from research universities: smart graduates and open access to knowledge. In one market, a university may focus on developing continuing education and technical assistance programs; in another, technology conferences and collaborative research projects.

"In any economic environment I would urge a broader view of the university's role in the economy than just patenting and licensing," Lester said. **f**

OLD-FASHIONED TECH TRANSFER

LICENSING ISN'T THE ONLY WAY FOR
INDUSTRY TO TAP INTO UNIVERSITY
KNOWLEDGE

RightNow Technologies of Bozeman, Mont., doesn't license any technology from nearby Montana State University. The 11-year-old, rapidly growing firm developed its products—software programs to manage customer service and sales—in-house, using code written by its own software engineers. But the company depends on MSU nonetheless, as the go-to source for those programmers and other highly skilled workers. Over 20 percent of the company's 700 employees hold MSU degrees, said Chief Operating Officer Susan Carstensen, who herself is an alumna.

It's "highly unlikely" that the firm would be in Bozeman—a small city remote from coastal information technology centers—without the opportunity to hire MSU graduates, she said. "That source of talent is so important, especially in the computer science area. ... [T]he Internet removes geography, but you still have to have a great source of human capital."

Research universities play a vital role in promoting innovation in the marketplace and prosperity in their home states and communities. For RightNow and technology companies across the district and nation, much of this knowledge transfer occurs through conduits that existed long before passage of the Bayh-Dole Act of 1980. The most obvious and broadest of these alternative pathways are education and public research, the traditional twin missions of research universities.

University teaching provides industry with a renewable source of human capital—graduates who use their knowledge and skills to create new, commercially viable products, processes and services. "It is often said that the best form of technology transfer is the moving van that transports the Ph.D. from his or her university laboratory to a new job in industry," wrote Massachusetts Institute of Technology professor Richard Lester in a 2005 report on universities' contribution to local economic development.

Often freshly minted baccalaureates, masters and doctorates take jobs in their alma mater's host city or state, enriching the area talent pool. A 2006 survey of graduates from the Twin Cities campus of the University of Minnesota found that over 80 percent of Minnesota resident students who earned a four-year degree were living in the state five years later. It also found that almost half of international students who earned a baccalaureate degree were living in Minnesota.

Companies tap into basic university research through publications in scholarly journals, presentations at conferences and seminars, and informal elbow rubbing with academic researchers. By enhancing understanding of scientific principles underlying technology, basic research increases the efficiency of research and development carried out by industrial labs. The result: more

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industry-patented inventions, marketable products and corporate revenue flowing through the economy.

Studies of industrial patents have demonstrated that openly published academic research stimulates commercial innovation to a greater degree than university patenting and licensing. Unpublished research by Bhaven Sampat, an economist at Columbia University, shows that this is true even in the pharmaceutical industry, where exclusive licensing is commonplace. In his analysis of drugs approved by the U.S. Food and Drug Administration over the past 25 years, less than 5 percent of the drugs owed their development directly to licensed academic patents. Nearly one-third were based on general university patents or published research.

Other modes of tech transfer that don't necessarily involve licensing and patenting include:

- Agricultural extension offices, technical assistance programs, small-business assistance centers and other free university programs that help businesses solve problems or improve products and services.
- Cooperative relationships between universities and industry focused on carrying out applied research or testing infant technologies (although such links raise concerns about the commercialization of university research—more on this below).
- Consulting to industry by individual faculty members, either for a fee or on a pro bono basis.
- Public forums such as university-hosted conferences, seminars and alumni events for the exchange of information about new technology and market opportunities.

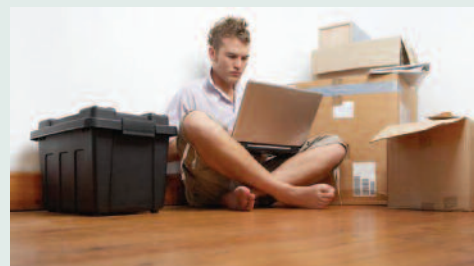
The ties that bind

When asked about tech transfer, businesses themselves express a strong preference for these alternative, often overlooked channels of tech transfer. In a 2007 University of Minnesota survey of top executives at Minnesota firms, the top three reasons given for seeking assistance from the university were to hire students, participate in continuing education programs and make use of university faculty and research facilities. Licensing technology from the university ranked fifth.

National studies of industry attitudes toward tech transfer have yielded similar results. A 2002 survey of manufacturers found that in most industries, R&D managers considered licensing technology from universities much less important than publications, conferences and informal interaction with university researchers.

Anecdotal evidence supports the idea that many companies sustain advantageous connections with research universities that go far beyond licensing agreements.

Rural Technologies Inc., a veterinary contract research firm in Brookings, S.D., does license university technology—diagnostic reagents invented at South Dakota State University that it sells to research institutions. But that's just one nexus between the company and the university. Eighteen SDSU



graduates or faculty members work for the 22-employee company, either as staff or consultants. “A lot of people here at RTI have ties with SDSU,” said Chris Mateo, the firm's chief operating officer. “They were students at SDSU, or related in some way to the university. There's a huge common denominator there.”

In addition, RTI staffers participate in veterinary science seminars at SDSU and work cheek by jowl with faculty and graduate students on federally funded research projects. One joint project, to develop a method of detecting chronic wasting disease in elk and deer, may yield new diagnostic tools that the company can patent and license to other companies, Mateo said.

Another frequent collaborator with university researchers is S2 Corporation, an early-stage optical communications firm in Bozeman that licenses sensor technology developed at MSU. Often the company shares federal grant funds and lab space with the Spectrum Lab, an MSU research center that strives to commercialize optoelectronic breakthroughs at the university. “We have a separate and very close relationship with MSU that is going on independent of the licensing,” said S2 President Kris Merkel.



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However, such cooperative projects—pathways for tech transfer that have become more prevalent since the 1980s—raise questions about the influence of commercial interests on university research. Research collaborations and other contractual arrangements between university

researchers and industry may effectively transfer knowledge to the private sector, but they create the potential for blurring the distinction between public and private research.

University research is mostly government funded because markets tend to underinvest in basic research—fundamental investigations of natural phenomena that cannot be readily converted into intellectual property. Allocating government funds to commercially oriented research valued by industry risks short-changing basic research without adding to the country's store of knowledge. A 2000 study of a federal grant program intended to increase commercial research by small businesses found that such research simply substitutes for research that firms would have otherwise paid for themselves.

What about research projects funded by industry? University faculty and staff involved in the SDSU chronic wasting disease study are paid consultants to RTI, the principal investigator on the U.S. Department of Defense grant that is funding the work. At first blush, industry sponsorship benefits both universities and the taxpayer. Support for applied research by “corporate partners”—last year business contributed over \$46 million to research and other programs at the University of Wisconsin-Madison—frees up university funds for basic research.

But caveats apply to sponsored research as well. Corporate funding of university research on early-stage technology is often contingent on the firm getting first crack at licensing any inventions arising from the research. Competitors are barred from making use of key elements of the research in a specified “field of use.”

And some economists fear that other types of research-for-hire that involve tire-kicking of industry inventions invite conflicts of interest. Sampat worries, for example, that commercial patronage could unduly influence academic researchers performing clinical trials of new drugs.

—Phil Davies

Startups are powerful engines of economic transformation because they tend to stay in the communities where they were born, increasing their payrolls and tax contributions as they prosper. And in high-tech regional “clusters” such as Madison and the Twin Cities, one thriving startup often leads to the birth of another that in turn begets its own spin-offs.

THE FEW, THE RISKY

SHOULD UNIVERSITIES INVEST RESOURCES IN CREATING STARTUPS TO EXPLOIT LICENSED TECHNOLOGY

By PHIL DAVIES
Senior Writer

Success is sweet, but James Prudent is betting that the reverse is also true. Centrose, the Madison, Wis., startup that he heads, plans to use sugars to enhance the potency of existing drugs, including a treatment for lung cancer. The company’s core technology for attaching sugar molecules to drug compounds was developed by a pharmacy professor at the University of Wisconsin-Madison and licensed from the Wisconsin Alumni Research Foundation (WARF), the university’s tech transfer agency. “Our concept of enhancing drugs with novel sugars has immense market potential,” Prudent said. “The challenge now is to pick the right drugs and move them through the development pipeline.”

Earlier this year, Centrose raised \$1.3 million in private equity to fund further development of sugar-based drugs, and Prudent believes that the firm can attract more investment and grow in Madison, a burgeoning center for medical technology.

Directors of university tech transfer offices (TTOs) dream of startups like Centrose. They’re seen as a vital part of the tech transfer mission, even more important than licensing in general when it comes to stimulating local and regional economic development. Startups are powerful engines of economic transformation because they tend to stay in the communities where they were born, increasing their payrolls and tax contributions as they prosper. And in high-tech regional “clusters” such as Madison and the Twin Cities (a hotbed for medical devices), one thriving startup often leads to the birth of another that in turn begets its own spin-offs.

Licensing startups is also appealing to universities because of the possibility of a big payday if a company hits the commercial jackpot. As a condition of licensing, many universities, including UW-Madison and the University of Minnesota in the district, acquire equity in new companies—a stake worth potentially tens of millions of dollars if a

new firm subsequently goes public or is taken over by another company.

“The problem with startups of course is that they’re extremely high-risk,” said R. Timothy Mulcahy, vice president for research at the U of M. “Less than one in 10 ultimately gets acquired or goes to an IPO [initial public offering]. But they represent such a great opportunity that everyone’s pushing for them.”

Enthusiasm for startups has led tech transfer offices at research universities in the district to put considerable effort into licensing inventions to new, preferably local technology firms. WARF draws from a \$10 million Venture Fund to provide seed capital to promising startups, sometimes in tandem with venture capital firms. In the U of M’s Venture Center, a recently expanded off-campus facility focused on licensing startups, former CEOs looking for their next venture help fledgling companies write business plans, build management teams and pursue funding from private investors. Montana State University (MSU) in Bozeman works closely with TechRanch, a local nonprofit organization that assists high-tech firms, to launch its licensed startups.

The benefits that these activities bestow on universities and their communities are questionable, however. A headcount of startups that have come out of district research universities over the past decade shows that TTOs have had limited success in creating new companies through technology licensing. And the inherent risks of investing resources in embryonic enterprises cast doubt on business formation as a tech transfer strategy.

Few are chosen

Every year WARF executes dozens of licenses based on hundreds of discoveries disclosed by UW-Madison faculty, students and staff. Typically, all that inventiveness and paperwork yields a handful of licensed startups. Centrose was one of six new companies to take out a WARF license last year; over the past five years, the organization has averaged seven startups annually—roughly one for every \$130 million in research expenditures. Other district universities have produced fewer licensed startups (see chart on page 9). The U of M launched

four in 2007 and has averaged three a year since 2003, as has MSU. North Dakota State University (NDSU) in Fargo has licensed no startups in the past decade.

These numbers are on par with the startup performance of TTOs across the country. Just a few institutions, among them the University of California System and the Massachusetts Institute of Technology, regularly achieve double digits in annual licensed startups. Most U.S. universities launch fewer than 10 annually.

So relative to their peers, district universities seem to be doing an effective job of creating new enterprises crucial to the economic well-being of their home states and communities. But a different picture emerges when the statistical lens widens to include companies that start life in the region without a university technology license.

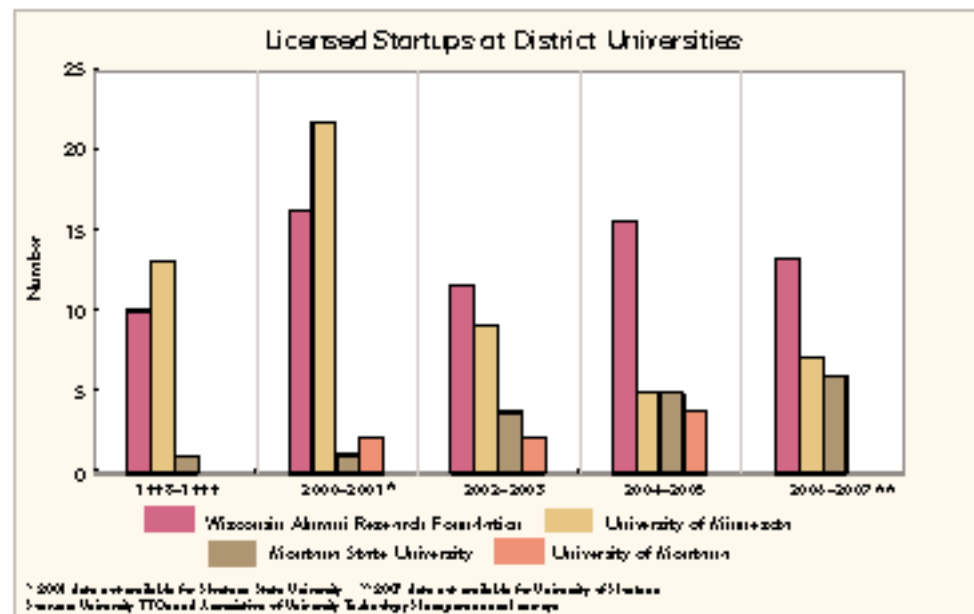
Compared with the number of businesses started annually in the region by entrepreneurs outside universities, the birthrate of university-licensed firms is negligible. In Minnesota, for example, over 28,000 new businesses registered with the secretary of state’s office last year. About 4,500 new companies were established in North Dakota. Many high-tech jobs pay higher wages than positions in retail, food service or tourism. Still, the relative rarity of university-licensed startups means that their effect on regional economies is minimal.

The number of startups that owe their existence to university licensing also amounts to a fraction of the number of firms that trace their origins to a district research university. Little comprehensive research has been done on businesses formed by faculty, staff or graduates of universities, but a 2004 report by the U of M’s Institute of Technology suggests that university licensing is just the tip of the iceberg. The study identified roughly 4,150 companies, including Medtronic and Cray Research, that IT alumni founded or co-founded. Two-thirds of the firms were operating in Minnesota, employing more than 175,000 people and generating approximately \$46 billion in annual revenue.

Many of the firms in the IT survey

“Building a company around a university technology is difficult because oftentimes those technologies are developed without a market in mind, which is the exact opposite of how a traditional entrepreneur would go about starting a business.”

—Gary Bloomer, TechRanch



were founded decades ago, before universities had the opportunity to license their discoveries in earnest. But the survey's findings are supported by anecdotal evidence, such as the number of unlicensed firms on the client rosters of university technology incubators.

Virtually every startup licensed by MSU goes through TechRanch, said Gary Bloomer, the organization's client development director. But those firms make up only about 40 percent of TechRanch clients linked to MSU (typically half the total assisted each year). The rest are unlicensed and connected with the university in another way—headed by a former professor or student, or advised by a faculty member on the board.

Likewise, NDSU's futility in launching startups means that no licensees reside in the university's year-old, \$7.5 million Business & Technology Incubator. However, two of the seven current tenants were founded by NDSU graduates.

Risk and reward

Every TTO in the region can cite a success story—a startup that blossomed into a major employer or earned shareholders (including its parent university) a handsome return when it went public or was acquired by another company.

WARF hit a home run with TomoTherapy, a 10-year-old Madison firm that developed a radiation therapy

system for the treatment of a wide variety of cancers. The licensed technology has generated millions of dollars in royalties, said WARF Managing Director Carl Gulbrandsen, and the organization's equity stake yielded millions more when TomoTherapy sold stock to the public last year. “That's been very good for us,” Gulbrandsen said. The firm is profitable and currently employs about 660 people.

More recent WARF licensees that have made hopeful beginnings include Centrose and Cellular Dynamics International, another Madison company co-founded in 2005 by acclaimed UW-Madison stem cell researcher James Thomson. Both Centrose and Cellular Dynamics have received government grants in addition to private equity financing.

At the U of M there are signs that the Venture Center's hands-on approach to launching startups, intended to maximize long-term revenue potential, is working. Director Doug Johnson points to Orasi Medical, a 2007 startup that has developed a method of diagnosing Alzheimer's disease and other brain disorders, as a product of his strategy to focus on launching a few firms with a good chance of success.

“I would rather have us start one company a year that's another Medtronic than 25 failures,” he said. Last fall, Twin Cities-based Orasi landed \$2.4 million in private financing, including a contribution from Glen Nelson,

former vice chairman of Medtronic.

Successful licensed startups have also emerged from MSU and South Dakota State University in Brookings. Ligocyte Pharmaceuticals, an MSU licensee partly owned by drug giant GlaxoSmithKline, has grown into a 47-employee firm over the past decade.

But for every TomoTherapy, Orasi and Ligocyte, there are many more university startups that never attract private capital, produce a viable product or turn a profit. As Mulcahy observed, less than 10 percent of university licensed startups—actually 8 percent, according to a 2002 analysis of data gathered by the Association of University Technology Managers—ever progress to an IPO. And going public doesn't ensure survival, or sustained commercial success.

The hard truth about university-licensed startups is that jump-starting a new business out of a campus lab is arduous and risky. “It's a little bit easier licensing technologies to the DuPonts of the world,” said Bloomer of TechRanch. “Building a company around a university technology is difficult because oftentimes those technologies are developed without a market in mind, which is the exact opposite of how a traditional entrepreneur would go about starting a business.”

Not only are university technologies usually raw and unfocused; their inventors are often more interested in conducting research than running a company, and they tend to be ignored by institutional and angel investors. “Most of the technologies that we evaluate are too early and too undeveloped for external investors because the risk of failure is too high,” said Johnson of the U of M. Startups like Centrose and Cellular Dynamics that have attracted sizable private investment are the exceptions.

What would markets do?

These uncertainties and risks raise the question of whether universities should be spending public funds—or royalties earned from the licensing of publicly funded research—on cultivating startups.

Identifying promising technologies and guiding them along the tortuous path to market entails an investment that sometimes extends to direct finan-

cial aid for startups. In addition to funding the Venture Center, the U of M has set aside \$1 million annually in licensing proceeds for grants and loans that inventors can use to further develop their discoveries and launch firms. Such support also exacts an opportunity cost; resources allocated to nurturing startups are not available for licensing technologies to existing firms, or for investments in education and basic research.

At what point should universities let the market decide which technologies should give rise to new companies and which ones should be licensed to established firms—or sent back to the drawing board? Markets have proven themselves more astute pickers of valuable technologies than government-supported institutions. Arguably, if entrepreneurs and investors outside a university don't take interest in an invention, it's probably not worth commercializing through a startup.

Michael Gorman, founding managing director of Split Rock Partners, a Twin Cities venture capital firm, believes that some university support for startups is appropriate. Tech transfer offices can serve as entrepreneurial catalysts, helping to recruit talented managers and providing seed capital to sustain a new firm until it can secure institutional funding.

But “one of the key questions is how is something like that managed, because the danger is for market forces not to be applied,” Gorman said. Without input from business and financial experts outside university walls, internal politics and favoritism can influence decisions about which discoveries and startups receive university backing.

Given the limited impact of licensed startups on local and regional economies, and the risks of investing in untried technologies, the larger question for district universities is whether the home-run potential of such investments justifies the costs. **f**