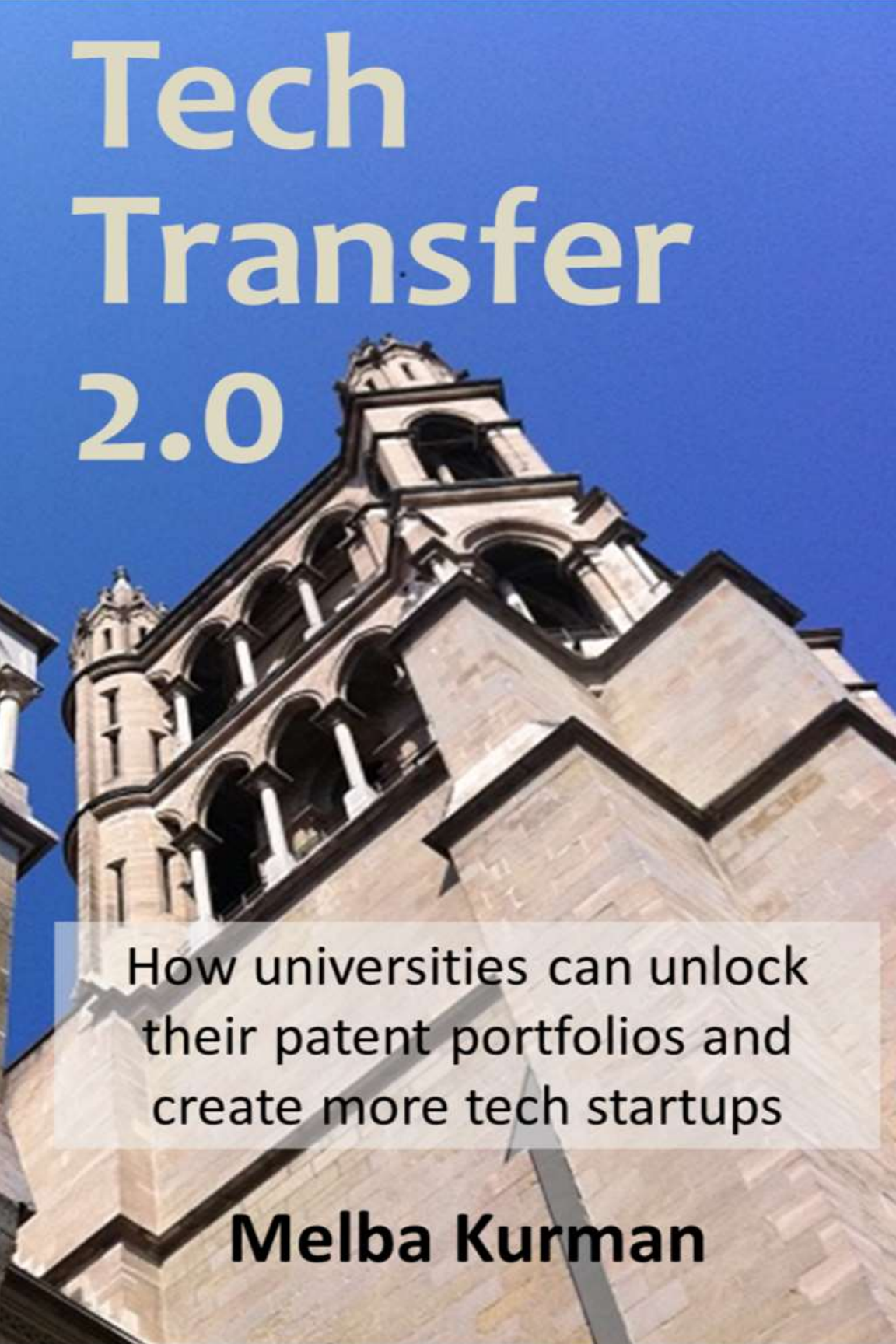
Tech Transfer 2.0



How universities can unlock their patent portfolios and create more tech startups

Melba Kurman

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To my husband Hod Lipson

About the author

Melba Kurman is an author, analyst and consultant. Her interest lies in understanding disruption, making sense of the promise and peril of new technologies. Her most recent book, *Fabricated: the new world of 3D printing* has been translated into Chinese, Korean and Japanese. Melba's professional background is in high tech product marketing (at Microsoft) and university R&D strategy (Cornell University). Over the course of her career, she has done market research, competitive strategy and intellectual property licensing. She is a graduate of Cornell University, the University of Illinois and the United States Peace Corps.

Foreword

If you've had ever received a CT scan, drunk Gatorade, had your dog vaccinated for kennel cough or used fluoridated toothpaste, you've experienced the direct benefits of university research. University research is why we are able to search Google or swallow Allegra to ease an attack of allergies before playing a nice game of golf on lush, green Bermuda Grass. Read this book to learn more about how U.S. research universities manage the inventions and patents that are the result of billions of dollars of federal funding.

This book is a compilation of two years of selected and updated articles from my now-retired blog, *"Tech Transfer 2.0."* I share my experience gained from four years of working at a large research university in a university's technology transfer office. A technology transfer office is an administrative unit. Its charter is to manage a university's patent portfolio and other intellectual property created in university research labs.

After a few years of explaining my new profession of university technology transfer to friends, relatives and other intelligent people, I realized that although all of us touch, use and benefit from university research on a daily basis, few people know how, exactly, their tax dollars eventually morph into a useful product, a new plant line, advances in genetic research, new vaccines and more.

Most research universities in the United States and Canada have a technology transfer office. They're busy places. Each year, the federal government pours billions of dollars into university research labs. Each year university scientists create thousands of new inventions, some of which are patented and then licensed to companies to help them development new products.

Here's how the university tech transfer process works: federal agencies fund basic research on campus. Professors and graduate students come up with breakthrough ideas and new inventions which they formally report to their university's technology transfer office. Businesses and startups who wish to create a new product or service using a university patent work with the university's technology transfer office to negotiate and sign a contract with the university for patent rights.

I learned the ropes inside the technology transfer unit of a large research university. The evolution of my perception of the sprawling world of university research followed a perhaps predictable arc. My first year, I was new to the entire notion of university technology transfer. I was fascinated by the rich and complicated interplay of new technologies, intellectual property marketing and the rich soup of on-campus innovation that bubbled on our well-funded, palatial campus.

Now, I had been an undergraduate at this very same university years before, and my re-immersion into the campus as a humble staff member was a bit of a shock. By accepting a job in my alma mater's technology transfer office, I morphed from being a cosseted (in other words, paying) undergraduate customer into a small cog in a rusty and somewhat bent administrative unit. In other words, I gained a front-row seat at the sausage factory, observing what U.S. universities do with the results of tax-payer funded research.

My second year in the technology transfer unit I had learned enough to feel confused and at times, a bit uneasy. My previous job had been in product development inside a large, famously paranoid technology company. In that particular culture, a product manager who failed to document and describe the flaws in our product or business strategy was failing at her duties.

Yet, inside the four walls of our university's tech transfer office there was a resounding silence when it came to business strategy and customer satisfaction. We simply never spoke about whether customers -- university faculty, students and businesses -- were happy with our services. If we discussed workplace issues, critical topics -- for example, whether our current contractual agreements for patent rights were effective -- were kept off the discussion table.

I found the silence puzzling and counterproductive. (Although this is not the case at every university), our director would warn us in staff meetings, "Do not question the way we do things or all of us will lose our jobs." Why would we would lose our jobs if we attempted to evolve our strategies? Shouldn't continual improvement create more, rather than less job security? You'll see my struggles with these questions running throughout several of the essays in this book.

This warning to let sleeping dogs lie eventually became something I got used to hearing. Eventually, the best explanation I could come up with was that the reason this particular tech transfer director could insist of this veil of silence was that he didn't have to face the merciless rigor of a hard bottom line. In industry, a company's customers vote with their dollars, hence weak business strategy can't remain secret for too long before it becomes a direct threat to a company's future and continued well-being.

In contrast, our university technology transfer units did not rely on the dollars and continued patronage of happy customers. Instead, we were financially supported by the university budget. The result was that there was more incentive for people of a certain mindset to protect the status quo, to fight transparency, to defend the incumbent technology transfer model.

End of third year: by now I was a full-blown skeptic. I was still fascinated by the complex ecosystem that surrounds the intersection between university, government and industry and converges in a university's tech transfer unit. I was proud and intrigued by the wealth and diversity of inventions that flowed into our office on a weekly basis.

What troubled me was a sense of disconnect. A feeling that I was living behind the wall of a totalitarian country where there was a formal "state truth" and a taboo "real" truth. And the real truth was a lot more nuanced, unflattering and contradictory than what the state truth could allow. A culture of organizational secrecy permeated our office dealings

The cone of silence extended outside of our office. The next administrative official one rung higher on the organization ladder was our boss's boss, the Vice Provost of Research, a semi-retired physics professor whose career was spent in the cushiony confines of an academic research lab. The VP of Research was a rotund, dignified fellow who somehow found himself thrust to the helm of a diverse and complex, 300+ employee administrative unit.

In spite of (or perhaps because of) the daunting mini-army of employees in his tract of administrative land, our Vice Provost's first love remained the heavens. Literally. He was frequently out of the country viewing the stars at the Arecibo Space Laboratory in Puerto Rico. We caught a glimpse of his celestial presence once a year, on stage at our annual holiday party where he urged us to keep up the good work. He didn't have time to think about the intricacies of research administration, let alone the bumpy journeys of new inventions to the world off campus.

Third year. I couldn't help myself. I began to look for more information on the whole technology transfer ecosystem. The

writings of a few inspired experts helped me make sense of the silent places and logical leaps that didn't make sense. Gerry Barnett at the University of Washington meticulously digs into the legal and regulatory frameworks that laid the groundwork for intellectual property policies currently in play at many research universities.

Eventually, the right book at the right time changed my life. A team of professors at Columbia University wrote *Ivory Tower and Industrial Innovation: University-Industry Technology Transfer before and after the Bayh-Dole Act.*[1] Finally, I thought, a readable, thoughtful and factual exploration that explored the big picture and debunked the tired rhetoric I heard throughout the day!

Fourth year. I couldn't keep the silence any longer and was bursting to take part in the growing conversation about university-generated innovation that was growing in volume outside the four walls of my office. I resigned my position at Cornell and tentatively starting putting my thoughts into a new blog I called *"Tech Transfer 2.0"* which is the basis for this book.

At this point, I should pause and make it clear that the intent of both my original blog articles, and now this book, is to respectfully and fairly explore better ways to bring university research to the people that need it. Many university administrators and technology transfer professionals are capable and inspiring people. I've met many, and have been inspired by their professional approach.

As a profession, tech transfer staff are dedicated to carefully managing the patents under their stewardship. Many tech transfer directors and Vice Provosts of Research are transparent, fully engaged and committed to the well-being and professional advancement of their employees. In fact, if their universities would support them in taking bolder action, these are the people who have

the necessary ability and vision to move today's technology transfer strategies forward.

In hindsight, a few years later, I can see that my front-row seat at the tech transfer sausage factory was not a bad thing. True, you never view sausage the same way again. If you're like me, you might have a hard time restraining yourself form lunging to yank unsuspecting grocery store shoppers back as they reach for a deadly packet of Italian sausage. That's the down side of a few years in a sausage factory. However, there's also an upside. The upside of a stint on the front lines of tech transfer sausage-making was that it inspired me to take what I learned, write about it, and share it with the rest of the world.

I write to break the silence, to fill in the missing gaps in the story. And perhaps I am a natural-born skeptic when handed received wisdom, a fact I've reluctantly become resigned to over the years. I suspect my first words as a chubby toddler were probably the phrase "wait, tell me why you think that?"

Behind these essays beats an idealistic and hopeful heart. I believe that our North American university research model is a national treasure that earns back our public investment several times over. To keep this system alive and well, federally funded university scientific research needs public, respectful and informed dissent. My hope is that if you read this book, you will feel better-equipped to draw your own conclusions and find your own answers to the big questions. *Who* exactly, should benefit from tax-payer funded university research, and *what*, exactly, is the best way to make that happen?

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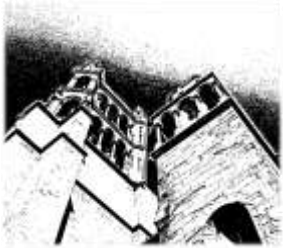


The big picture: why should I care about university research?

Once I had a hard-nosed boss. When anyone on our team was scheduled to present their work to an external audience, he would sit impatiently through their dress rehearsal presentation and then at the end, bark, "now tell me, why should I care?" It hurt. But he was right.

Why should you care about university research and how universities manage their research and patent portfolios? Here are a few reasons.

Your quality of life, national security and healthcare: Federally funded basic research at universities is a gift that keeps on giving. University research led to the development of the World Wide Web, Google, DNA sequencing, fiber optics, GPS and laser technologies and more.

Because university research is the bedrock of the future: Universities and colleges perform about 14% of all U.S. R&D.[2] High-growth fields such as nanotechnology and biotechnology are increasingly reliant on university research. Individual universities own a growing number of patented "building block" nanotech and biotech inventions.[3]

- Universities own more than two-thirds of essential "building block" nanotech patents.[4]
- Universities own 18% of core patents in biotech, plus an increasing number of once-freely shared biological research materials[5]

To aid product development and technology innovation: As large corporations shut down their own internal R&D labs, companies increasingly rely on scientific insights and technological breakthroughs from publicly-funded university research. In new patents filed by companies, a whopping fifty percent of cited and relevant patents are owned by universities. In contrast, only 27% of cited patents in industry patent applications came from other companies.[6]

Humanitarian reasons: In the past, cell lines, plant materials and software were once informally shared between researchers. Today, most universities require a formal "Material Transfer Agreement" which sometimes involves a fee, plus "reach thru" rights to any resulting follow-on inventions or new technologies. Sometimes plant lines created by university plant breeders are patented and licensed to giant seed companies.

If you're an entrepreneur: Some universities make it easy for a startup to license the rights to a university-owned patent; some complicate matters with fees and contractual clauses that may negatively impact a startup's future prospects. One major snafu that would-be entrepreneurs deal with is a "reach thru clause;" a reach thru clause gives the university the right to claim royalties from any second and third generation products that may involve the university patent. Some universities take significant chunks of

equity that shrinks the size of the equity pie available for future investors and employees.

If you are, or are planning to become a university professor, graduate student or staff member: When you signed your employment contract, you agreed to give the university rights to any new technology or invention that you create during the tenure of your employment. The good news is that the university will pay your patent fees. But if you plan to create a product or new company from work independent of your university employment, tread carefully.

'Cuz most of its funded by your hard-earned tax dollars: We pay taxes; the government passes some of that money to universities in the form of grants to individual scientists and researchers. The federal government pays for roughly 60% of the research that takes place on campus, or about $32 billion a year.

Because it's just too risky not to know more. We know little about the real downstream impact of university-owned patents on the downstream advancement of science, technology and knowledge. Some data is available but not necessarily utilized by policymakers and university administrators. Ignorance is risky.

A National Academy of Science Issues Magazine position paper described it well:

> *"...Universities have been naively viewed as "engines" of innovation that pump out new ideas that can be translated into commercial innovations and regional growth. This has led to overly mechanistic national and regional policies that seek to commercialize those ideas and transfer them to the*

private sector. Although there is nothing wrong with policies that encourage joint research, this view misses the larger economic picture: Universities are far more important as the nation's primary source of knowledge creation and talent..."[7]

These are reasons that I care. In the following pages, I explore these concerns. Hopefully a few of them have sparked your interest. Next, let's move on to the people involved.

Who's who? University tech transfer stakeholders

In a sense, all of us are stakeholders in the R&D process. In the university R&D ecosystem, I've selected five groups that I would consider to be the leading stakeholders in the process. Clearly there are more people impacted and involved who are not mentioned explicitly here.

1. **University researchers, faculty and grad students.** Most of the inventions that eventually become patents are created by faculty and students in engineering and science departments or in medical schools.

2. **Businesses and startups**. Companies might sponsor a particular research project in a university lab. Companies and startups license patents from a university's tech transfer office.

3. **University administrators.** Most tech transfer units have a director of daily operations; higher up the ladder is a Vice Provost of Research, then a Provost of academic affairs.

4. **Federal research funding agencies.** In the United States, the federal funding agencies keep universities afloat by giving faculty research grants. Six federal agencies provide almost 98% of the funding for academic R&D support: the National Institutes of Health (NIH), the National Science Foundation (NSF), the Department of Defense (DOD), National Aeronautics and Space Administration (NASA), the Department of Energy (DOE), and the Department of Agriculture (DOE)

5. **Government officials and policy makers.** This group includes senators, house representatives and also state and regional economic development officials.

Each group of stakeholders has their own unique goals, concerns and incentives. In more details, here's what the various groups of university technology transfer stakeholders care about:

1. University researchers, faculty and grad students

- Getting tenure
- Getting research funding
- Getting published
- Protecting their academic freedoms to conduct innovative research, publish it freely, and collaborate with other researchers

- Achieving professional recognition and advancement (at most universities, patents and licensing deals do not count towards tenure or promotion). Broad broadcasting of research is key, not licensing revenue earned.
- Having their industry research partnerships run smoothly with minimal administrative overhead, restrictive contractual clauses and fees.
- Having freedom to share data or biological materials with their peers at other research institutions if they choose to
- Having academic freedom to publish research and data quickly and without restrictions imposed by non-disclosure agreements or contractual restrictions.
- Building a vibrant research lab full of graduate students

2. Businesses and startups.

- Keeping abreast of emerging, cutting edge research that takes place in university labs.
- Having hassle-free access to university scientists' expertise in informal conference settings and via formal research collaborations
- Avoiding bureaucracy and excessive negotiations when arranging collaborations with faculty scientists
- Being able to license a university patent quickly with a minimal negotiations, contractual requirements and fees
- Help negotiating the maze of a typical research university's beehive of different administrative units

- If they're for entrepreneurs forming a startup, reasonably priced access to university patents with minimal contractual restrictions

3. University administrators.

- Managing their department's costs and budget
- Efficiently managing the administrative process involved in receiving federal research grants and industry research sponsorships
- Attracting the best and brightest university scientists
- Maintaining their university rankings by excelling on key performance metrics such as faculty productivity, staff diversity and research funding
- Avoiding public scandals involving faculty conflict of interest. For example, universities suffer bad PR if a company funds faculty research and the resulting research is corrupt or partially complete, but is used to support a pharmaceutical or tobacco company's claims
- Maintaining positive connections to industry and to their university's affluent alumni population

4. Federal research funding agencies.

- Ensuring that their allocated funding continues
- Figuring out how to best spend their organization's money to give the appearance of promoting critical and valuable scientific research.

- Deciding which submitted grant applications merit the grant funding awards
- Increasing the involvement of women and minorities in the scientific research and engineering fields

How does a bit of breakthrough research totter from its university research lab to wind up in a sleek, commercial product? The answer is that there's no single path; knowledge and ideas are slippery things that bounce around in a random, decentralized fashion. The reality is that most university research flows to the world off campus in a leaky and informal manner without the aid of formal vehicles such as patents and contractual arrangements.

Most of the content in this book addresses the formal university technology transfer process. I use the term "formal university technology transfer" to describe the official, centrally managed administrative process on campus. One important fact to keep in mind is that the formal technology transfer channel is but one of many different ways that research finds its way into productive use off campus. Yet, the formal tech transfer channel, small as it may be, is what gets much of the attention and administrative support.

The formal technology transfer process runs on patents; its aim is to earn royalty revenue by licensing university patents to companies. The formal process is centrally managed by an administrative division and defined by a university's intellectual property policies.

Universities as innovation merchants

Most people know that university scientists and students conduct research on campus. However, not many people know that universities patent this research, and then broker it out to

companies in exchange for royalty payments from sales of any products that might result. Modern universities are patent brokers.

In 1979, all U.S. universities obtained a total of only 264 patents. New U.S. patent applications filed increased from 6,500 in 2001 to 11,300 in 2009. Today, most U.S. research universities own a patent portfolio of a thousand or two patents invented by university scientists and researchers.

Big research universities harbor a secret world. Tiled hallways wind past dozens of stark, fluorescent lit chambers where fresh-faced graduate students toil. Their boss? A professor who manages what is essentially, a small R&D firm.

Research grants keep university labs running. Graduate students and professors deliver their R&D firm's "products:" data and academic papers. Occasionally, they'll create a new technology or uncover a scientific breakthrough that's deemed patentable by their university's technology transfer staff.

How did universities – once the bastion of open-ended scientific exploration -- acquire patent portfolios? With a few exceptions, before the 1980s, most universities did not own large patent portfolios, nor did they monitor their research labs to identify potentially commercially valuable patents.

In the United States, today's nearly universally used university tech transfer model took root in 1984, formalized by a new piece of legislation called The Bayh-Dole Act. The original intent of the Bayh Dole Act of 1984 was to increase uptake of federally funded science, to earn a better return-on-investment from public tax dollars invested in university research. The passage of the Bayh-Dole Act marked the start of the modern era of today's patent-based technology transfer university technology transfer process

Before the Bayh Dole Act was passed, each federal funding agency owned the results of its funded research. Universities conducted scientific research, but it was not theirs to claim. Since federal funding agencies fund what's known as early stage, or basic scientific research, much of what university researchers created was not immediately commercially viable. Most university research, ground-breaking as it may be, takes years of additional development before it can be put to work in a commercial product or process.

The long time lag between scientific insight and commercial product -- before and after universities gained the right to patent their research -- has led to one of the most stubborn misconceptions about the university technology transfer process. That misconception is that before the Bayh Dole Act, publicly funded basic research languished, un-used, under the care of the individual funding agency that sponsored it. This misconception has led to a widely held, yet unproven assumption, that before individual universities stepped in and began to obtain and broker patent portfolios, on-campus inventions languished un-used, hence shortchanging the tax-paying public.

If you keep an eye on public debate about federally-funded science, you'll run into this unproven assumption. Here's a typical example. One university administrator glowingly testified to the House of Representatives that the enactment of Bayh-Dole as "representing the creation of a vast research enterprise that has brought immeasurable and invaluable benefits to society."[8]

A more disturbing example of the lack of understanding of the value of university patents was recently played out in the U.S. Supreme Court. Seed company Monsanto sued a soybean farmer for patent infringement. The farmer's crime was that he planted

second-generation seeds derived from previous generations of Monsanto's patented, genetically modified seeds.

In the ivory tower depicted in movies and popular culture, universities would have protested the unfairness inherent in this David and Goliath lawsuit. In this alternative universe -- perhaps more importantly -- university administrators would publicly question the notion that a private corporation could patent a genetically modified biological life form and also lay claim to subsequent generations of this biological life form. In reality, a group of large research universities -- led by the University of Wisconsin -- came out in public support of Monsanto.

In an official *amici curaie* submitted to the U.S. Supreme Court, Wisconsin et al. claimed that stringent enforcement of patent rights on benefits all of us. Their logic goes as follows: [before the passage of the Bayh Dole Act}

> "*There was no uniform statutory authority for federal agencies to grant exclusive licenses for their patents. Indeed, more than 25 different patent licensing policies existed among various federal agencies. As a result, efforts to commercialize patents held by the federal government were frequently unsuccessful and the public did not benefit from access to these inventions."*[9]

The university's claims that "efforts to commercialize patents held by the federal government were frequently unsuccessful" are not backed by real evidence. Yet various versions of this story have stuck and continue to pass for truth. In this brief, Wisconsin's support for Monsanto concludes with a flourish.

> *"Reversal* [if the Court decided that the soybean farmer had the right to plant unpatented, second-generation seeds he purchased] *in this case would weaken patent rights for*

artificial, progenitive technologies and upset the flourishing innovation system created by U.S. patent law through the Bayh-Dole Act and technology transfer organizations."

A cynic could simplify this legalese and interpret this legalese as in order to help the farmers, Monsanto has to sue the farmers. At the time of this writing, Monsanto won the Supreme Court case. Now, it's true that Monsanto invested millions of dollars and years of research to create this genetically modified soybean. It's also true that this particular type of genetically modified soybean has been eagerly embraced by soybean farmers and is now the most widely used strain of soy bean used in commercial farming. What I found disturbing about the case was not just the outcome, but the fact that these large research universities banded together to present a united front that consisted of firm adherence to a pro-patent party line.

This group of well-funded universities insist that strong enforcement of patent rights is critical to "the flourishing innovation system created by U.S. patent law through … technology transfer organizations" is not fact. This statement, however, is not fact; it's ideology. It's quite possible that perhaps "the public" does not benefit from the fact that universities own valuable chunks of federally funded inventions, technologies, genetic materials and medicines. The reality is that nobody knows for sure.

My goal in writing this book was to question broadly held, yet unproven "truths" about publicly funded scientific research. In my mind, the problem is not that people disagree. The problem is that too much of the discussion amongst key stakeholders consists of defending the status quo.

The veil of silence that hangs low over universities protects unproven assumptions. Unproven assumptions begat faulty technology transfer models. Faulty tech transfer models, to survive,

must be shrouded from external assessment and protected from the rigors of a hard bottom line, a truth my former tech transfer director instinctively embraced.

Unintended consequences

Life teems with unintended consequences. In 1848, Frédéric Bastiat, a French economist wrote: "In the economic sphere an act, a habit, an institution, a law produces not only one effect, but a series of effects. Of these effects, the first alone is immediate."

The most well-intentioned acts trigger unforeseen consequences that can threaten a once-healthy portion of an ecosystem or living organism. Pharmaceuticals induce side effects. Green energy has a dark side as photovoltaic batteries leach heavy metals into groundwater when they're thrown away. Birds are sucked into windmills.

In the words of Frédéric , university-owned patents are a relatively new "act" that have unintended consequences (to borrow from the words of Bastiat). The passage of the Bayh Dole Act and the resulting "university owns" formal university technology transfer process have introduced unforeseen consequences. Like an intricate, decentralized and delicate regional weather pattern, university research, federal funding dollars, and industry product development twine together to form a rich and complex ecosystem.

This R&D ecosystem has existed for decades. University engineering and science departments have never been "ivory towers." Instead, for more than a century, professors and students have exchanged innovative ideas with the rest of the world in a decentralized and circular feedback loop.

People's understanding of the today's formal university technology transfer process is stymied by the widely held

assumption that ideas travel in a straight line from lab, to the university's technology transfer unit, and finally to a company, all under the legal "protection" of a patent and contract. The science of optics, or the behavior of light, was stunted for decades by scientists who assumed that light travelled in a straight line. Like light particles, ideas do not travel in straight lines.

University and industry scientists keep up with one another's work in a medium that is sometimes called "open science." Open science is the notion that knowledge exchanges flow freely, informally, in many directions at once through several different channels. Scientific papers have been, and remain one of the most widely used channels of open science. So are conferences, graduating students and launching them into the world and open-sourced software written by university students.

Patents are not channels of open science. Nor are formal contractual rights granted to a third party for use of a particular patent. That doesn't mean that patents aren't useful and in some cases, the right channel to use to get early-stage scientific research into a state that a company can invest in and make good use of. The problem lies in the fact that today's formal university technology transfer process injects unintended consequences into the R&D ecosystem.

A new medicine might improve one aspect of a patient's health, but also induce unintended and possibly even more problematic side effects. Formal tech transfer strategies rest on the unproven assumption that research needs to be bundled into concrete units of intellectual property, patents, in order to be useful outside the lab. Unintended side effects, at best, can be uncomfortable, at worst, deadly.

What if one of the unintended side effects of the current "university owns patents" model is that it chokes essential channels of open science? If this is the case, given the vast difference in volumes of knowledge flow, the bad news is that patents would be no replacement for open science. Compared to decentralized, leaky and non-exclusive channels of papers, graduates, conferences and joint research projects, patents and patent licenses actually play a minor role in transferring publicly funded scientific research to the companies and people that benefit from it.

Nobody has the answers.

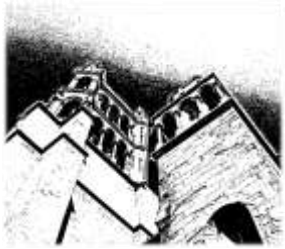
The Bayh-Dole Act is not sacred, but was simply a bold and experimental 30-year old piece of legislation. Today, after more than 30 years of experience, critics and proponents disagree whether the current formal model of university technology transfer is helping or hindering innovation. But there's more to the story.

The goal of this book is to raise questions. Some of the following essays are practical in nature. Other essays point out flawed assumptions that tend to permeate public discussions about the university tech transfer process. Finally, in the last few pages, I broaden my focus and write about broader issues around innovation such as organizational culture and fair trade electronics.

As you can see in the table of contents, I've divided this collection of essays into major sections by topic area. Please feel free to jump from section to section since the essays are not intended to be read in a linear fashion.

Chapter 1

University technology transfer strategy



Innovation is like love: set it free and if it comes back to you, it's (partially) yours

Innovation is like love, aptly described by those old posters I used to see at my dentist's office, "if you love something, set it free, and if it comes back to you, it's yours…" Same thing for innovative university technologies, novel methods and creative people. Here's a poster that should hang in campus hallways: "If you want innovation to take place, set it free, and if it comes back to you – well – it's not precisely yours, but at least you've succeeded in introducing genuine value to the rest of the world…."

So what's the problem? The problem is that innovative university research is not set free. Currently, university technology commercialization strategies rest on the assumption that university research is most commercially appealing when managed as potentially lucrative, university-owned intellectual property. The current approach to commercializing university inventions is due for an overhaul. Yet, universities and federal agencies continue to invest money and resources in initiatives and programs that merely re-hash the technology commercialization model we already have, one

built on the assumption that more, not less, central control over university research is needed to increase its commercial uptake.

Celebrating the status quo

If you scan Google news, you'll see what I mean. Headline after headline announce university initiatives to build a bigger infrastructure to "protect" and organize university inventions. Universities announce they will hire more staff to better manage the university's invention portfolio; universities will apply for more patents, offer more entrepreneurship education programs and run various flavors of business plan or best practice competitions. University press releases announce, "A big patent licensing deal was signed! Seventeen university startups were spun off! Amazing new Director was hired who's gonna turn the ship around!" I know because I used to write those sorts of homages before I learned to apply my powers to tell the unsanctioned story of the Dark Side of university innovation… (that's a joke)

Celebrating the status quo, however, is just a symptom, not the *real* problem. The real problem is that innovation does not happen from central planning. Innovation happens when you give intelligent, capable people the tools, resources and storefronts they need. Next, set down some a few minimal ground rules to ensure decency and fair play, and then get the heck out of people's way (unless they voluntarily come back to ask you to remove a barrier that they can't remove alone).

Now don't get me wrong. I applaud that those in charge of university research and funding understand that change is needed. It's a good thing that the people who steward our nation's tax-payer funded university research are struggling to stretch their thinking. There's no quick and easy solution; change is hard and its effects

take years to register. Also, I've met plenty of thoughtful, business-savvy intelligent university administrators (who, by the way, are a more diverse-minded bunch than they are permitted to publicly express) who deeply care about their university's contribution to our nation's economy and are struggling to figure out how they can help.

The Cathedral and the Bazaar

Let me frame the situation another way: in the metaphorical context of the cathedral and the bazaar. Before I go into detail, let me explain what this metaphor means. The notion of the cathedral and bazaar refers to two different approaches to technology development. It was articulated by open source visionary Eric Raymond in the late 1990s to describe two ways to build software: a cathedral mode, a traditional centralized, top-down commercial model in which a lead engineer presides over a tightly controlled group of paid software developers. In cathedral building mode, software code is proprietary and its use is typically permitted in exchange for payment.

In contrast, the bazaar mode symbolizes the open source development paradigm. The bazaar mode of software development is a de-centralized effort driven not by a single company, but by a typically unpaid leader who originated the project. In the bazaar model, a loose federation of volunteer software developers write the code and the documentation, both of which are shared freely under an open source license. Community recognition is the reward. Project planning takes place via a process of transparent decision-making from the lead developer, frequently accompanied by heated debate. No single entity owns the project code. Companies are free to utilize portions they need (although different sorts of open source licenses permit different degrees of commercial application).

Raymond conceived of the cathedral and the bazaar in the context of software development. But the notion aptly describes the tension between the formal and informal formal mechanisms that bring university research to market. Here's how the metaphor can be applied to university research. Imagine a cathedral surrounded by a vast, bustling bazaar. In this scenario, the hypothetical cathedral represents the formal technology commercialization programs and policies celebrated in press releases — the way decision-makers *want* university research to be doled out to the rest of the world. In contrast, the hypothetical bazaar represents how university research is actually conducted and shared.

The cathedral mode of formal university technology commercialization consists of licensing patents in exchange for revenue, mandatory compulsory university ownership of anything invented on campus, and ever-lengthening intellectual property policies. So what does the bazaar mode look like? Actually, the bazaar mode is alive and well. More than just alive and well. The bazaar model of university technology commercialization is large and in charge. The vast majority of university knowledge, in the past and today, flows to the rest of the world via the channels of open science: scientific publications, conferences, or open source software. Or via people: graduating students, interpersonal relationships between researchers and faculty consulting engagements.

The cathedral mode is actually a relatively recent method of extracting the commercial value of university research. Before the 1990s, few universities owned patent portfolios. Campus intellectual property policies and commercialization planning committees were either non-existent or not of broad concern. There were few technology transfer offices, no startup boot camps,

business plan competitions or degree programs in entrepreneurship. Yet university knowledge found its way over to the marketplace just the same.

Disorganized as it may be, the bazaar mode is better aligned to meet the needs of an increasingly bazaar-oriented commercial world. When asked about the value of various channels of academic knowledge to their company's R&D efforts, industry researchers ranked university patents well below scientific publications, relationships between research experts and conferences ("Links and impacts: the influence of public research on industrial R&D," Cohen, Link and Walsh, 2002). The bazaar mode adapts faster to changes in the industrial climate and new research directions.

The bazaar approach to technology development works. Even in complex environments. Similar to the open source software bazaar, scientific discoveries rarely spring from a single individual. Creating innovative technologies is a haphazard process that relies on serendipity and the free flow of information rather than a centrally laid-out research agenda. As described by Eric Raymond, the bazaar mode, by letting go of centralized control and rigid procedures unleashes the power of multiple "agents attempting to maximize utility, which … produces a self-correcting spontaneous order more elaborate and efficient than any amount of central planning could have achieved."

There's no single path to technology commercialization

The cathedral mode of technology commercialization, however, should still have a place on campus, but as one of several options Whether you like them or not, patents still play a central role in industry product development strategy. As a result, many companies and startups, particularly those in the pharmaceutical,

chemical and medical device industries, prefer to license patents when they work with university researchers. And given how costly it is for universities to build their patent portfolios, some central oversight of where patents get licensed is necessary. For example, if a would-be entrepreneur insists that his startup will only survive if he is issued an exclusive patent license, some screening of this individual's plans by university licensing staff needs to take place.

In addition, painful and unpopular as they may be, many sweeping campus intellectual property policies originated with good intentions. Although it's an administrative failure that the tendency is to keep adding, not pruning university policy, some centralized guidelines are needed. After all, most campus policies don't come out of thin air but were triggered at some point by the misbehavior of one or two bad applies somewhere in the research food chain. Finally, even inventors who happily freely share large portions of their work, in some instances, may prefer to develop some innovations in a proprietary manner.

In an ideal world, the cathedral and the bazaar would happily co-exist on campus. After all, the commercial software world has learned to accept, even embrace the open source bazaar. I'm not sure, however, that universities are adapting as well as have commercial software companies. It's a troubling trend that efforts to address to the problems of the formal university technology commercialization process attempt to expand, rather than moderate, or even shrink, centralized control. Blind acceptance of the value of the cathedral mode and the strategies and policies that come with it threaten to choke the free, informal and un-choreographed knowledge flow that fuels the bazaar.

So what should be done? Here's a thought. Wouldn't it be great if the next technology commercialization competition were to be The

Bazaar Cup? The winner of the Bazaar Cup would be the university that did the *most* dismantling and the *least* architecting of its formal technology commercialization practices, programs and policies.

Entrants to the Bazaar Cup would submit a five-page document describing university strategy and policy "before" and "after." Extra points to the university that offers detailed, quantifiable descriptions of what practices, exactly, were relieved of central oversight. Entries would be submitted online for anyone to read. Judging would consist of an open ballot with the condition that each judge make her vote public (to minimize political shenanigans). I'll bet that the online debate from Cup judges and spectators would kick up a whole lot of valuable best practices for policymakers to pore over.

Protecting university inventions from…university administrators?

Some people are surprised to learn that most U.S. research universities own large portfolios of patents and copyrights; universities also stake claim to other by-products of federally funded research created by faculty and students such as research tools, integrated circuit chips, biological organisms, engineering prototypes and data. Right now, federal law (the Bayh-Dole Act of 1980) is somewhat vague about exactly who gets title to the invention, the university inventor or her university. As a result, most universities clarify this grey area by writing intellectual property policies that put them in control of anything invented on campus.

How today's U.S. research universities manage, or protect, their intellectual property portfolios is an increasingly controversial topic. Managing ownership issues around research results, patents, and knowledge in general is not a straightforward matter. Depending on who you ask, one person's idea of protection could be another person's idea of being shaken down, as evidenced by high-profile IP disputes such as Stanford vs. Roche, and more recently, University of New Mexico vs. Intel.

The debate goes something like this: those in favor of the current tech transfer model claim that universities are indeed protecting tax-payer funded innovation by owning research, patenting it, and trying to making money off of licensing royalties. Other stakeholders, however, claim that some universities, in the name of "protecting" their IP portfolios, are actually not protecting anybody but their own interests, sort of like a mob thug who "protects" civilians from harm in exchange for hefty payments. The truth lies somewhere in the middle.

University IP policies that define who on campus gets to control university inventions are becoming the new battleground of the debate. Many universities have risen nobly to the challenge and have done a great job of ensuring that under their stewardship, university research is fairly and capably put to good use serving society. Sometimes, though, things don't go smoothly, IP policies fail, and disputes arise between university inventors, businesses and the university. When things go wrong, the finer points of a university's IP policy move from a previously low-profile, marginal existence into the spotlight. Most people involved in university innovation don't know what their university's policy says until they find themselves in a dispute, publicly arguing the finer points of the policy in the context of the Bayh-Dole Act.

Companies cite IP problems as their biggest challenge in establishing connections to the university.[10] Sponsored research agreements between a company and a university contain intellectual property clauses that give the university ownership of any patents that result from the project, and may require the company to later negotiate for rights to the patents their research funded. While these IP clauses are viewed as a common deal-breaker in industry/university collaborations, it's important to keep in mind that a university must avoid the appearance of being a "lab for hire."

Universities are not the bad guy in this scenario, nor are businesses, inventors, federal funding agencies or would-be entrepreneurs. Writing good policy is hard and IP policy is even harder, since defining ownership rights to knowledge and innovation is like trying to catch a greased pig in a crowd of animal rights activists. It's important to point out that even poorly written university intellectual property policies were drafted with good

intentions in response to local challenges and regional needs. In addition, an IP policy must prevent fraud and abuse of the system, yet also serve the honest majority of people that are working hard and getting good results.

With that said, perhaps it's not surprising that many university IP policies reflect how hard it is to balance all of this in a climate of shifting political realities. It's no small task to write flexible and effective policy when you have to combine a complicated and controversial topic, with a maze of tight regulation, with accumulated years of administrative tweaks and conflicting agendas.

I read several university IP policies to see how they're faring. Common existing challenges are listed below with actual excerpts underneath each point in italics.

Problem 1. The IP policy permits the university slow action (or no action) on refusal of title: policies should make the tech transfer office adhere to a quick and set time period to turn down an invention; transfer of title back to the inventor should be automatic and quick (weeks, not a year) and not require the inventor to make a special request or to appeal to the tech transfer office. Letting inventions sit for a year could kill a viable commercialization opportunity.

> **EXAMPLE:** "In cases in which the university has an ownership interest in an invention and the university or its designee has not pursued commercialization within one year, the inventor who intends to pursue commercialization of the invention may request in writing that all university rights be reassigned to the inventor."

Problem 2. No fair hearing for IP-related issues: Too frequently, the tech transfer office is given sole discretion to make

judgments on ownership of inventions and other IP issues. This represents a conflict of interest since the tech transfer office is not neutral. The tech transfer office should play the role of an expert witness. However, other campus players need to be involved and the decision process should be public and transparent.

> **EXAMPLE:** "All inventions must be disclosed in writing to the tech transfer office, which will determine ownership in accordance with the terms of this policy. If the tech transfer office determines that University Z has an ownership interest, the inventor must assign all rights and titles of the invention to the university or its designee, and cooperate and assist the university."

Problem 3. Don't have the fox guard the henhouse: The VP of Research should not be the final arbiter of an IP dispute. VPs of research manage the tech transfer office and therefore, are not neutral.

> **EXAMPLE:** "Disputes regarding ownership determination may be appealed to the Vice Provost for Research, whose decision will be final."

Problem 4. Mandating university inventor assistance with commercialization: It's great if the university researcher chooses to be actively involved. What is she doesn't have time, or needs to work on getting tenure? Then what? Requiring an inventor to assist the university, however, smacks of a lack of a rigid and authoritarian attitude on the part of the tech transfer office. In an ideal world, cooperation and assistance between TTO and inventor would flow naturally; the fact that this university mandates it in its IP policy indicates a sub-optimal relationship between the tech transfer office

and university researchers. What happened to adding value to attract clients, or at least, asking nicely?

> **EXAMPLE:** "If the tech transfer office determines that University X has an ownership interest, the inventor must assign all rights and titles of the invention to the university or its designee, and cooperate and assist the university."

Problem 5. Don't let the tech transfer office make all the decisions alone: The spirit of successful commercialization needs to be a two-way street. Having the tech transfer office make all commercialization decisions alone can lead to secrecy, agenda-serving, and a lack of accountability. The spirit of the language below does not indicate a partnership.

> **EXAMPLE:** "The tech transfer office will evaluate all disclosed inventions for their commercialization potential and determine the appropriate means for protecting and promoting the development of the invention. Inventors will cooperate with the university or its designee in the university's effort to evaluate and protect University Y inventions."

Problem 6. If you're gonna give it back, then really give it back: Many universities actually do return inventions to their inventor. But some only do so with strings attached.

> **EXAMPLE:** "The release of the supported invention may be conditioned on the inventor … sharing with the University 20% of the net income received by the Inventors from the Invention. "

Problem 7. Make it easy and quick for people to get unpatented research materials: If a tech transfer office does not plan to pursue commercial opportunities on research materials and related tools, researchers at universities and in companies should assume they can use the material; charging fees and case-by-case licensing procedures does not serve the public interest.

> **EXAMPLE:** "The University shall own all rights in Unpatented Materials and may make appropriate distribution in the public interest, including licensing or transferring Unpatented Materials, for research and commercial purposes."

Problem 8. Be careful about delaying publication in favor of commercialization: This is a matter of opinion but putting a commercialization opportunity before public dissemination of the invention may be favoring the private, not public interest. I realize that there can be good reasons for not sharing something publicly if a major licensing deal is in the works, but still… Delaying public sharing of results can do major damage to a researchers' career and hamper the advancement of the field.

> **EXAMPLE:** "If the publication of research results may reveal an invention, University personnel must ask the tech transfer office for advice on how and when to publish the results in order that patent protection for the invention is not compromised. It is the University's policy to publish the research results as soon as possible consistent with the securing of patent protection."

Problem 9. Be flexible: Consistency is key, but blindly clinging to policy is not a good idea. Somewhere, there's a middle-ground that

considers special aspects of each case and doesn't stonewall the person who's making an appeal. This tech transfer office does not seem like a team player.

> **EXAMPLE:** "Provisions of this policy may be waived only in extraordinary and compelling circumstances and in accordance with steps outlined in Procedures."

A university's IP policy reveals whether that particular university views itself as a publicly funded organization with social responsibility, or as a private corporation that whose commercial "product" is on-campus research. As expressed by entrepreneur Neil Kane in testimony to U.S. Congress in a special hearing on university technology transfer,

> *"Rather than seeing themselves as stewards of public property, due to the Bayh-Dole Act, universities have to come to believe that innovations developed with federal funds are theirs. I suggest modifying Bayh-Dole to require that any license agreements executed for subject technologies become publicly accessible. This should be legislatively mandated. Universities will vigorously oppose it, but it will level the playing field and reduce transaction costs across the board. This action will dramatically shorten the time needed to get companies formed and licenses executed. From the university or federal lab standpoint, the public contract should change from "the government funded it but we own it," to "if we want to profit from retaining title to the intellectual property which was funded by the taxpayers, then we have to be willing to tell the taxpayers what we charged them for it."*

Universities have their work cut out for them and many of them are doing an extraordinary job of wrestling with complicated and controversial intellectual property issues. In addition, we can't

easily change the patent system, nor the stipulations of the Bayh-Dole Act.

While there's a lot of debate about exactly how much leeway universities have in IP clauses while still remaining compliant with their tax-exempt status, it's worth understanding that university research contracts are bound to stringent federal tax regulations. Many universities attempt to meet their tax exempt obligations by offering an industry sponsor an exclusive option to later license any resulting patents from a sponsored research project. A university may request that the sponsoring company license any resulting patents at a fair market rate.

While many companies would prefer that a university offer a set, upfront price for a patent at the time the sponsorship is arranged, most universities don't feel that doing so would be establishing a "fair market value" for the patent (another requirement as a tax-exempt organization). Some universities are exploring ways to make the sponsored research process easier by offering one-time upfront payments in exchange for patent rights, or by allowing the sponsoring company to have a no-cost, non-exclusive patent license.

U.S. universities, particularly publicly funded ones, must manage their sponsored research agreements carefully to honor their 501(c)(3) tax exempt status. When companies sponsor private research in a non-profit organization such as a university, according to U.S. tax law, the university is required to serve the public interest by ensuring that any resulting intellectual property is "made public on a non-discriminatory basis." An IP clause in a sponsored research agreement sounds arcane and annoyingly trivial. But it's worth getting right.

Most companies no longer invest in open-ended, early stage research. Instead, companies conduct what's known as "applied research" that directly aims at incremental improvement in a particular commercial product or process. Modern corporate R&D activities (if they exist at all), are lean and mean stripped-down versions of the grand and glorious in-house R&D labs of the 1960s and 70s exemplified by Bell Labs and Xerox Research Parc.

In the 1970s and 1980s many Fortune 500 companies shifted their focus away from exploratory, long-term product research in favor of quicker profits. Corporate in-house R&D labs were closed and product research focused on incremental improvements rather than great leaps forward. Today, with some notable exceptions such as Microsoft, IBM and Proctor & Gamble, most large or small companies do not conduct their own in-house, early-stage, exploratory scientific research.

As corporations focus on short-term revenue, today's U.S. universities are assuming more and more responsibility for conducting open-ended, scientific research across a broad range of industries. As a result, companies look to universities for new product ideas, data and game-changing research and technology. According to the Association of University Technology Managers, in 2009, companies paid for over $4 billion worth of research, about 10% of a typical university's annual research budget.

Ideally, "protecting" university research should be done in the name of protecting the public interest and helping companies advance their products and services. But if things go wrong and businesses and university inventors are forced to pay prowling university administrators "protection" money in exchange for being left alone, something's not right.

Underfunded or underperforming? Depends on who you ask

A neat bit of wordplay takes place when people talk about whether U.S. research universities need to change their strategies for commercializing the inventions and patents that arise from on-campus labs. This particular debate involves two camps: those who believe universities are underfunded, and those who believe they're underperforming.

The first camp, the "Underfunders," are in favor of the current approach. They claim that the university unit that patents and licenses inventions – aka the technology transfer office — is doing fine but just needs more money. This is the stepping off point for this group's recommendation that the best solution would be for the feds to give universities more money to keeping doing what it's doing, but bigger: hire more staff, set up lots of entrepreneur networking events, institute on-campus classes to teach professors how to be better at business, and build proof of concept centers.

In contrast, the other camp, the "Underperformers," advocate radical re-thinking of the current university technology transfer process. Their recommendations focus on changing, not upgrading the current approach. For example, an oft-discussed alternative strategy is that universities de-centralize the technology transfer process by permitting faculty and students to manage the commercialization process themselves. Another sometimes recommended alternative strategy is to ask science funding agencies to mandate that universities utilize non-exclusive, royalty-free licenses to enable cheap and easy public access to university-owned patents. Additional alternative strategies include instituting regional, multi-university patent pools, instituting an online patent

auction system, or releasing un-licensed university patents into the public domain.

So what is it? Underfunded or underperforming? Two standard answers work just fine here: first, "it depends on who you ask," and second, "the truth is somewhere in the middle." Not very satisfying, eh? Here's my quick and equally unsatisfying answer to this question: "nobody knows whether university technology transfer strategies are underfunded or underperforming."

What do I mean by this? I mean, that the classic "underfunded" vs. "underperforming" debate is not the core discussion here; instead, it represents the tip of a larger iceberg. Hulking underneath the surface of the water lurks a more imposing challenge: no one can agree on what constitutes "effective university technology transfer" since the question of underlying mission remains a moving target. If you ask ten different people what a university's technology transfer mission should be, you get ten different answers.

No clear mission = countless different ideas of what success should look like = no clear discussion. Intelligent discussions of university technology transfer strategy end up shipwrecked since stakeholders come to the table to lobby for, or to defend their own version of things should be. But of course everybody has harbors her own agenda and priorities! That's not the source of the problem; that's just reality. The problems arise when stakeholders think they're taking part in the same discussion but are actually debating within their own unique frame of reference without acknowledging their biases and agendas. That's how groups of people such as the "Underfunders" and the "Underperformers" end up speaking past one another.

Consider the following groups: 1) university scientists /inventors 2) federal and state scientific funding agencies 3)

university administrators and technology transfer staff 4) companies and entrepreneurs and 5) humanitarian agencies.

Imagine asking these diverse groups of people to intelligently debate one another on the merits and drawbacks of the current system of university technology transfer. Would meaningful dialog emerge? Lots of interesting ideas would likely be offered, but I'd bet that you'd wonder whether they're all talking about the same system. Even better, imagine asking them for recommendations on how to make the current system better. Cacophony.

In psychological lingo, the tendency of people to view things a certain way as a result of what role they play in a social system is called "role bias." Unexamined role bias is a large part of the reason that technology transfer stakeholders appear to be interpreting the same situation is such dramatically different ways. John Tyler, general counsel for Kauffman Foundation, once aptly described the situation as follows:

> *"To some degree, how universities have operated under Bayh-Dole might be analogized to people who tend to look at advancing innovation through a particular window in a room with a full circle, panoramic view of forests, meadows, beaches, and mountains, depending on the window. Even if the view through any particular window is good, it is not the only window in the room. There are other views––other windows—that contribute to the overall view from the room with the other windows enhancing appreciation of the beauty. Failing or refusing to take advantage of the views offered from other windows denies potential by denying information and alternatives; it also can lead to a distorted reality reminiscent of Plato's Allegory of the Cave."*

How do we break this gridlock? It's time for stakeholders to surface their role biases and factor in its effect on their perception of the university technology transfer process. Imagine the corrective power of understanding role bias in discussions in which stakeholders — despite good intentions and even good information — continue to insist on widely varying interpretations of the same reality. Lobbying for one's selfish agendas becomes more difficult. Disagreements over core issues begin to make more sense.

What to do? The federal government has made various attempts to learn more about the university technology transfer process but my sense is that their efforts are also stymied by the "underfunded vs. underperforming" dilemma. In 2009, the White House, Office of Science and Technology Policy and National Economic Council issued a Request for Information two years ago to ask regular people their opinions on how to improve the university technology transfer process. More than 200 people and organizations toiled to craft thoughtful and comprehensive responses, but there was no public follow up or actions that resulted from the information. (Did they issue that RFI just to keep us busy and quiet, like giving little kids crayons in a restaurant?)

The Department of Commerce's latest stab at leadership has been to sponsor a recent gargantuan report on technology transfer and federal laboratories. The report has a lot of intriguing insights in it but I'll be $10 that like the RFI responses, it also sits and collects dust with no resulting action. Other federal attempts include the $12 million i6 challenge launched by the Economic Development Administration (EDA), and its follow-on, the i6 Green Challenge. These are all worthy attempts. But my sense is that research and RFI responses haven't been transformed into concrete action. And the i6 proof-of-concept centers expand on an approach that already exists

now at MIT and UCSD, but won't bring us any closer to exploring alternative strategies that should be piloted as well.

The Department of Commerce - to lead us towards greater clarity – should toss a few dollars at the problem of role bias. It will be money well spent. The Department of Commerce should fund a study to learn whether stakeholder role bias is preventing meaningful and productive discussion of the university technology transfer process. Here are the blind spots that appear to be currently impeding our understanding: 1) people can't agree on the underlying mission for a university's efforts to place research into commercial use. 2) Some believe today's approach working well, others want to change it 3) for those who believe that change is needed, what aspects of today's strategy, exactly, needs to change and how?

It would be interesting to see who believes what. Do you think that a person's answers to the following questions would change if say, they worked inside a university's technology transfer office, or were trying to spin off a startup, or were an inventor? For example:

1. Should a university technology transfer office be an optional service to university faculty or should it be a profit center for the university?
2. Is the university's role to ensure broad adoption of federally funded research or should the university manage its collection of patents and inventions as if it were an intellectual property broker or merchant?
3. If a university invention "gets away" and falls into widespread mainstream use without being patented or earning the university any money, did the university fail in its technology transfer mission?

4. Why do almost a third of patents attributed to a university faculty member land in companies without the university administering a license. Is this a good thing or should a university attempt to curtail the dissemination of what some call "rogue IP."

5. Is the university's patenting and licensing process having a beneficial or negative effect on innovation in your industry or field of research?

6. Should university faculty be permitted to play a formal leadership role in a startup based on their invention?

7. Should the current system remain the same, or should it change? If so, what should change?

8. What should government policy makers do to improve the current process? Should changes be mandated as a condition of a university receiving federal funding for scientific research?

I, personally, would love to see the impact, if any, of role bias in determining how people answer meaty questions such as these. These stakeholders may be speaking their truth, but given the complexity of the process of bringing raw university research to the marketplace, several versions of the truth can ricochet around without connecting.

So back to the Big Question: underfunded or underperforming? My hunch is that role bias has a strongly influence on one's answer. But right now, given the lack of real insight and honest discussion, it's impossible to know.

Introducing the free market into university technology transfer services

An effective university technology transfer model should take advantage of lessons learned from the current process, tap into the power of the free market, use today's internet technologies, and enlist emerging open innovation paradigms. The good news is that drastic change to today's university tech transfer process may not be necessary.

I propose an new, alternative method to commercialize university research. Let's call this proposed model the "Plan B" approach. Plan B would complement, rather than replace, the work of the university TTO. This proposed model would maintain the core of today's university tech transfer model, but would take advantage of the power of the free market, capture the long tail of invention licensing, and make use of open innovation licensing paradigms.

In the Plan B approach, universities would give their TTO first right of refusal for new inventions, remaining the first step in the university commercialization process. Within a specified time frame, the TTO would choose one of two options: commit to managing an invention or formally turn down the opportunity and would hand the reins over to the inventor. If the TTO declined, faculty would be offered the chance to manage the invention themselves, or would be permitted to enlist third party commercial agents.

The selected agent would work on commission only and would assume the costs associated with getting an invention ready for market such as patent, marketing and prototyping expenses. In essence, the agent would fully step into the role ordinarily played by

the university TTO. Regardless of the TTO's decision, the university would still retain title to the invention.

The university TTO would continue to co-exist with faculty-led, third party commercialization efforts. By adding a second alternative pathway to technology transfer, there would be no reason for hardworking, under resourced university TTOs to struggle under the avalanche of inventions they simply do not have time or resources to work on.

The Plan B approach would make it clear to university administrators that each languishing unpatented and unlicensed invention represents a real and marked opportunity cost to the university and inventors. As a result, the university would strongly encourage the university TTO to share its workload with inventors and third party agents, especially since the commercial agents would assume all costs and get paid on commission. Rather than continuing to store thousands of unpatented and unlicensed inventions in a central university tech transfer office, commercial agents would get a crack at finding a use for the thousands of inventions the TTO does not have the time to fully focus on.

Agents could write their own license terms as long as they agreed to the single university-mandated condition, royalty distribution. Agents would receive a third of the distributed royalties for any license they execute; the inventor and the university would receive the remaining 2/3s. The university would continue to receive a third of distributed royalties, regardless of whether the invention was executed by the university TTO, by the inventor, or by a third party commercial agent.

To prevent aging inventions from dying a slow, silent death in the university TTO, after two or three years of disclosure, universities would place all unpatented, unlicensed inventions into

the public domain. Regardless of who was managing the commercialization process, all unpatented, unlicensed inventions would be handled the same way, by being released into the public domain. If businesses or tinkerers wanted to use the technology, they could sign an optional, click-thru, non-exclusive variant of a Creative Commons license. The motivation to do this small bit of paperwork would be that this license would bind neither the university nor the licensee; instead, its purpose would be to release the university from indemnity and provide verification that the university gave up title, therefore will not sue over IP issues.

In summary, here's how this proposed model would work.

1. Faculty and student inventors would disclose their invention online to the university-provided tech transfer office. To accurately capture the technology and ease the TTO workload, inventors would describe and post their own inventions.

2. All disclosed inventions and materials would be immediately publicly available in a database that anybody could search and browse.

3. The university TTO would first assess the invention. They would exercise the first right of refusal within a specified time period of 2-3 few months (some universities already do this; Stanford is a good example).

4. If the university TTO decides that it lacks sufficient resources or subject expertise to effectively patent and market the invention, then the TTO would formally hand the reins over to inventor to manage the commercialization process.

5. The inventor would now be at the helm of the commercialization process. Key point: even if the university TTO elected not to manage the commercialization process, the university would continue to retain title to any future patent or copyright.

6. The inventor would now have a few choices: do nothing (this is why the initial disclosure should publicly posted online),

pursue a patent and license on her own, or select a third party, commercial agent. This is where the free market would come in.

7. If the inventor were to select a commercial agent, the agent would work on a commission model to manage the commercialization process. Key point: Commercial agents would have to agree to the university's royalty payment scheme as a condition of accepting the job. Therefore, if a license were to be successfully executed by an agent, the university and the inventor would still receive 1/3 apiece. The agent would take the remaining 1/3 as commission.

8. If neither the university TTO, nor the commercialization agent chose to pursue a patent and license for an invention, two years after the initial public disclosure of the invention, all unpatented, unlicensed inventions would go into the public domain. The invention would now be available via a simple, non-exclusive license that would release the university from indemnity and verify the university gave up title and will not sue for patent rights.

9. To increase transparency, hence accountability, all inventions in the public database would be clearly flagged as to their status, the name of the selected commercialization agent, and the time elapsed since the invention was first publicly disclosed.

Everybody benefits.

The great thing about the Plan B approach is that it addresses the backlog of unpatented, unlicensed inventions that comprise the majority of most university IP portfolios. The university still gets first chance to cherry pick the inventions it considers the most valuable. Since the university receives royalty payments regardless of whether their TTO or a third party agent made the deal, universities have nothing to lose by opening up their tech transfer process to third parties, especially on inventions the university TTO does not have the time and money to develop.

Fear, uncertainty and doubt and university IP strategy

Fear, uncertainty and doubt (FUD) provide a shoddy foundation for an effective innovation strategy. Blogger Jeffrey Phillips argued that FUD-based marketing campaigns value "what's known and experienced … in a decision process [more] than what's new or unknown. [FUD marketing] argues that consistency in decision making and loyalty to the status quo are more valuable and more defensible than change."

FUD may be a shoddy strategy but it's widely used. Here's an example of a typical FUD marketing technique: FUD-utilizing company X says "if you buy competitor's <rival product (s)>, though you will pay less for their product at first, you will pay far more down the road in support fees, poor product security and poor compatibility with existing industry standards."

FUD is a great technique for incumbent companies that have a strong incentive to want things to stay the same. However, a company too fluent in FUD marketing puts their own internal culture at risk. How? A relentless focus on defending the status quo may spill over into from external marketing messages into a company's core culture. When FUD becomes part of an organizational fabric, it fosters a negative, innovation-resistant internal environment, steering would-be strategy-setters away from fact-based decisions and deterring them from exploring great new ideas.

Inward-facing FUD is devastating to an organization's ability to innovate. Inward-facing FUD is when people use fear as a tool to make a point or to justify to their peers and management or shareholders why strategic change is dangerous and should be avoided. Frequently, inward-facing FUD also goes by another name: "politics."

Inside a FUD-infected company, inward-facing FUD is employed as a tool by competing fiefdoms to gain control. FUD-slinging political animals use fear, uncertainty and doubt to justify strategy that wins them a bigger slice of the pie and limits the productivity of other parts of the organization. When inward-facing FUD works, eventually, a strategic decision-making process that would have been best carried out in a rational, fact-based manner ends up becoming a deformed, unrecognizable version of its former itself. Some people call this "a Dilbert moment."

Internal FUD has an even darker side. It can provide a smokescreen for someone defending a self-serving and unpopular course of action. Internal FUD can be is harder to identify than outward-focused marketing FUD, and more difficult to inoculate against when you're swimming right in the midst of it. Companies use marketing FUD to defend their incumbency against their competitors. Internal divisions use FUD to convince themselves and others that even though the status quo is miring an organization in dysfunctional procedures and antiquated products or services, the division and company need to keep doing what they're doing or else "bad things will happen."

I've seen internal FUD used everywhere I've worked — corporate, academic and government — so no sector is exempt. In my experience, however, despite good intentions, university administrations are particularly vulnerable to rampant infestations of inward-facing FUD. While undoubtedly all parts of a university administration are riddled with FUD-slinging fiefdoms, in my experience, a particularly FUD-ridden university strategy — or lack thereof – is conducted by the university fiefdoms that manage university patent portfolios.

Most universities work hard to develop a reasonable strategy to navigate the complicated ecosystem that surrounds innovative university research. However, too frequently, universities, even prestigious ones striving to foster an entrepreneurial climate on campus, use fear, not facts, to justify their IP policy, particularly when it comes to IP clauses in industry/university research sponsorships.

For those unfamiliar with university/industry research collaborations, when a company wants to formally conduct joint research with university scientists, the company is required to agree to an IP clause that gives the university full ownership of any patents, materials and data that result from the research project. Since businesses, obviously, also have a stake in the results of the research they are sponsoring, they're not so eager to both fund the research project and to also sign away their rights. As a result, many businesses report that their biggest barrier to joining forces with universities to pursue innovative research is an IP clause whose purpose appears to be to protect the university's interests. If neither side is willing to give in, it's not uncommon for a one-sided IP clause to become a deal-breaker.

Why would a university jettison a perfectly good research collaboration by insisting on owning phantom patents that may or may not arise from research results? Because the technology commercialization unit is tasked with monetizing and safeguarding the university's IP portfolio. When a faculty wins an industry research contract, the tech commercialization office must approve the deal.

Imagine you're responsible for your university's patent portfolio. Just this once, you agree to an industry-sponsored research collaboration that has no IP clauses. In other words, the

company gets to walk away with whatever intellectual property (if any) results from the sponsored research.

Now imagine this: the company walks away with a new algorithm that becomes the next Google, or a new chemical formula that becomes the next Gatorade. You, the unfortunate soul who approved the contract, have seriously dented your professional standing and in the university's eyes, have let millions of dollars of intellectual property slip out the door. Because of the one-in-a-thousand chance that a joint research project might result in a lucrative new idea, the technology transfer office is incented to err on the side of caution and insist on strong and mandatory IP clauses.

Here's where FUD kicks in. At unfortunate universities where a conscientious tech commercialization service is perceived by its customers as the grim reaper of innovation, to defend its frequently unpopular position, its administration will claim that without stringent IP clauses, the university would be mercilessly fleeced by greedy companies (fear). Rather than defending the university's IP strategy with rational arguments backed by solid data and several convincing case studies, instead, a skilled FUD-meister will paint a fear-based, statistically unlikely, but compelling picture of how he or she is singlehandedly saving the university from foolishly giving away millions and millions of dollars in licensing revenue.

Letting phantom patent revenue stifle research partnerships is not in the best interests of the university, the faculty, and the tax-payers. At most universities, future patent revenue is a case of wishful thinking since 99% of university patents never earn money. In fact, since universities take a hefty overhead cut on every research grant — corporate and federal — that comes in the door, the income a university earns from research grants far outweighs the revenue earned from licensing patents. In contrast, the university's

technology commercialization service, with a few exceptions, costs its universities a million or two dollars a year in office overhead and in legal fees for patents that no one ever uses.

Most U.S research universities lose money on patenting and licensing university technologies. Almost 75% of universities with technology transfer operations don't earn enough in licensing revenue to cover the costs of procuring patents and paying for technology transfer office operations. Approximately 15% barely break even, re-couping less than 4% of university research expenditures.

Fewer than 10% earn enough income from licenses to earn more than 5% of research expenditures; of these "high earners," over half rely on revenue from one or two "jackpot" licenses rather than a robust, sustainable and distributed revenue stream. Yet, ever hopeful, 76% of surveyed university administrators from 100 top research universities reported that their university viewed patents as a "sought-after revenue-generating source.[11]

Aside from money, perhaps the most biggest opportunity cost of faltering university/industry partnerships are the intangible benefits. Our society benefits from unfettered information-sharing between university and company researchers, job opportunities and internships for students, and perhaps most importantly, an open, collaborative atmosphere where researchers can work together without worrying about their university cracking down on unreported inventions or unapproved resource sharing.

To be fair, universities sometimes have good reasons to be wary of companies bearing gifts in the form of sponsored research agreements. Many responsible, astute university administrators correctly want to ensure that their labs do not end up being cheap,

outsourced corporate research satellites. And, although it may be unpopular, a flexible, case-by-case basis IP clause is not without merit. However, IP clauses become innovation killers when they're enforced rigidly and mechanically. FUD may be a proven and powerful marketing technique, but should not be the foundation for an organization's ineffective innovation strategy.

Since universities lack the corrective force of a firm bottom line, they can afford the high cost of FUD-driven innovation strategy. Thanks to the Internet and new business models, the past few decades have brought about profound changes in the way innovative research and technologies are generated, managed and shared. Universities, however, are buffered from these winds of change.

University's deep pockets and loyal customers offer university administrations little incentive to set up a culture of checks and balances to protect their strategic capacities against the quicksand of FUD-driven thinking. Unlike a company that must continue to please its customers, universities have the luxury of exceedingly loyal "customers" – current and prospective students, alumni donors, businesses that sponsor research, and federal funding agencies. University "customers" are forced to be tenacious; switching universities, while possible, is not a simple as switching cell phone providers. As a result, universities enjoy the dubious benefit of being able to fail slowly.

If we continue to defend the status quo in our university IP policies, we risk choking off our nation's universities ability to freely explore fresh ideas, and the opportunity for faculty and students to tap into the industry know-how and funding they need. Let's think positive for a second: perhaps university IP clauses are NOT a necessary evil. Maybe open and flexible management of

university/industry partnerships would have FEWER negative consequences than maintaining the course universities are on now.

Even many frontline university IP managers (yes, lots of them are forward-thinking people who would love to try new approaches) privately disagree with their university's IP policy, yet, when faced with a stone walling management, keep their heads down and their mouths shut. What a shame that the process of hammering out IP strategy is based on FUD, and not informed by factual insight from the practitioners actually managing the sponsored research contracts and patent licensing deals.

FUD-oriented marketing has its uses, and defending an incumbent market position is not always a bad corporate strategy. However, continuing to permit inward-facing FUD to justify suboptimal university IP strategy could paralyze our nation's vital innovation ecosystem. Since technology commercialization staff are muzzled and most university administrators are incented to restrict the free flow of university innovation, who on campus will lead the charge to dismantle their university's FUD-based IP strategy?

I think it's time for university inventors to put some skin in the game. Inventors need to band together and push their administrators to justify incumbent IP policies with real facts and real research. Don't grieve, organize!

Oh yes, while we're on the topic of anti-entrepreneurial university environments. Some universities are claiming ownership of their employees inventions that were created offsite, on their own time, not using university resources. Under the guise of a "conflict of interest" policy, these clumsily crafted efforts to prevent a Big Idea from getting away by prying into university employees' after-work activity are perhaps the epitome of fear driven, doubt inducing ineffective university strategy. We're all against corruption and

misuse of tax-payer funded resources. But it seems that rampant FUD may make the prophylactic -- IP clauses and all-encompassing claims to any output of employee brains -- more devastating than the original disease.

Why offshoring some tech transfer functions could help create U.S. jobs

U.S. research universities churn out roughly 2/3rds of our nation's basic, game-changing research. In this era of tight budgets, some universities are offshoring the work involved in bringing on-campus inventions to market, paying companies in India to do market research and low level legal work such as patent prior art searches. Offshoring remains a taboo subject in our faltering economy, but it may not be as simple as we have been led to believe. I share the same reservations about offshoring work that any American does — after all, I live in upstate New York, the land of decaying manufacturing cities.

It's counter-intuitive, but could offshoring the commercialization process of university inventions help bust out some of the un-used backlog of innovative university technologies, and actually *help* our universities create domestic, high-value jobs? Strange as it may seem, universities that offshore knowledge work such as patent analysis and market research reports report a significant increase in new invention disclosures and happier faculty inventors. And, giving overworked tech transfer staff some freed up time to work on more strategic, higher-visibility projects could raise the perceived value of the university's tech transfer services.

It goes against what most of us believe, but there's increasing evidence that offshored jobs do not decrease the number of domestic jobs. In fact, recent research concludes that "an increase in offshoring pushes the average task performed by [U.S] natives toward higher cognitive and non-routine content."[12] Of course nothing in life is free, or free of risk. Like anything that offers

tempting upfront cost savings, offshoring has significant downsides.[13]

Some people fear that offshoring could put the university at risk of violating export control laws, expose university innovation to intellectual property (IP) theft, and undermine the perceived value of existing on-campus tech transfer services. Not to mention the horrors of modern-day sweatshops in unregulated work environments. There are serious and proven downsides to offshoring knowledge work. What could be the potential upsides?

It's entirely possible that offshoring patent and market research is not the right strategy for managing a university IP portfolio. But if something could offer your university some of the benefits listed below, wouldn't you at least be curious enough to investigate further?

1. Cost savings on legal fees: Patenting early stage university technologies is an expensive and uncertain business. In 2008, the top 20 U.S. research universities spent an average of $6.7 million a year on patent-related activities. However, on average, these same universities got only half of that investment paid back. (AUTM, 2010 data)

Each year, the top 20 U.S. research universities continue to file on average, 150 or so provisional "placeholder" patent applications (AUTM 2010). Investing in prior art patent searches may save money; if a report uncovers prior art for a new invention, a university will know not to file a provisional patent application. Universities that commission offshore prior art reports find that on average, prior art exists for about 15% of new inventions. Some faculty, based on what they learn in a

prior art report, have steered their research into a fresh and novel direction.

Further down the road, if a university has already paid for a prior art search and then later decides to file a utility patent on an invention, the U.S.-based attorneys that draft the final patent claims can do that a lot faster, hence more cheaply.

2. Speed: The top 20 U.S. research universities receive an average of about 340 new invention disclosures each year.[14] University staff are burdened with hundreds of inventions to manage, so digging into the details of a single invention can take months (80-90% of university inventions never find a home in industry). It takes an offshoring company about a week to conduct a simple prior art and market search and three weeks to conduct a complex analysis.

3. Being business capable: Raw, early stage university research has no commercial value without a market context. When I worked in a university tech transfer office, the most common complaint about our technology marketing efforts was from business people. They complained that we only provided technical information, but nothing about the potential business value of an invention. We agreed completely agreed with their feedback, but staff simply did not have time; providing inventors and businesses high quality market research reports and patent assessments of university inventions (perhaps fairly enough) were not a priority of the **administrators of our tech transfer office.**

4. Freeing up staff time for higher-value functions: One technology transfer manager told me that he commissions patentability and market reports for about 40% of new

inventions. The reason he pays somebody else to do these reports is that his tech transfer office has four staff members, a tight budget, and needs to continually prove value to university inventors and administrators.

His situation is typical. Small tech transfer offices are actually the norm in U.S. research universities. Over ninety percent of U.S. university tech transfer offices have fewer than ten professional staff members. As a result, sixty percent of universities must rely on undergraduate and graduate students to conduct patent prior art searches and do marketing research on new inventions.[15]

5. More, and happier university inventors: During my days as an employee in a university's tech transfer office, it used to worry me that we did not based our patenting decisions on facts. When we told an inventor his technology was not worth patenting, no one had time to conduct a real market analysis. Hence we could not offer the disappointed inventor substantial evidence to support our decision. As a result, some inventors lost trust in us. The benefit of having real data would have been that like humans of all ages, when we're told "no" and handed a convincing reason why, we walk away feeling much better.

Inventors like quick, objective and precise feedback on their invention. Happy inventors are more likely to come back again with new inventions in the future. University technology transfer units that offshored prior art searches to give to their inventors find that inventors responded positively and started to submit more invention disclosures.

In conclusion, all of us want to help the U.S. economy find more solid footing. You wouldn't be reading this if you weren't a

passionate advocate of the potential social and economic value of federally funded university research. Offshoring some of the work associated with managing university inventions is not a step that should be taken lightly, or without significant investigation. Rural and land-grant universities face additional PR challenges if they were to offshore what today are core university functions, since they tend to be the largest and most visible employer in the region.

Yet, rather than dismiss a potential catalyst for university innovation without a fair hearing, let's at least explore the pros and cons of offshoring some university tech transfer functions. What if a university could save money, place more inventions into the marketplace, create more startups, attract more invention disclosures and free up staff time for more strategic work activities?

What universities can learn from IBM's IP licensing strategies

U.S. research universities have something to learn from IBM's intellectual property (IP) licensing strategies. IBM owns the world's biggest patent portfolio. Now I am not saying that I approve of every IP strategy used by Big Blue. Nor do I mean that universities should behave like a for-profit corporation and attempt to wring revenue out of the plethora of intellectual activity that takes place on campus. This wouldn't work for several reasons. I mean that some elements of IBM's IP licensing strategy might improve the way U.S. research universities manage the patents that result from publicly funded on-campus research projects.

Here are some elements of IBM's IP licensing strategy that are relevant to university patent portfolios, although not necessarily in the way you would expect:

- At IBM, revenue related to intellectual property holdings includes more than just royalties from licensing patent rights. Instead, IBM includes consulting fees, payments related to "know-how," and other intangibles as "IP-related" revenue
- At IBM, decisions on what new technologies are patent-worthy are made in a de-centralized manner; individual inventors given performance bonuses
- Selected IBM patents are cross-licensed out to other companies
- Some IBM-created technologies that could be patented are placed into the public domain for anyone to use
- Some selected IBM-owned patents are donated to open source projects

- Instead of just attorneys, IBM engineers are encouraged to search for potential patent infringements

Clearly, IBM's licensing strategy is designed to suit a for-profit, corporate environment. What could universities learn from IBM and what would strategies might be appropriate for a university mission and culture?

IBM strategy 1: Monetize a broad swath of company know-how and resources. IBM's reported revenue stream from licensing intellectual property is earned by monetizing a number of different types of company expertise and resources, not just patents.

IBM earnings category 1: Sales and other transfers of IP ($138 million USD a year): this category involves fixed fee transfers of IP and cross-licensing arrangements of patents. Some of this includes valuation of IP in IBM divisions that were sold or spun off.

IBM earnings category 2: Licensing/royalty-based fees ($514 million USD a year): this category contains patent licensing revenue, which, according to a figure cited in an article by Joff Wild, accounts for an estimated 40% of earnings. The remaining revenue in this category is from technology licensing. That includes the transfer of trade-secrets, technical know, training, loans of personnel, or providing access to IBM labs.

IBM earnings category 3: Custom development income ($501 million USD a year): this income consists of consulting fees for IBM developers who are providing customized software solutions to clients running proprietary IBM solutions.

In a university setting: Unlike IBM, universities do not license most of the innovative technologies and know-how that comes out of

university research labs. There are good reasons for this. University research is funded to improve public health and promote open-ended scientific inquiry. Therefore, university inventions are typically exploratory and in an early stage of development.

Some university inventions make their way into a patent, but most university patents aren't commercially applicable, hence remain unlicensed. In addition, university research careers are built on broadcasting knowledge and know-how, not contributing to commercial product development efforts. As a result, the vast majority of university IP is distributed via scientific publications, personal relationships with industry researchers and by graduating students out into the work force. IBM licenses as much of its company IP as it can; universities, however, should continue to favor open innovation.

IBM strategy 2: Patenting decisions are de-centralized; IBM inventors get bonuses. Within each business unit, teams of engineers and lawyers meet regularly to review invention disclosure forms filed by unit engineers. About half of the reviewed inventions end up filed as patent applications, earning its inventor a $1,000 bonus. If an invention gets a patent, the inventor receives a second bonus. Each year, the company CEO identifies three or four inventors who have made a special contribution. Their rewards can reach as high as $100,000.

In a university setting: I do not believe that a faculty's commercialization activity should factor into her tenure process (i.e. as measured by a faculty's number of patents, commercial licenses, or involvement in startups). However, there's a more subtle point here, that IBM's engineers conducting innovative and commercially viable research are not only tolerated by their departments, but

recognized for their contribution to the larger organization. To recognize inventive faculty, universities could award annual cash bonuses per patent issued or add patents into the formula used to calculate faculty annual raises. While many university technology transfer offices recognize their leading inventors, small-scale ceremonial recognition is not as attractive as a nice bump in one's paycheck.

The second point here is that patenting decisions are made by IBM's inventors, not by a centralized unit. At IBM, a central unit manages the legal and contractual aspects only after a patent has been identified and licensed. In contrast, university patent decisions are made in a centralized technology transfer office with varying degrees of input from the university inventor.

If universities were to de-centralize their patent decision-making process, a few staff members could remain in a central technology transfer unit to manage patent paperwork and license-related billing transactions. Remaining headcount and budget could be distributed amongst university departments in proportion to inventor activity (as measured by the number of invention disclosures per department for the past five years). In-college technology transfer staff would work directly with faculty to identify inventions and their patentability. Staff placed directly into colleges would gain a better understanding of faculty research. Each department could retain a share of resulting patent licensing revenue; each department would make its own patent decisions using its own allotted budget.

IBM strategy 3: Cross-license patents to other companies. To save money on potential patent infringement litigation, IBM cross-licenses selected patents with other companies. Companies agree to

freely share selected patents in one another's patent portfolio without negotiating each separate transaction.

In a university setting: Universities can't directly cross-license their patent portfolios with a single company given the obligations associated with publicly funded university research. However, universities could cross-license patents with other research universities to form large, central patent pools. Once pooled, corporations interested in licensing one or several patents from the university patent pool would sign a single license. Participating universities would divide the revenue at year's end, either evenly or proportionately by the number of patents licensed. Non-profit, public health initiatives would also benefit from university patent pools. Organizations such as UAEM and UNITAID are advocates of pooling university-owned patents to foster lower-cost treatments for AIDS, TB and malaria.

IBM strategy 4: Donate patents to open source projects: In a well-publicized maneuver in 2005, IBM donated 500 software patents to open source software projects, promising not to sue anyone who used them. Unfortunately, five years later, IBM ended up suing a company that used a few of the donated patents.

In a university setting: Most university scientists already place their discoveries into the public domain by publishing it, or if it's software, releasing it under an open source license. Universities should consider placing patents that are more than five years old and still unlicensed into the public domain. Taking a cue from IBM, universities should consider open sourcing patents that are more than 3-5 years old and still unlicensed.

IBM strategy 6: Hunt down patent infringers. At IBM, within each business unit, engineers and lawyers search out patent infringers. Some engineers are even tasked with pulling apart competitor's technologies to figure out whether they are utilizing IBM patents without paying IBM a license fee. If an engineer finds and reports an infringement, company lawyers pressure the company to pay for a license.

IBM's dedication to finding potential infringers is viewed by some as a bullying behavior that halts innovation. Particularly in cases when a potentially infringing company caves into IBM's license demands simply because it cannot afford litigation.

In a university setting: Not a good idea. Several lawsuits over the past two decades were the result of a university suing a company — even its own researcher –for perceived patent infringement. On a philosophical level, I believe that when a university launches a patent infringement lawsuit, it's a sign there's something deeply amiss with its approach to managing federally funded university research.

On a practical level, a university simply can't win on patent infringement issues. If a university sues a small company, the university's image suffers. If a university sues a large company, the university's pockets may be slowly drained by years of pointless litigation. Finally, universities do not have the personnel to search for infringers. University inventors have other concerns. Staff in the technology transfer office do not have the technical skill, the time, nor the organizational backing to follow up on reported infringements.

Conclusion

IBM has a staunch corporate commitment to monetizing IP. It has deep pockets, and is willing and resourced to play patent-related hardball with competitors and standards bodies. In contrast, the university mission and revenue model is not well-suited for aggressively monetizing intellectual resources. Nor is IP-based hardball an appropriate role for a university that has agreed to act as a steward of federally funded scientific research.

Some elements of IBM's approach, however, should be considered. Universities should apply IBM's largely de-centralized patent decision-making process and shift patent decisions, staff and budgets into university departments. Universities should also recognize and reward prolific inventors. Universities should consider forming patent pools and donating unlicensed patents to open source initiatives. Finally, when conventional methods to find a commercial use for a patent have failed, universities should embrace alternative agent-based methods to bring research to the marketplace.

Don't ship the org chart

One of the former Vice Presidents at Microsoft Steve Sinofsky, was fond of saying "don't ship the org chart." What does that mean? It means your product or service (in the software business, a product is completed when it is "shipped" to customers) should reflect your customers' needs, not your organization's internal structure and politics.

Revenue-dependent organizations such as businesses, intuitively understand this, and if they don't, they go out of business. It's not so simple for university business units such as the technology transfer office. On campus, university business units are the campus administrative units that don't teach or do research.

Let's start with the org chart part. U.S. research universities are split into two major service areas: the teaching and research portion (faculty and students) and the administrative portion (the university workers who run programs, handle grant applications, process student applications, athletic coaches, and high-level figureheads such as college Deans and the President). In the U.S., almost all formal university technology transfer efforts are housed in the university's research division.

The research divisions is administrative, not academic. What this means is that research division employees don't teach or do research. Research division employees handle mostly internal university paperwork and research-related logistics. A typical research division is made up of the following units, or offices:

- The unit that processes the paperwork for faculty grant applications for research funding
- The unit that processes the paperwork associated with getting and receiving research grant money

- The unit that takes care of the lab animals on campus
- The unit that keeps an eye out for potential conflicts of interest of university employees

… and the technology transfer unit

Here's where it gets interesting. The technology transfer unit is supposed to be a bridge between industry and university. Somehow, this unit that's buried deep within an administrative division is supposed to successfully meet the following lofty expectations of its stakeholders:

- Stay on top of the fast-moving world of IP issues and changing licensing paradigms
- Deeply understand the potential market value of each disclosed university technology
- Launch and run highly visible marketing campaigns for a few thousand active university inventions
- Win tough negotiations quickly against top notch corporate IP lawyers
- Write and oversee quick processing of high quality patent applications
- Make sure licensees are paying their bills on time
- Build strong networks of business people, entrepreneurs and VCs since as is commonly stated, "university tech transfer is a contact sport."
- Respond quickly and effectively to stakeholder questions and problems

Is it working? Are university tech transfer offices shipping the above services or are they shipping their org chart? Would you be reading this if they were shipping the above services? Would I be writing this? Probably not.

However, university tech transfer offices themselves are not the root of the problem: they operate in a difficult environment. Given the Bayh Dole Act's ambitious and open-ended mandate to "take this early stage university research and make sure it gets used somewhere in industry," it's a tribute to the determination and grit of university tech transfer professionals that they have managed to tackle as many of these goals as they have.

The Bayh-Dole Act was a bold and wonderful experiment, but it did not provide a clear set of instructions, nor did it earmark federal funding to pay for an on campus technology transfer unit. As a result, without a clear roadmap, funding, and without the ability to think and behave like a real, for-profit business, over the years, universities have tasked their tech transfer units with a set of spectacularly unrealistic goals. If you read the mission statements of most university tech transfer offices, they appear to be additionally tasked with several grand but hopeless missions: 1) help the greater good and 2) foster regional economic development and 3) enrich the university and faculty inventors.

So what should we do? What do successful companies do when negative customer feedback indicates the company product is a shipped org chart, rather than a quality product that customers want? Here's what used to happen at Microsoft during its glory days. Given the company's unfortunate recent performance, however, I suspect that this may no longer apply.

If the product development process was corrupted, impacting product quality, the first step was for the product team to spread the word internally to company executives and staff that there's a threat on the horizon – that things need to improve (yes, when Microsoft used to be top dog, its employees are *encouraged* to point out what could be better and paranoia is commonplace). Once the threat was

accepted, internal working groups would take shape. These groups were not assigned committees; instead these teams would form rapidly and organically as people with needed skills were swept into the group. Useful people became part of the internal working group.

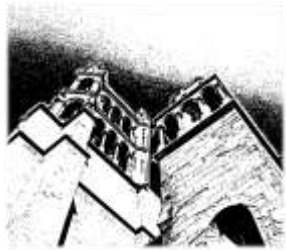
At the senior levels, execs and sales people would fan out and do as many customer visits as they can handle in a few weeks. The internal working group would continue to pull together the learnings, dig into existing data and if there was time, unearth new information. People were assigned to learn what the competitors eat for breakfast. Potential alternative strategies were synthesized and sketched out.

Finally, a rough course-correct strategy would be crafted. If part of the course-correct strategy was a re-org: people would get a new manager, a few people would be promoted and a few people would be fired. If all went well, the product improve. The "org chart" syndrome would be temporarily halted. The company's customers no longer have to struggle with a product that was a reflection of the company's internal politics.

This kind of fast-moving "all hands on deck" response would be impossible to coordinate in a slow-moving major research university. Universities are built to stay the same over long periods of time, not to turn on a dime. That's part of what makes them great, their longstanding traditions and ivy-covered walls. The downside, however, is that university administrative units have become notorious for shipping their org chart rather than a killer product. University units are immune to the forces of industrial Darwinism since they're not reliant on revenue from paying customers.

Chapter 2

Federal policy



Three tribes, policy, and three realities

In 2009, the U.S. Office of Science and Technology Policy (OSTP) put out a Request for Information (RFI) and asked anybody who wanted to comment to offer weigh in on the process of commercializing university research. I wrote up a response. And later waded through everyone else's writings -- many from university provosts, some from entrepreneurs, a couple from state economic development agencies and a few cranky essays from individuals disgruntled by a difficult experience with a university patent.

As I read through the submitted responses, I felt like I was reading a conversation between three tribes, each with its own unique language the other could not understand. Expressed perceptions of current problems as well as proposed solutions were strikingly consistent with tribal identities: the tribe of university administrators, the tribe of university faculty and researchers, and finally the business tribe.

University engineering and science faculty and grad students are tuned into industry trends and problems, and industry researchers read scientific publications. When a bit of research matures into a commercially viable or useful technology, it's no

different. In fact, the majority of licensing deals are brought to the university tech transfer office by the faculty inventor, not the other way around.

At many major U.S. research universities, engineering faculty are given a full day off every week for industry consulting engagements. They also compete for industry research dollars. It's not unusual to see a long line of professors in suit jackets, patiently standing in line in the hallway of the engineering quad, awaiting their 10-minute slot to pitch their research to a visiting rep from McDonnell Douglass or Kodak or DuPont.

But, if you look at university-sponsored programs, you'd think that university faculty and graduate students are innocent lambs being led to slaughter.

Here's what each tribe said in their responses to the OSTP RFI.

University administrators and tech transfer offices wrote that the best course of action would be to maintain the current technology transfer model as it is. Their recommendations were incremental. The most popular recommendation was that federal funding should sponsor on-campus classes on entrepreneurship for faculty and grad students.

Another popular suggestion was that networking events would help university faculty and students meet industry coaches and mentors who could mentor them to have more commercial hustle. After classes, networking and mentoring, university administrators suggested that the federal government fund university-based proof of concept centers, or POCCs, where early-stage university inventions could be developed to form startups or be licensed to an existing company.

The second tribe that responded to the government's request for information was the scientists and researchers themselves:

university faculty. In contrast to the administrative tribe, the inventor tribe had no interest in attending on-campus classes to teach them to become more entrepreneurial. Based on my own direct experience, this makes sense. Most universities already offer countless courses on how to be an entrepreneur; in fact, a primary function of many tech transfer offices is to set up a steady stream of networking events.

The third tribe was that of business people and venture capitalists. They recommend that universities improve their technology transfer process by stepping out of the way. Common suggestions were that universities should offer businesses and startups quick and transparent license options, not ask for administrative fees on patent licenses, impose fewer reporting requirements onto anyone licensing patent, and to ease IP-related clauses and restrictions in university/industry collaborations.

Interestingly, most people in the business tribe did not want the university to give them access to a university-based proof of concept center. Their perception was that the technology development process is too iterative, consisting of several feedback loops between inventors and their industry colleagues. In contrast, proof of concept centers assume a linear product development process, from prototype to final product, hence offered resources aren't flexible enough to move as quickly as small businesses demand.

Two university faculty from the University of California, Davis offer some refreshing insight. They're currently surveying a couple hundred faculty inventors at the University of Minnesota to ask them to share their experience and perceptions of the university technology transfer process.

> *"Given the importance of technology transfer and the latent problems that have emerged with this process, it is remarkable*

> *that there has been no comprehensive large N study of the experiences and perceptions of the inventors producing the inventions regarding the operation of their university Technology Transfer Office. Only through such a study will the data become available to make informed national decisions on how to increase the flow and utilization of taxpayer-funded research and the goal of increasing technology-based entrepreneurship."*[16]

These UC researchers raise a good point and a well-kept secret: on university campuses, faculty and grad students are already closely tuned to industry, perhaps more than anybody at the university. However, most university IP policies continue to reflect the popular stereotype that university inventors don't know how to work with industry. In addition, as part of their employment contract, faculty and grad students are required to hand off their research results to a central technology transfer office that will manage the patenting process, set a marketing strategy to find industry partners, and then write and negotiate any resulting licenses.

Campus licensing staff work hard to cultivate strong and productive relationships with their faculty and grad students. However, at many universities (for various well-intended reasons), after handing over an interested business partner, the inventor is not allowed a seat at the negotiation table, nor permitted to read the resulting license for his or her own invention. University administrators justify the centralized control over technology commercialization by claiming that their faculty and grad students need oversight when they venture out of their academic Ivory Tower.

Clearly there are major disconnects between people with a stake in university technology. Why? Here's what somebody needs

to ask the different tribes who are passionately conversing with one another in mutually unintelligible tongues.

How would university scientists and researchers prefer to find their research a productive home off campus? What about their industry colleagues? Would-be entrepreneurs? What would be the best incentives? Should university inventors be permitted to take the lead on commercialization strategies and licensing options? What would be the most efficient operational arrangement? What if we opened up the university IP portfolio to third party agents who would manage the inventions the university-provided tech transfer office didn't have time to manage?

I wonder whether the Office of Science and Technology Policy learned anything from their Request for Information. In a way, they captured the cacophony of conflicting versions of reality in writing -- not an entirely unproductive exercise. However, my hunch is that whoever waded through the pile on their side was overwhelmed by the conflicting perspectives, not to mention the mystery of how ten people can examine the same situation and come up with ten different interpretations and corresponding solutions. Rather than funding yet another series of classes or office space for university startups, wouldn't it be refreshing if the federal government could fund a bit of formal exploration and sponsor some independent research to make some sense of the Tower of Babel?

Fund the future, not the past

Two pieces of proposed federal legislation -- the America Innovates Act (bill proposed April, 2012) and the Startup 2.0 Act (revised in May, 22, 2012) share a common goal: to improve the flow of university research to society and thereby, increase industry innovation and create startups that create jobs. After that, their similarity ends.

These two bills reflect the Great Debate: are university commercialization efforts just underfunded, or are they underperforming?

For years now, people have held strong, diametrically opposed opinions about whether universities are doing a good job of getting on-campus research into commercial use. The dissonance sometimes makes you wonder whether they're all talking about the same system. It seems that federal legislators are as divided as the rest of us.

On one side, the America Innovates Act presumes that university commercialization strategies, policies and programs are essentially on the right track — they just need more funding. In contrast, the Startup 2.0 Act falls into the "universities are underperforming" camp. Like the America Innovates Act, the Startup 2.0 Act intends to give funding to universities to help them bring research to market (in addition to proposing broader changes to U.S. immigrant and visa policies). However, the Startup 2.0 Act is disruptive: it proposes to give commercialization grants directly to entrepreneurial faculty, thus enabling them to take charge of bringing their own research to market, should they choose to.

Not surprisingly, the Startup Act has stirred both ire and jubilation. Many university faculty, of course, would be happy to get

funding to get their research into commercial use, or to found a startup. Not so thrilled are those who feel strongly that university administrations — not individual faculty — should set strategy, policy and run programs.

If both bills become law, it's going to be interesting to watch what happens when the funding starts to flow. First, some more background.

What's in the America Innovates Act

The bill for the America Innovates Act proposes that the big federal funding agencies hand over 15% of their research budgets to the Department of Commerce to set up an independent agency called the American Innovation Bank. Guided by an appointed Advisory Board, the American Innovation Bank would give grants to university administrations.

Innovation Bank grant money would go directly to university administrators, not to individual university faculty. Administrations would use commercialization grants to develop raw inventions into working proofs-of-concept. Some of the money would pay for the creation of new, university-approved curriculum to train graduate students in STEM fields. Some grants would support as-yet-unspecified university commercialization activity. All in all, basically sound ideas.

Here's the catch: the Act proposes to fund projects and curriculum that reflect today's incumbent, but arguably out-of-date (some would even say faltering) system. Conspicuously absent from the bill is funding that would let university faculty and companies explore newer, and perhaps better strategies. Why fund what we already have?

The America Innovates Act reminds me of the way people fondly describe their well-intended but misguided cousin, "his heart's in the right place." What, exactly, is askew in the America Innovates Act? I'll be more specific.

Stop counting patents

The first shortcoming of the proposed AIA is the performance metrics for Annual Reports from funding recipients. Of four listed metrics, the first is… you guessed it… patents. By choosing patents as a core metric, it seems that AIA sponsors are laboring under one of the biggest and most stubborn misconceptions about bringing university research to market — that in order to be commercially viable, university research must first be "protected" by a patent.

Managing university research as if it were potentially lucrative intellectual property in need of a patent's protection is like trying to lay claim to the ocean's waters by frantically scooping out single jarfuls for yourself. Patents are a relatively tiny conduit of knowledge transfer compared to the firehose of what's called "open science" — published papers, conferences and interpersonal relationships. Other active channels are graduating students, industry collaborations and faculty consulting gigs.

Now, patents have their place in product development and startups. After all, if a university researcher feels her research is best brought to market by patenting parts of it, then she should be given the resources she needs to do that. However, if the government plans to go as far as to scrape 15% from budgets intended to fund basic science and spend it on commercializing that science, then for heaven's sake, let's figure out some more relevant performance metrics.

Commercialization grants to faculty should be applied for, and given, at the individual level

Next issue. The AIA reflects another common misconception about university research: that a single strategy under central control works better than a decentralized and diverse set of strategies. The Act is built on a faulty foundation, the notion that university knowledge and technologies won't flow off of campus unless channeled through, and controlled by a university technology transfer office.

For example, in Section 105: GRANTS TO INDIVIDUALS, the AIA proposes to give commercialization grants to individual university researchers. However, in order to apply for one of these commercialization grants, the investigator must apply together with his university's technology transfer office. Such a mandate does a disservice to the people that work in the university's technology transfer office. Tech transfer services should be a valued and optional administrative service available to faculty and graduate students, not an administratively imposed tax.

To be clear, it's not the staff in the tech transfer unit that is the problem with this part of the AIA. In fact, university technology transfer offices are full of smart, hard-working people who do a lot with the resources they're given; many would relish the opportunity to work more freely and creatively with university researchers. I've seen, first-hand, how capable and imaginative staff struggle against administrative constraints. The real problem lies at a deeper level, that the AIA proposes to force yet more federally funded research through a single pipe. That's not how university knowledge transfer works.

Fund disruption, not the status quo

Third issue. If the America Innovates Act proposes to fund what we already have, in contrast, the Startup Act proposes to fund a critical piece of what's been missing from university technology commercialization strategies in the U.S. — strategic diversity. (Note, the Startup Act isn't the first time that a faculty-led model has been proposed: the Kauffman Foundation, one of the sponsors of the bill, proposed it two years ago; I proposed a modified version last year.)

As mentioned earlier, this particular provision in the Startup 2.0 Act has been met with quite a bit of resistance by stakeholders invested in maintaining university commercialization programs as they stand now. On the one hand, I suppose it makes sense to fight this proposal if you fully believe that university faculty should not make decisions about the commercial prospects of their own research. However, here's what I don't understand: if you're in the business of getting university research to market, shouldn't you be eager to try out different methods, especially if there's a chance that some of them might yield better results?

Think about it. If entrepreneurial university researchers were to given the resources and freedom to commercialize their own research, several good things could happen. First, faculty and graduate students would likely create some pretty useful and creative strategies that could perhaps be applied in other universities. Next, if faculty were given access to commercial research commercialization services, they would get the chance to compare their campus technology transfer services against other options.

Sure, there would be some greedy apples in the faculty barrel – there always are. However, I've seen some questionable apples in the administrative ranks and in government and businesses too — who hasn't? Consider that there's already an active grey market of

research commercialization on university campuses. And, administrative efforts to clamp down tightly on "rogue research" is costly in terms of staff time and industry and faculty good will.

I would be the first to agree that tight administrative control should be exercised if it were proven that faculty are using tax-payer funded research to line their own pockets. However, the irony of the commercialization grey market is that it's not typically about money. Instead, faculty, students and companies find themselves sharing research in the grey market in order to find freedom to freely collaborate with, share information, and learn from one another.

Rather than roundly condemning the Startup 2.0 Act's provision to give funding directly to faculty, university administrators should be pleased to support it. What if faculty and companies were to discover that that their university's technology transfer services are better than other options? If faculty and companies were given a choice and still chose to work with their university's technology transfer office, that would be the ultimate endorsement. In fact, faculty freedom of choice could finally get hard-working university tech transfer licensing staff the credit they deserve for their efforts.

Nobody can pick the winners

Fourth issue. The AIA proposes that the Director of the American Innovation Bank appoint an Advisory Panel. This expert panel would decide which university technologies should get commercialization grants. In gambling, trying to pick winners when there's very little evidence and lots of unknown variables is called… well, gambling. The same thing is true when a committee of experts attempts to pick out which early-stage inventions have the most commercial potential.

Venture capitalists and stock brokers have already learned that no one can pick the winners. That's why VCs invest in so many companies, and why there are index funds. University technology transfer licensing staff are learning that despite repeated attempts, even they can't predict which of their hundreds of university inventions will score big in industry.

If no one else has been successful, how possibly will an "expert panel" of appointed Advisors choose which university inventions will be winners? Each year, university researchers create thousands of new inventions. Maybe the proposed America Innovates Act should just honestly acknowledge reality and instead, hand out thousands of micro-grants each year in near-random fashion to university researchers, startups and businesses.

Don't teach ideology, teach something useful

Last but not least, the AIA, in Section C. 202. INDUSTRY-RELATED REQUIREMENTS FOR CERTAIN GRADUATE RESEARCH FELLOWSHIPS, proposes to establish a set of training requirements for graduate students on federal fellowships in STEM programs. This portion of the proposed Act would be managed by the big federal funding agencies, namely the National Science Foundation and the National Institutes for Health.

For decades, these large federal funding agencies have given out billions of dollars in grant money to university researchers to fund basic, exploratory research. The results have been mostly magnificent. Yet, if you look at what federal agencies propose in their portion of the AIA, these funding agencies, once proud advocates of exploratory science, seem to have been put to the political plow.

As the AIA is proposed, to get fellowship funding from federal agencies, STEM graduate students will be mandated to take the following curriculum.

1. The importance of disclosing discoveries and filing for patents.

2. Obtaining proof of concept or development funding.

3. The characteristics that make a scientific discovery attractive to private investment.

4. Resources that may assist researchers in creating a new start-up company.

I don't know about you, but if I were a graduate student in engineering, I would want a bit more than this. When a course's stated intent is to teach a student "the importance of disclosing discoveries and filing for patents…" to me, that's a big red flag that the course is going to teach ideology. The worst case scenario would be if the American Innovates bill became law and this training were to deteriorate into a cynical, mandatory exercise, sort of like Defensive Driving School.

Federal agencies whose charter is to fund exploratory, open-ended scientific research should know better than to fund curriculum that teaches "the importance of." Instead, they should teach what students can actually apply. Just for starters, how about teaching students how to navigate the gritty details of SBIR and STTR grants and federal accounting regulations, state and regional sales tax regulations, the basics of intellectual property law, and other topics entrepreneurs need.

Topics (2), and (4) in the proposed AIA curriculum sound more promising. I wonder whether the intent of the NSF is to aligm Item

(4) above with another similar but separate NSF curriculum program, the Innovation Corps which aims to teach faculty and graduate students basic business concepts. However, NSF funding rules to get money for Innovation Corps reflects the same top-down mentality that pervades the America Innovates Act: the NSF mandates that only academic Deans and higher can apply.

I'd be curious to hear why the NSF is willing to give research grants to individual faculty, yet is so hesitant give faculty resources to help them to further commercially develop the resulting inventions and technologies.

Fund the future, not the past

The upside is that legislators have joined the debate. The downside is that even at the legislative level, it seems that we still haven't made progress on the core questions that no one seems willing to ask, or to answer: is the current model the best solution? Why or why not? If not, what would be better and what funding and policy changes need to take place to get there?

Making good policy on top of this unresolved, gaping fault-line is going to be challenging. Universities are fumbling towards a solution towards a complicated problem and they're under lots of political pressure to prove their worth. Stakeholders of the university research ecosystem, despite their disagreement with one another, are fighting hard to do what they believe is right. There's no easy answer.

The American Innovates Act needs to dig deeper and give grants to universities, faculty and small businesses to fund exploratory pilot programs. I suspect that many universities would be happy to accept federal funding to test-drive daring new methods of getting university research into commercial play. But they're cautious,

keeping quiet while their more vocal brethren strong voice disapproval of giving university faculty some freedom to tinker.

Both of these proposed Acts are exciting pieces of legislation. It's good to see that interest in strategy to commercialize university research is reading the highest levels. However, policymakers need to understand that resources should be directed towards the future, not the past. If legislators choose to fund what's familiar, nothing will significantly improve.

It's not law: legal requirements for university tech transfer are minimal

Federal policymakers continually struggle to interpret the original intent of the Bayh Dole Act. In a scenario that seems to be regularly re-enacted, yet another assessment of the Act studied the original intent of the Act. This time, a few government officials delved into whether the Act permits universities to try new technology licensing strategies that utilize some elements of e-commerce.

It seems the answer is a cautiously worded yes. To share the results of this particular deliberation, in 2011, Henry Wixon, Chief Counsel for the National Institute of Standards and Technology (NIST), wrote an open letter to Thomas Kalil, the Deputy Director for the Office of Science and Technology Policy (OSTP). In the letter, Wixon combs thru Bayh Dole's legal underpinnings to conclude that

> *"Neither Bayh Dole nor its implementing regulations imposes upon contractors* [meaning the university that receives the grant funding] *any particular approach to be used in licensing subject inventions…whether through e-commerce or other creative approaches."*

Below is NIST's definitive read of what the Bayh Dole Act requires of universities. My comments, in italics, demonstrate why universities have much more leeway than most people think. In writing, the Bayh Dole Act requires that…

1. University employees disclose in writing each invention they create while under contract

> *<melbak: This is a big point of confusion on campus: it's mandatory for the university to require *disclosure* of the invention, but it's not mandatory that the university *own* the*

invention. Alternative license approaches are entirely possible if the university gives up the traditional ownership —> commercial license model for some technologies.>

2. That the university disclose each resulting invention to the funding Federal agency within two months after the inventor informs the university about it

3. That the university notify the Federal government within two years of receiving the invention disclosure whether or not the university wants to retain title to any subject invention

<melbak: So universities ARE NOT required to take title; they just get first crack at it. In a perfect world, university tech transfer offices would quickly give up rights (in a specified time period) to technologies they don't want to patent. Tech transfer staff would be supported in this, and assured that they will not be punished if a refused technology hits the marketplace some other way. Universities could choose who gets title next: faculty or an ecosystem of free agents.

Having the university offer a clear flow of title would open up all kinds of potential new licensing models. One of many possibilities could be for universities to post unwanted inventions on a web site; for example, non-patented inventions could be made available via an available smorgasbord of ecommerce-style click-thru, non-exclusive license whose primary function would be to document university consent and help track high-level trends in public uptake.>

4. That the university must file an initial patent application within a year after disclosure if it chooses to retain title to an invention

<melbak: In the same perfect world, if a university did elect to take title and file a patent application, the faculty member should be offered the option to choose to lead the patenting process. Most may not want to, but for the ones who really care about the outcome, they could do a better job than overworked licensing staff who routinely handle brutal case loads of over 200 active inventions. And the faculty would be less likely to complain about the outcome.>

5. That the university must notify the Federal agency of any decision not to continue the prosecution of a patent application

6. That anyone who files a patent application on an invention created with federally funded research must state that the invention was made with government support

7. That the university or whoever ends up with title must permit the government to exercise "march in rights" whereby the Federal government may step in and grant a license to an appropriate applicant

8. That the Bayh-Dole Act has requirements that involve licensees [the companies that license the university-owned patent] of federally funded inventions that universities must meet. These include:

9. That the licensee submit periodic reports on the utilization of an invention and efforts towards that utilization

<melbak: while required, the reporting requirements pose a burden to both tech transfer office and the licensee. Licensees hate the reporting burden that universities impose on them. For small companies, detailed, multi-page reports have a real impact on their staff time. However, universities could work towards a very streamlined and automated approach towards reporting that could ease the burden on everyone.>

10. If the licensee [the company using the university-owned patent] **wants the exclusive right to use or sell any inventions, a substantial amount of their product must be manufactured in the U.S.**

<melbak: while required, this mandate imposes an unfair burden on the tech transfer staff. These days, for better or for worse, most products are made in many different locations and later assembled; biotech research is also worldwide. The tech transfer office shouldn't have to do the policing on this. They don't have the time or training. Nor should companies have to spend time putting together manufacturing roadmaps of complicated products.>

Finally, universities must share royalties with inventors

11. Utilize resulting royalties to support scientific research or education

<melbak: Most universities give about 30-40% of royalties to fund the costs of running the tech transfer office and the research division administration, neither of which count as research or education.>

12. Make reasonable efforts to attract licensees that are small businesses

Here's what the federal agencies involved with university R&D should encourage universities to do:

Explore new licensing strategies: federal agencies should support initiatives that push the boundaries of new ways to commercialize university technology, particularly with an eye to the tools used in e-commerce such as good online catalogs, easy click-thru license templates, transparent license terms and so on.

Clarify university IP policy: a university's IP policy should be concise, specific and clear. Vague policy that claims it's fulfilling requirements of federal law is not appropriate. It's not innately a bad thing for universities write their own local IP policies, but in order for universities to offer effective radical new licensing models, there needs to be a clear understanding of where federal mandates stop and where local policy begins.

Think outside the box: The current university technology transfer model is shaped by received wisdom that's neither based on real law, nor solid data. Universities should aggressively lighten the required reporting requirements on businesses. What this all boils down to is that Bayh Dole leaves a lot more space than many people think for other ways to share university inventions.

Turning the battleship with small-scale, high risk, high reward pilot programs

If it ain't because of federal law, then why not try different things? Since the federal government already spends billions of dollars each year on university scientific research, the least it can do is to spend a few million to fund a series of small-scale, test pilot programs to test out people's suggestions. Right now, most federally

funding for university tech commercialization are in the form of large grants that are doled out to large universities to build up existing programs.

What would be better would be small scale, government-funded pilot programs. Funding for the pilot programs would be targeted towards small, regional businesses who would define their proposed pilot and if they received funding, would then implement the pilot over the next 2-3 years. The small business would be required to pair up with a local university as a condition of the funding, much like an STTR grant.

Successful pilot programs would offer a solution that is novel and can be quickly implemented and later scaled up. Small programs given to lots of different universities and regional businesses would yield fast results and enable a lot of different tech transfer models to be tested. Small pilot programs would reflect the diversity of IP models needed by different industries.

A small business that's not part of the university would be the ideal executor of a pilot program because they would be small, lean, agile and focused. In order to receive the positive visibility and hopefully, learnings from the pilot, university administrators would need to agree to be host and advocate for the pilot. To get things going, a chunk of the tech transfer function being tested would be handed over to the small business. University inventors and students would be involved as advisors and test customers of the solution being pilot-tested. To ease the logistical burden on everybody involved, university tech transfer offices would cooperate with the small business running the pilot program to clearly delineate pilot boundaries, rights and responsibilities.

Each funded pilot could have a different assigned goal. One possible pilot program could test out a new method to improve the

marketing of inventions. Another pilot could test a novel best practice practiced by one university by placing the same process into a pilot at a university in a very different region. Multiple pilot programs should run at the same time in different locations. If there are several pilot programs going on at the same time, it would be possible to explore a number of different approaches in a relatively short period of time.

The closest approach to this type of field-testing I've seen is the Department of Energy's recent investment in five university "innovation ecosystems." As I mentioned earlier, this DOE grant inadvertently bolsters what we already have now. I applaud DOE's vision and determination to make things better, but their approach isn't going to help matters.

The "innovation ecosystems" proposed by the selected universities consist of activities which are already being handled by the campus TTO and business school. The DOE funding will eventually end up paying for business plan competitions, university/industry consortiums, training for entrepreneurs are all valid and excellent tools. There's nothing new or particularly innovative about re-enacting commercialization techniques that have been kicking around for years.

Now, if the DOE (or DOD or NSF or NIH) were instead, to fund small pilot programs, what would those look like? A useful pilot program could be to fund potential solutions that would make it easier for university scientists to exchange, catalog and distribute biological research materials. The good thing about starting with biological materials would be that the material transfer process is a thorn in the side of almost every university tech transfer office and researcher that I've spoken to.

I was inspired to dream up this "test pilot" approach when I came across an online catalog managed by MIT that stores and distributes the building blocks of life. The Registry, called MIT's Registry of Standard Parts, was started by researchers (not assigned to them by the university's administration) as a useful tool to get their job done. A pilot program that utilizes core concepts of a successful tool such as MIT's Registry could confirm whether such a solution could work at other universities.

Here's how the Registry works: the Registry acts like a lending library of more than 3000 DNA segments. Registered scientists and students can request parts and submit parts. The Registry's lending licensing model (or lack thereof) is loosely based on those of open source software, but so far, is less structured. DNA segments submitted to the Registry conform to the Biobricks ™ standard so each scientist and student can work independently but easily exchange biological building blocks (similar to software standards or machine part specifications).

This de-centralized, low-overhead model for sharing biological research materials is a far cry from the university's technology transfer unit. In my experience, material transfer agreements made up more than three times the volume of paperwork than any other sort of licensing agreement. My former tech transfer unit exchanged such a high volume of research materials that we eventually had to hire a half-time person who was dedicated to processing the material transfer paperwork.

The material transfer process was hard to manage, even for an administrative unit. We struggled to understand and explain the byzantine paperwork process to our faculty and industry partners. The desire to streamline the process of materials transfer amongst researchers is universal. Yet without external support and a proven

better model in mind, universities administrative units don't have the resources, support, or motivation to embrace radical, new approaches as risky as MIT's biological parts registry.

Would taxing universities save regional economies?

Politicians keep popping up on podiums to urge university administrators and researchers to find new ways to contribute to their region's economic well-being. However, it's an unfortunate fact that many university economic development programs are missing the mark. Standard university "economic development" programs will never become the bedrock of a region's economic prosperity -- entrepreneurship mentoring, anyone? How about a Patent Showcase? No, the best way for universities to improve the local quality of life would be by literally sharing their wealth directly with local and state economies — by paying federal, state and municipal taxes.

Economic prosperity results when residents enjoy a high quality of life that's aided and enhanced by a healthy tax base. In the words of poet James Oppenheim, sung by striking women textile workers a hundred years ago: "Yes, it is bread we fight for, but we fight for roses too." It's that simple. Regions flourish when people have good public schools, reasonable tax rates, easy commutes, clean and safe streets and abundant recreational opportunities.

Yet, U.S. universities do not pay federal, state and municipal taxes. Why not? In theory, at least, universities are considered non-profit organizations by the IRS and their state-level tax codes, hence are tax exempt. In these times of hardship, we need to at least publicly discuss this. If the IRS and state tax agencies were given the right to tax universities at corporate rates, our devastated city and state economies would receive a badly needed infusion of billions of dollars.

There's no simple answer. But people need food. People need housing and safe communities. Could we please think this issue

through? We need you to push this issue to bring state governments and their local universities to the table, to talk about this openly.

Let's face it. Today's big research universities are non-profit in name only. In the past twenty years, university culture has changed dramatically. Their original stated non-profit mission — to provide education and to conduct research – has been dwarfed by activities more typical of for-profit corporations: reaping capital gains from multi-billion dollar university-owned investments, renting commercial real estate space, running pro-level athletic programs, brokering university-owned patents in exchange for revenue and selling, selling, selling the university brand to alumni to attract private donations. Executives at large or private universities enjoy salaries and fringe benefits equal to those of private sector CEOs.

Questioning university tax exempt status is not a condemnation of their tremendous social, scientific and economic contributions. Nor is re-assessing university non-profit status a criticism of the individual university administrators, professors and staff who work hard to maintain the high value of university degrees and to conduct world-class, innovative research. Universities are not the bad guy. However, we can no longer afford to ignore the fact that major research universities have become commercially-oriented entities whose growing wealth, if taxed, could make a tremendous difference to their increasingly distressed state and city economies.

How much money are we talking about here? To give you a sense of the dollars at stake, I've done some quick illustrative calculations on three major taxes from which universities are currently exempt.

Federal capital gains taxes

First, let's explore the size and potential tax revenue of university-owned investment portfolios, or endowments as they're sometimes called. The table below contains data on last year's gains from the ten largest university endowments (source: Chronicle of Higher Education). The two right-most columns were calculated and added by me to illustrate the dollar amounts that remain currently are tax exempt. I estimated a conservative 25% average tax on the gains.

University	Dollars in endowment	1-year change	Dollar amount gained	Money that could become available if university endowments were taxed
Harvard	$27.6b	+5.4%	$1,490,400,000	$372,600,000
Yale	$16.7b	+2.0%	$901,800,000	$225,450,000
Princeton	$14.4b	+14.1%	$777,600,000	$194,400,000
Texas	$14.1b	+15.5%	$761,400,000	$190,350,000
Stanford	$13.9b	+9.8%	$750,600,000	$187,650,000
MIT	$8.3b	+5.5%	$448,200,000	$112,050,000
Michigan	$6.6b	+9.4%	$356,400,000	$89,100,000
Columbia	$6.6b	+10.6%	$356,400,000	$89,100,000
Northwestern	$6.0b	+9.2%	$324,000,000	$81,000,000
Texas A&M	$5.7b	+12.9%	$307,800,000	$76,950,000
Total			**$6,474,600,000**	**$1,618,650,000**

Now, keep in mind this potential tax revenue represents only one year's earnings from the top ten largest university endowments. Imagine the additional billions that could be generated by taxing every university's endowment gains. Capital gains taxes are federal. However, since this money would quickly be absorbed without little trace if it were paid to the federal government, tax revenue from university endowments should be re-directed to fund regional and local economic development programs where it could have a greater impact. (For an excellent and detailed analysis of university

endowments, read the "Educational Endowments" report by the Center for Social Philanthropy and Telus.)

State sales tax

Next, let's look at what universities are not paying in state sales taxes. Large universities spend billions of dollars each year procuring in-state goods and services. University procurement data is not that readily available. To give you a snapshot of the dollars involved, I dug up expenditure data from six, randomly selected universities. Kudos to the universities listed here who had the civic spirit to publicly share their data on in-state expenditures. Many universities unintentionally obfuscate or do not publicly share this number.

Below is a chart that estimates how much money would become available each year if university spending was taxed.

University	Goods and services spent annually in state	State sales tax rate	Money available each year if spending was taxed
University of Minnesota	$908,107,850	7%	$61,751,334
Johns Hopkins University	$998,000,000	6%	$59,880,000
Stanford University	$582,000,000	8%	$46,560,000
Harvard University	$843,565,000	5%	$42,178,250
Cornell University	$425,000,000	8%	$34,000,000
Bucknell University	$54,162,000	6%	$3,249,720

This data represents a fraction of the potential sales tax revenue that universities could in theory, contribute to their cash-starved state governments. Clearly, given the complexity of this issue, to arrive at real numbers, more analysis is needed. It makes you think, though, doesn't it?

Imagine if some money from university sales taxes were earmarked to fund local economic development initiatives, for

example, to provide seed capital or low cost office space for small businesses. Imagine if these millions were used to fund university scholarships for students in the state. Or lower the cost of in-state university tuitions. Or thinking bigger, to build local broadband infrastructure, or to re-build vital health and human services programs that are facing severe budget cutbacks.

Local property taxes

Finally, what about municipal property taxes? Throughout the U.S., large universities own billions and billions of dollars in valuable real estate; however, since they do not pay local property taxes, cities lose out on a significant source of potential tax revenue. In fact, local residents of college towns end up paying *higher* local taxes to offset the unpaid taxes of their regional university. In smaller college towns, university real estate holdings can have an assessed value nearly equivalent to the taxable real estate of the entire town.

Similar to procurement data, it's difficult, if not impossible, to find solid numbers on the value of university real estate holdings, most of which is never made public. Some universities negotiate their tax exemptions with the local and state governments and agree to make agreed upon payments in lieu of taxes (PILOTs). However, may do not, or pay PILOTs that are a fraction of what they would pay otherwise.

Just to give you a taste of the kind of municpal tax monies we're talking about here, according to the "Educational Endowments" report, "Boston University, Brandeis University, Dartmouth College, Harvard University and the Massachusetts Institute of Technology—as major property holders in their communities … own tax-exempt real estate worth more than $10.6 billion, yet collectively they made

negotiated payments in lieu of taxes (PILOTs) totaling less than 5% of the $235 million i… they would owe if they did not have the privilege of their tax-exempt status."

You should calculate and publish the value of university tax exemptions… and share the data

Please don't misunderstand me. Funding university scientific research is money well spent. However, struggling families, cities and states should not have to pick up the tab to further enrich multi-billion-dollar tax exempt university "corporations." Our next generation of skilled workers should not have to start out life crushed by student loan debt. Residents of college towns should not have to scrimp and stretch to pay constantly increasing city and property taxes. Let's continue to fund innovative research, but also explore what would be the impact of fairly taxing universities and re-directing the monies into regional economies and student aid.

Transparency is the root of change. Right now, university data on procurement, capital gains and property values is not easily publicly available. True, many universities publish regular economic impact reports. However, the intent of these reports is not to share data, but to sell the notion that universities are generous benefactors to their economically devastated regions. For example, an argument popular in these reports is that university investment breeds a "multiplier effect," hence contributes billions of dollars to regional tax coffers. In actuality, this so-called multiplier effect means simply that university employees are paying their local and state taxes (it's a bit like making your kid brother cough up the money to pay for your mom's birthday gift, and then making him let both of you sign the card).

Another frequently cited university contribution to the region is that universities are educating the next generation … but heck, these students pay tuition and isn't educating the next generation the job that universities are paid to do? One university report went so far as to include alumni wages in its calculation of its local economic contributions since the university "helped graduates earn more than they would have otherwise."

We, the tax-paying public, already pay our nation's universities several times over. We pay for the scientific research that takes place in university labs. Students and their families pay exorbitant costs for tuition. We pay for the low cost, tax exempt bonds that enable universities to build new buildings while they reserve their endowment funds for higher risk, higher reward investments. According to the Congressional Budget Office, tax exempt university bonds cost the federal government an estimated $5.5-billion in forgone revenue in 2010.

Those of us who live in college towns pay higher than average property taxes to pay for university use of community resources and infrastructure such as roads, public safety, local power grids, schools and city services. In order for universities to provide real economic development to states and cities, it would be a good first step to look into whether universities begin to pay taxes.

First, four star Army generals, now four star university professors

What if the unthinkable happened and the U.S. government imposed a mandatory and public ranking of research universities and individual faculty according to their "research excellence?" Just to be clear, I'm not advocating that such a ranking be done. However, no matter how strongly one might disagree with the idea of mandatory public rankings based on data that is currently largely private, I'll bet that in the next few years, we'll start to see policy makers cautiously exploring this idea.

Starting in 2013, those of us engaged in the university R&D ecosystem will get a rare opportunity to see such speculation in action. The U.K. university system is about to launch a major new government-mandated university assessment process, the "Research Excellence Framework," or REF. When I was in the UK recently, the upcoming REF dominated discussion at dinner tables and coffee breaks.

In a radical new twist on university assessment, nearly 2/3rds of a university's REF score will be based on the research output of individual faculty. University faculty deemed by their departments to be the most likely to rank highly will submit their best four papers to a government appointed panel. The panel will assess and then publicly rank each faculty member according to a star system, one star being the lowest and four stars the highest.

I'm guessing that the British government didn't intend an academic version of a military-style hierarchy, yet a star-based ranking system is reminiscent of the tradition in the U.S. Army of anointing four star generals. Professors in the U.K. who fare well on their assessments will be assigned a four star ranking. Of course

money has to enter this picture at some point: the more four star faculty a university employs, the more government funding the university will receive. Four star academics will be worth their weight in … pounds. Literally.

Here's the catch: U.K. REF faculty assessments are not quantitative. Instead, a professor's merit is based on evaluations conducted by the appointed panels of experts. To evaluate university submissions, the government agency managing the REF process will oversee panels of government-appointed, nominated judges.

A university's total REF score will be based on reported activity in three major arenas:

- individual faculty research output
- a university's total social and economic impact, and
- a university's environment and facilities.

In more detail, here are the three categories each university in the U.K. will be assessed on:

1. faculty research output: 65% of total REF score. Output equals the traditional scholarly stuff of publications, book chapters, conference activity, etc. This is the portion of the REF where individual faculty will receive a star ranking from the REF oversight committee.

2. university impact: 20% of total score. Impact is a university-level measure. Essentially, impact is the non-scholarly activities that benefit the world off-campus; impact is gauged by submitted case studies. (This is how university technology commercialization offices have been pulled into the REF process.) Impact measures can

include university startups, having a positive impact on government policy, or developing industry products and services.

3. university "environment:" 15% of total REF score. This is mostly traditional educational data, e.g. the number of doctoral degrees a university grants, what percentage of those degrees went to women, how much research funding a university earns, what sort of facilities it has, and so on.

I applaud the underlying goal of the British REF, to improve the quality of research and teaching at their universities. Yet, a key shortcoming of the REF assessment process is its subjectivity. Two of the three portions (faculty research output and university impact) of the U.K.'s REF assessment are qualitative.

A subjective judgment process may undermine exactly what the REF was intended to accomplish. Peer reviewed measures of "excellence" may set up a process that's ripe to become heavily politicized, rendering it perhaps yet another empty exercise in who's who in a particular academic fiefdom. If that happens, the U.K.'s investment in REF will crumble into yet another non-productive counting activity that reinforces the entrenchment of already dominant academic fiefdoms –not a strong strategy to improve the relevance, innovation-capacity and impact of the U.K.'s university research infrastructure.

A REF in the U.S: data, good data mining tools and a user-friendly interface

So let's imagine that the U.S. government — motivated by a current harsh economic climate and public concern over bloated, irrelevant and costly universities – demands that universities and individual faculty prove that federal research funding is a

worthwhile investment. If the government were to implement a nation-wide assessment, the heart of the process should be simple data transparency. Both university-wide and individual faculty rankings should be based on quantitative data from external sources, not on the subjective judgments of government appointed panels.

The university system in the U.S. is vast, decentralized and diverse, and that's part of its strength. That's why a top-down process to evaluate an arena as creative and fluid as research and technology development won't work. In fact, creating and then managing all the moving parts and pieces of a centrally orchestrated REF assessment will cost the U.K. government lots of money that could be better spent elsewhere. University administrations will pay in terms of their time.

Everyone likes to talk about transparency. If transparency is the best process, what, exactly, do I mean when I say transparency should be the heart of any faculty assessment process?

To have transparency, first you need data. U.S. university systems already have the data they would need for a U.S. take-off on the REF. However, just dumping data into yet another impenetrable government-funded databank won't help. Instead, data should be placed into a smart, quantitative, publicly accessible tool.

A good example of what a nation-wide university assessment tool should look like is Microsoft Academic Search. MS Academic Search lacks the content coverage of Google Scholar. But its user interface and pattern mapping and comparison capabilities are light-years ahead. Take a look at MS Academic Search to see the potential insight a good analytical tool could introduce into the world of university research and innovation strategy. For example, in Academic Search, you can:

1. Compare research productivity of individual faculty at universities around the world. See how individual faculty fare when ranked according to their publications, citations, and h-indexes.
2. See the intellectual links between researchers who are citing, co-authoring and collaborating with one another.
3. At the university level, see how entire universities compare, and what their organizational-level h-indexes are.

Academic Search is getting it right. Imagine its power if even more infographic and data mining capabilities were added to it.

Just for fun, I'm going to propose a set of measures that universities and individual faculty should be assessed on. All of these datapoints are currently readily available. They just haven't been bundled up and placed into the right database that feeds a user-friendly web portal.

University-level metrics

In a nutshell, university administrations should be evaluated according to their ability as stewards, how much research and applied innovation they're managing to extract from federal research dollars. Data that U.S. universities submit should be normalized by annual research funding received to correct for differences in resources.

Metric 1. University-wide scholarly impact: university-wide h index: the total average h -index of all full-time university researchers

Metric 2. Total, combined faculty research output: the total number of scholarly papers, per institution, as logged in ISI normalized by the university's annual research money received.

Metric 3. University ability to turn research into public benefit: The number of university inventions in external use per federal research dollar; "external use" means under some form of external contractual arrangement, paid or not. This should include open source and Creative Commons type licenses too.

Metric 4. A university's industry impact: per federal research dollar, the amount of industry funding received for on-campus collaborative research

Metric 5. University technology commercialization impact as measured according to the following technology transfer health indexes: 1) commercial health index: distribution of patent licensing revenue across entire patent portfolio 2) jobs created by startups health index: FTEs distributed across all startups founded on a licensed university patent and 3) speed to licensing index: distribution of weeks between invention disclosed and date to executed license.

Individual faculty-level metrics

Public ranking of university faculty will make or break careers. Therefore, the process needs to be as free of politics as possible. That's why data is better. It speaks more fairly. True, even external and quantitative performance data is created in a political ecosystem of journal editors and grant reviewing committees. But a system of evaluating committees nominated specifically to assign star rankings would be even worse.

University faculty are evaluated all the time by their departments. Nearly every working university professor knows her h-index, number of times cited, number of publications, and the

journal impact factor of her accepted articles. Here's the data that should be collected for individual faculty assessments;

Faculty metric 1. Scholarly productivity and impact: the individual h -index of all published scholarly work. (This data exists on Google Scholar and on MS Academic Search already).

Faculty metric 2. Innovation impact: how many of a faculty's inventions or books are in external use (commercial or not) : This metric would be the number of formally disclosed inventions that are under some form of external contractual arrangement, paid or not. Also published popular books and software. This should include inventions that got patented, plus work that's been released under open source and Creative Commons type licenses.

Faculty metric 3. A faculty's ability to add value to industry: how much industry funding a faculty member has received in the past year for collaborative research

Bidding over star faculty

Maybe having a new class of elite, four-star of university professors would taint the system. It could certainly take much of the fun out of being an academic, a profession in which tenure and the freedom to pursue one's own research agenda are core perks of the job. Public rankings also introduce the risk of bullying and finger-pointing towards those faculty who land in the bottom 50th percentile.

For those fortunate faculty who end up at the top of the rankings, however, life would be sweet. Rightly or wrongly, four star faculty will enjoy money and prestige. Four star professors would fend off ever-enriched job offers from competing universities vying

to attract high-rated faculty. This reminds me of the article I wrote for NCURA magazine about faculty tenure. In this article, I speculated that if tenure were to go away and faculty were to become a mobile workforce, the top ten percent or so of faculty will be bid for, sort of like star baseball players.

In the U.K., I suspect that an unintended outcome of ranking faculty publicly will be the creation of a tiered system in which top faculty will benefit from being hotly pursued and benefit in the form of higher wages. The battle for four star faculty in the U.K. has already begun. One highly productive professor I was scheduled to meet with emailed me the day before to tell me was no longer with that university: he and his students had been hired away by another university, and his entire lab was moving immediately. Another professor I spoke to (whose distinguished career would likely make him a four star faculty) was brought back from retirement by his former employer to boost his university's REF score.

The first thing graduate students would do, while choosing where to apply, would be to shop for their future advisor by her national ranking. Research money from governments and sponsoring companies would rain down on four star faculty. Companies would browse the faculty ranking tool to decide who to approach for research collaborations.

A downside of transparent faculty rankings might be to further tip the balance towards rich universities who can afford to purchase an all-star faculty team. Teaching universities would left out in the cold if this were to happen. Some corrective, balancing provision would need to be set forth to help poorer universities purchase a few all-star faculty of their own. Frequently, universities with smaller budgets are the same ones who offer cheaper tuition and therefore, a critical social path upwards for lower-income students.

Conclusion

It remains to be seen whether the U.K. is helping or harming its world-class research university system by implementing mandatory assessments. Reactions to the REF in people I spoke to while I was in England were passionately divided. What everyone agreed on, however, is that faculty tenure and unpublished university performance measures are increasingly harder to defend in an era where unemployment and private-sector lay-offs are all too common.

Allocating broadband: university towns, manufacturing towns or rural areas?

Would investing additional federal funding to build up additional broadband in university towns create new inventions that ultimately create high-value jobs? University towns contain a rich resource of raw data, scientific knowledge and highly educated scientists and researchers. However, just harboring a research university should not automatically qualify a town for additional broadband. Many college towns lack a strong industrial base, meaning they are not home to manufacturing companies, nor to populations of people who make their living bringing products to market.

Manufacturing towns innovate, too

Why would the presence of a regional manufacturing base matter if a university town is already rich in human capital? Because mono-cultures are not fertile. If a university's R&D labs are isolated from the demands of commerce and manufacturing, additional broadband, alone, won't spark sufficient amounts of innovation.

R&D that remains abstract is at risk of withering from "small picture myopia." Instead, new ideas emerge when collaboration is decentralized and participants bring diverse skill sets to the table to address a particular technical problem. The most fertile regions will be those that boast local communities where university researchers and scientists rub elbows with industry engineers and technologists who have deep and applied industrial expertise.

Gig U is an initiative launched by a group of universities to make a case to private network providers that university towns are an ideal test-bed for additional investment in ultra-high-speed networks. It would be an interesting exercise to consider two

additional key variables in the context of what they're doing: 1) whether a university town has easy access to a manufacturing base, and 2) whether the local business community is of critical mass and knows how to work with manufacturing and design companies to transform raw university R&D into commercial goods and services.

Gig U is a good start. However, I would argue that even better, cities that should receive additional broadband are not necessarily university towns, but places that have people skilled in manufacturing, skilled in running businesses *and* a nearby research university — these are the raw ingredients that will enable a city to put a hefty, high-speed network to good use. Federally funded university research is rich raw clay from which many valuable new technologies and medicines are made. But supply chains, small businesses, and the collaborative spaces between people with different skill sets are also a rich and vital source of new thinking.

In an excellent article by Fred Block and Matthew Keller called "Where Do Innovations Come From? Transformations in the U.S. National Innovation System, 1970-2006," the authors analyze ten years' worth of 1,200 prize-winning inventions selected by R&D Magazine's prestigious annual contest. Their goal was to figure out whether the way inventions are made has changed over the past few decades. The authors discovered that in the 1970s, most winning inventions came from the R&D labs of a single, large, corporation. In recent years, however, more than two-thirds of winning inventions were the product of mostly federally-funded cross-sector collaborations between businesses and government and university research labs.

Changing modes of invention aside, another advantage to factoring manufacturing capacity into broadband allocation is the

fact that innovation springs from the people and companies on the front lines. Many people still believe that innovation happens in a simple, linear model where early-stage research leaves the lab in a tidy pipeline, is taken up by an entrepreneur and/or corporate product development team, and then hammered and packaged into a viable commercial product. In fact, new ideas come from everywhere.

According to an 2006 IBM study in which 750 CEOs ranked their sources of new ideas, over three quarters cited business partners, customers, even competitors as leading sources. Formal, internal R&D ranked eighth. Here's the list.

- Employees
- Business partners
- Customers directly
- Consultants
- Competitors
- Associations
- Internal Sales & Service Unites
- Internal R&D
- Academia
- Think-tanks
- Labs and/or other institutions

R&D labs and academia are indeed a valuable source of new ideas. However, broadband investments should reflect the fact that the new ideas arise from all the people who work up and down in different parts of the industrial ecosystem. The good news is that many top U.S. research universities are already located in an urban area that's dense with hundreds of thousands of manufacturing and professional workers. Allocating additional broadband to these universities (network resources should be made freely available to

their local communities) could spark the new economy jobs glowingly described by Friedman.

Remote rural areas could benefit from university broadband investment

Most manufacturing regions are urban, not rural. What about rural areas? In the U.S., the key for broadband allocation has been a region's population density; as a result, rural areas are currently underserved. Network service providers recover infrastructure costs by attracting paying subscribers. Therefore, cable, telephone and internet companies are more incented to sink money into setting up high speed networks in regions with lots of affluent people. A community that is remote or populated by people that have low incomes (or both) is more likely to be on the wrong side of the digital divide.

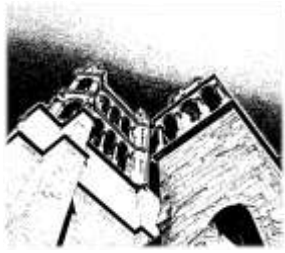
Perhaps participating Gig.U universities in rural areas could consider extending their efforts to include their regional communities. This would kill two big birds with one stone: many rural areas are already currently underserved. Second, high speed networks could jump start rural economies in university towns by bringing remote communities into closer contact with colleagues in commerce-rich, distant urban areas. Since remote regions are divorced from tools of mass production, they could be well suited to do the abstract and theoretical analytical work of extracting commercial value out of vast reams of raw data as described by Friedman, ".. mountains of data .. which can then be collected, sifted, mined and analyzed — like raw materials of old — to provide the raw material for new inventions in health care, education, manufacturing and retailing."

Conclusion

Broadband both affects, and reflects a community's economic opportunities. That's why it's essential that high speed networks are allocated fairly and thoughtfully, and that all types of communities are considered potential sources of innovative new technologies and business models. Yes, by all means, let's explore the potential ROI of investing in high-speed networks in university towns. But as the political battle over broadband allocation heats up, let's make sure that the allocation game plan accounts for the reality that talented human capital exists everywhere and that innovation is not a tidy, centralized process.

Chapter 3

Intellectual property and licensing university patents



Intel to universities: no patents, please, just open source

What would you do if you were the university official in charge of company research partnerships and a Fortune 100 tech company offered to fund a research center at your university to the tune of $2.5 million dollars a year? If it were me, in these tough financial times, I'd say "great, tell me more," visions of a nice press release dancing in my head.

But wait, there's A Catch: the company has made it a condition that in order to receive the millions, your university must open source any resulting software and inventions that come out of this research funding. Yes, open source. Your university cannot stake claim to any patents. There will be no intellectual property clauses, no negotiations, no… nonsense.

This situation is not hypothetical. Since January 2012, four U.S. universities have agreed to host Intel Science and Technology Centers (ISTCs) that will be funded at the rate of $2.5 million a year for five years. ISTCs will conduct research in various areas related

to cloud and embedded computing. Each ISTC is led by two principal investigators, one from Intel and one from the faculty of the host university. Each Center will host three Intel researchers who will act as technology scouts.

In Intel's own words:

"The IP policies and practices within the ISTCs will typically be designed to level the playing field for all of the participants, thereby enhancing cooperation and open collaboration. The preferred IP policy is to conduct open research wherein ISTC researchers, whether from academia or Intel, agree to not file patents and to publish all patentable inventions. All significant software developed in the course of conducting research will be released under an open source license."

Intel may be the latest, but it's not the first big tech company to prefer to sidestep university intellectual property (IP) clauses involving the negotiation of patent rights. Intel follows in the footsteps of HP and IBM, who also fund open source software collaborations with university researchers. Applications for additional ISTCs were submitted last week and more will be announced before year's end. Here are current recipient universities of Intel funding:

- Stanford, January, 2011, Visual computing,
- UC Berkeley, June 2011, Secure computing,
- Carnegie Mellon, August 2011, Cloud computing,
- Carnegie Mellon, August 2011, Embedded computing,

To learn more, I spoke with Intel's Matt Hancock, Director of Intel's Science and Technology Centers program office. Hancock explained that "Whatever technologies are produced in the ISTCs will be made public, meaning anybody else can continue to build off

of it, including Intel." Hancock said that Intel had three major goals in funding university-based Science and Technology Centers.

- To increase the flow of ideas between the academic community and Intel
- To build a robust hiring pipeline at top-notch universities
- To change the way that the global research community thinks about cloud computing

Of course Intel isn't purely altruistic. After all, the company has a bottom line to maintain and shareholders to answer to. Intel's investments in software development via ISTCs signal a new direction in Intel's product strategies. In search of better margins, Intel hopes to beef up its software practice to combat increasingly thin profit margins from chip sales.

According to Hancock, Intel is funding research in areas aligned with Intel's future. "We hope that the research will indirectly benefit Intel's product development efforts and perhaps Intel Capital, but that's not the short term goal. We're aiming at a long pipeline, 7 – 10 years out."

Why not open source everything invented in university/industry partnerships?

Open sourcing research results sounds so reasonable. In fact, what's not to like about this arrangement? After all, in many sponsored research negotiations that take place between university administrations and company legal teams, intellectual property (IP) clauses remain a sticky and sometimes time-consuming negotiating point.

What many people don't realize is that few new patents arise from company sponsored university research projects. Although university patents get a lot of press as vehicles of innovative

technology, according to the professional organization of university research administrators, NCURA, only 3% of industry sponsored research projects generate patents. Those are pretty slim odds, aren't they?

Consider the potential upsides if open source licenses became a standard requirement of university/industry research collaboration:

- Open sourcing fits nicely with the university's non-profit, tax-exempt status; not patenting and licensing ensures that sponsored research results will be made freely available to everyone at a fair market price
- Open sourcing supports a core university mission, to disseminate innovative technologies quickly, cheaply and broadly
- Open sourcing software lays the foundation for a sustained innovation ecosystem by creating a vibrant global community of researchers and tinkerers
- Publicly sharing research results avoids publication delays induced by patent applications and removes restrictions on disclosing research results
- Mandated open sourcing means no haggling over IP terms between university and company researchers, nor concern about patent rights
- Sponsoring companies could more easily bring in additional companies to jointly sponsor open source consortiums since IP terms would not have to be negotiated for every member company
- A heartily endorsed, decentralized, open-sourced approach would open up multiple paths to commercialization, increasing the odds that university inventions would eventually find a commercial application

- Open sourcing inventions would ease industry and public concern about the university's ability to commercially broker technologies that originate in sponsored on-campus research
- Open sourcing inventions would save the host university money on patent fees
- Open sourcing inventions would minimize administrative costs to the host university since there's little reporting, less oversight and no need for additional staff to manage the resulting research output

Universities are not required to file patents; they choose to

Universities are not required to patent what comes out of their research labs. Contrary to what many believe, there's no law that obligates university researchers to feed potentially patentable knowledge into the university's patent pipeline. However, you may hear people incorrectly claim that the Bayh Dole Act of 1980 made it mandatory that universities file for patents on on-campus research. True, the Act requires universities to take certain steps as beneficiaries of publicly funded research (see more info). However, rather than mandating that universities file for patents on university research, instead, the Bayh Dole Act gives universities the *option* to elect to take title to patents and the opportunity to commercially license them. The decision whether to patent or publish remains ultimately an inventor's choice; many university inventors elect to do both.

Mandates to file university patents are actually a product of dictates at the local, not federal level. First, many universities require that their employees sign an employment contract in which they agree to give the university title to anything they invent during the course of their employment. Second, a contractual arrangement laid down by a specific IP clause in a single industry sponsored

research agreement may require that sponsored research results be patented, if possible. Finally, many universities have campus IP policies that, at least in writing (typically not in practice), require researchers to get the permission of a central technology transfer office before they open source a technology.

Why patents have their place

But wait! Not all companies want their sponsored research to be shared freely. Although the private sector is increasingly comfortable working with open source technologies, many companies continue to prefer to fund university research that will be patented. Fair enough. A well-known example of a patent-reliant sector is Big Pharma. Given the long time-frame and high costs to get a drug through the FDA approval process, many pharmaceutical companies prefer to exclusively license patents in order to maintain a temporary monopoly position.

Open source works best in situations in which the company sponsor is not seeking crisply defined deliverables, but is seeking to broaden the existing knowledge base across the entire industry. Open sourcing results will not be appealing in cases in which a company wants a university research lab to do straightforward measurement or product testing or data crunching. Nor will open sourcing research appeal to companies looking to university research labs for proprietary improvements to existing commercial products, or to help develop an entirely new product.

As indicated by the approach used by Intel, HP and IBM, the software industry currently best lends itself to open source licensing. First, software is complex and a large part of its value lies not in viewing the source code, but in applying it productively. Second, software companies live and die by their operational prowess and

executional abilities, not solely on the strength of their code. Third, software patents are notoriously difficult to enforce, therefore they are of relatively little value in providing a short-term, temporary monopoly, not to mention the fact that the software industry moves at the speed of light.

Conclusion

Ironically, although universities are the leading hotbed of open source licensing, formal university technology commercialization operations continue to focus on patents. (It's important to point out that at the individual level, there are a number of forward-thinking technology transfer practitioners who are advocates of the commercial value of both patents and open source software licenses.) Nor do all faculty and students automatically embrace open source. In fields where a patent holds greater commercial value and does not disrupt the research process, a university researcher may elect to follow the formal technology transfer process and get a patent for her invention or technology.

The lesson from the Intel Centers is not that patents are bad, but that open source is a increasingly viable way to spark industry innovation and economic growth. A second lesson is that there's no single correct way to handle the intellectual property issues when companies sponsor university research. Open source hardware licenses loom on the horizon. Let's be open to them all.

Intellectual property "grey markets" at research universities

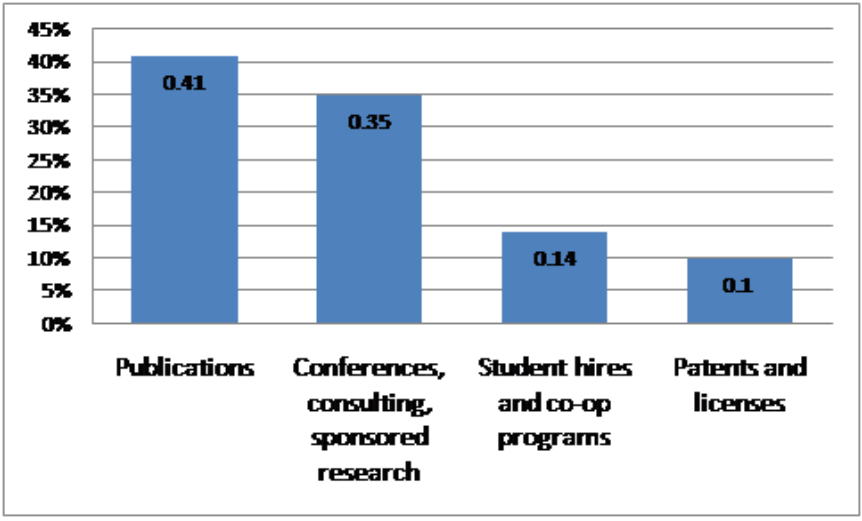
About a third of university research commercialization transactions take place in an IP grey market. Roughly 30% of university research is commercialized in self-regulated networks made up of primarily of university researchers and industry product developers.[17] The formal market, the university tech transfer office, handles only a portion of the university's intellectual property dealings.

Grey markets emerge when the formal market isn't giving people everything they want or need. For example, my second cousins in the former Soviet Union, during the Soviet era, like everybody else, were part of an elaborate, self-regulated network of under-the-table buyers and sellers of pork, cigarettes, baked goods, liqueur and other goods. People bartered what they grew or made in exchange for what they needed; periodically, someone would collect everybody's money and make the long drive across the border to a Russia-based hub of cheap gasoline and things that could not be produced locally. The state-provided grocery stores were dismal: if you relied on them for food, you would soon be missing teeth from scurvy.

Twenty years after the Berlin wall came down, the grey market in former Soviet countries still thrives, but on a smaller scale. The pig that used to live in my second cousin's back yard is no longer necessary and the variety and freshness of the food in the local grocery stores rivals that of the U.S. When the formal market improved, the grey market shrank.

Why, despite the hard-working, dedicated tech transfer offices, does almost a third of university/industry technology development take place outside the formal channels?

Because patents and licenses are only one of many connection points between university researchers and industry. In fact, according to NSF and other data, publications are the primary conduit between university research labs and companies, followed by conferences and consulting, then student internships and post-graduation hires.[18] Companies report that formal licensing is their least active channel to university innovation.



Despite the relatively small role of formal licenses in industry product development, the current university tech transfer model (set in motion by the 1980 Bayh Dole Act) is based on the belief that universities should own patents so they can license those patents to industry. A common interpretation of the Bayh-Dole Act is that each

university should have a central tech transfer office to patent and license faculty inventions.

Many people, when asked their position on the current model, state that they are "in favor of protecting Bayh Dole." What does that mean? If you "protect" Bayh Dole, then you're in favor of… what? A typical thought process is as follows 1) the university tech transfer office should be the commercialization broker on campus 2) patents give universities needed "control" over the commercialization process 3) patents and licenses are necessary vehicles to encourage local companies to take a chance on early stage university inventions and 4) faculty do not understand how industry works, so it's better that the tech transfer office manage the relationships between the university inventor and interested industry reps.

So to put this in another context, imagine that you were a citizen of the former Soviet Union before 1989 and were told that you should not partake in the grey market. Instead, you should rely entirely on the state-managed food chain; you should not make your own grey market arrangements, but as a good citizen, should live on black bread and the occasional gristly piece of pork. Maybe with a few withered potatoes thrown in on a lucky day when the system worked as it should. Any takers?

The Bayh Dole Act was a great start. But it's time to evolve. The vigorous IP grey market on university campuses is a wake-up call for all of us to take a step back and re-evaluate the how we've chosen to interpret Bayh-Dole. About a third of faculty and their industry colleagues choose not to use the office to manage their inventions, sidestepping a formal license. Instituting "crack downs" on how faculty manage their research is not the solution. Nor is blind defense of the status quo, which will only buy our faltering

commercialization system a little more time, but won't solve the underlying problem.

Unfortunately, it's all-too-common to hear critics of the current system place the blame on the operational inefficiencies or skill deficiencies of the university technology transfer office. That's just not fair. The presence of an active IP grey market is not the fault of the university tech transfer services. In fact, many of the savvier tech transfer practitioners know that faculty make their own arrangements with industry and, when invited to the table, have learned to add value by helping write business plans for startups, providing market research or good advice on comparable patents. Employee turnover in university tech transfer units is high, also perhaps a sign that practitioners are frustrated with the constraints of their role. For example, my former office, in just four years, turned over nearly seventy percent of its staff.

The presence of a grey market suggests a few things.

1. Many channels flow information back and forth between university research labs and companies
2. Faculty do indeed know how to work with industry
3. People would prefer not to negotiate the use of a university technology thru a central office
4. Companies prefer to go direct to the faculty researcher rather than deal with middlemen
5. The chimerical carrot of future fat license royalties that universities wave in front of their inventors' noses doesn't fly. Consulting gigs and industry sponsored research pay a lot now.
6. Patents are not necessary in many cases and
7. A heck of a lot of technology was commercialized before the Bayh Dole Act was passed

Open source hardware and university patents

Imagine that that a group of inventors of new circuit boards and machine parts aggressively published detailed descriptions of their inventions. These same inventors would open source the hardware behind their inventions, making publicly available all the schematics, detailed description of needed parts and software, drawings and "board" files – basically all the information anybody would need to identically re-create the product or object. Next time somebody tried to patent something similar, perhaps borrowing from open sourced designs, a wealth of prior art would appear in the USPTO search, making it impossible for an company, university or individual to claim ownership of the intellectual property.

The world of product development and IP management is changing. The Internet has opened up a huge collaborative space, speeding up product development cycles and the rate of prototyping. Patents take too long to get. Lengthy license negotiations are the kiss of death. Open sourced software is already an industry staple and steady source of product improvement. Open source hardware is next. The ground rules of the Bayh Dole were set in place 30 years ago in a dramatically different world. Remember the enormous mobile phone Michael Douglass used in Wall Street? That's how far things have come in the world of research, invention and product design and development.

Consider the findings of the great Eric Von Hippel who studies user-led innovation and its impact on product development and IP licensing. His book Democratizing Innovation is a must read for anybody who works around IP. Von Hippel's research reveals that consumers contribute a significant amount of product design innovation that's then slurped up by companies and re-introduced in

their next version of product. Market research, at best, provides a rough guess at what consumers need, but the real meat of product feedback is based in user created prototypes and improvements to their tools (e.g. kiteboards, mountain bikes, surgical tools, pipe fitting).

University researchers work collaboratively, in fact, many federal grants require interdisciplinary and inter-institutional collaborations. The cutting edge platform-type research typical of universities offers an enormous stage on which user communities can build, research and tinker, particularly when university research make the data, software and materials freely available to their colleagues. Given the fact that more and more innovation takes place on a public stage shared by many actors, patents, material transfer agreements (particularly those for a fee) and complicated license "negotiations" do not meet the original goal of the Bayh-Dole Act, which was and still is to "promote the utilization of federally funded invention."

Many university technology transfer practitioners are already onto this. They wish they could try new things. I've had many discussions with intelligent, industry-savvy licensing people who know the current model is creaky and increasingly more antiquated. University faculty researchers are already onto this. They are already voting with their feet by partaking in the IP grey market or open sourcing and publishing their work in order to make sure the world gets to use what they create. Pioneering work is taking place in the areas of humanitarian licensing to promote global health, thanks to the good work of groups such as the Technology Managers for Global Health as well as the Statement of Principles put together and endorsed by AUTM and six universities.

Based on my observations as a former university technology transfer practitioner at a large research university, here are some of the challenges that technology transfer offices face that prevent them from being more vocal and radical about exploring new technology transfer models.

- **Simple inertia and lack of higher level support.** Change is risky and disruptive and will force entirely new ways of thinking about things and staffing tech transfer offices. Many tech transfer offices must please Boards of Trustees and university higher ups; without their support, change is impossible.
- **Misinterpreting Bayh Dole.** It's a common belief that Bayh Dole mandates patenting. This is not true. There's a lot more leeway than commonly believed (see previous post).
- **Still wanting to recoup their university's "investment" in research.** Despite the fact that universities claim a hefty 50+% chunk of federal grant money in the form of administrative overhead, I can't tell you how many times I've heard high-level research administrators claim the university needs to at least try to commercialize the resulting inventions in hopes of making money from them. The university is fed by federal research grants, not the other way around.
- **Trying to do economic development.** The majority of university administrators don't have time to delve into the feasibility of these emerging models so they're not yet comfortable convincing their regional legislators that not patenting and licensing inventions is not always the best way to spark the creation of university spinoffs. Somebody in the

university administration has gotta learn to make a convincing pitch for change and then start doing it.

- **Fear of losing career momentum.** I have seen (and have experienced) intense pressure in university tech transfer offices to keep quiet about sub-optimal policies and procedures in order to be loyal to the tech transfer office by "protecting Bayh Dole." Most university technology transfer practitioners want to protect Bayh Dole in a wonderful way. Wanting to harvest the fruits of federally funded research to create jobs and a high tech economy is a great thing — that's what drew people to this field in the first place. However, equally great is the freedom to re-evaluate one's business model so that if necessary, one can course-correct in order to continue to improve.

Ironically, universities are based on the idea of promoting "intellectual freedom." Sadly, university business units who would otherwise prefer to change their methods can't, in part, because of internal pressure to remain silent about what's not working. Faculty may enjoy the freedom to speak and to explore innovative ways to improve the world, but academic freedom does not always extend to academic staff in tech transfer units.

Open source hardware: disrupting the centralized, linear university model

Patent reform is on everyone's mind. With a whole lot less fanfare, there are several new licenses being defined for open hardware projects by a community of volunteer hackers, business people, and other experts. Open source hardware is a new way to share design information. It gives inventors the option to eschew a patent and instead, freely publish design details, blueprints and other information about mechanical and electrical inventions (for example robots and printed circuit boards).

Open sourcing software code and hardware designs could be viewed as the ultimate enactment of the spirit of the Bayh Dole Act, whose purpose is to get federally-funded university inventions into widespread, public use. There are several ways to open source one's hardware project.

Not everyone agrees with the notion of borrowing core concepts from open source software and applying them to the physical world of circuit boards, machine blueprints and other hardware designs. Open source licenses are controversial. Depending on your point of view, open source hardware licenses could someday act as an "unpatent," flooding the coffers of prior art and stifling company innovation. Or, like low cost, customizable open source software such as Linux/Apache/MySQL/PHP, freely shared hardware design information could create a bigger playing field and stimulate innovation and profitable inventorship.

Open source software licenses are already in widespread use. If open source hardware licenses also gain widespread acceptance and are embraced by university inventors, this new licensing paradigm

will disrupt our current university technology transfer model and introduce new modes of commercial product development.

Disrupting the centralized, linear model of disclose invention –> patent invention –> commercial license

The broad acceptance of patents, combined with the lack of recognized alternative licensing schemes have offered hardware-oriented inventors few alternative, "do-it-yourself" licensing options. In comparison, a mature suite of open source software licenses offers hackers, developers and companies a widely recognized, well-defined alternative to traditional intellectual property vehicles such as patents, copyrights, and commercial licenses. Open source software licenses range from those that provide source code only for documentation purposes, to those that give permission to re-use code for any purpose, including commercially.

As they gain momentum, open source hardware licenses will disrupt the base unit of intellectual property — patents. Universities file for thousands of new patents each year. What will happen to university patent portfolios if university inventors choose to open source their hardware inventions rather than to add them to the university's patent portfolio? Once public, design information becomes prior art, which could directly counteract a university's ability to file for a patent later on down the road. In addition, traditional notions of inventorship dissolve in open source community. Co-inventors will become the norm; in university-driven open source hardware projects, many co-inventors will not be affiliated with the university, making ownership and compensation difficult to disentangle.

Today's patent-based university tech transfer model is not ready to operate alongside open source hardware licenses

Let's fast-forward ten years to a time when open source hardware licenses have become as commonplace as open source software licenses are today. Imagine you are a university professor or student and you have just invented a new widget that you do not want to commercialize via a patent and license. Instead, like your code-writing brethren, you want to release the design according to an open source hardware license that will give anybody full usage rights to your invention, commercial and otherwise. You believe that freely sharing your design will enable your fellow innovators to build on top of your invention and catalyze new business opportunities for companies in that space. In other words, you want to support the intentions underlying the Bayh-Dole Act.

So you publish your machine designs, supporting software information, and any other data and documentation that anybody would need to fabricate your invention. You do not follow up within 12 months with a provisional patent application and your invention takes off like wildfire. Are you guilty of mis-using university resources? You didn't earn a dime from the open source license. Yet, you also did not help the university earn a dime from your invention, either.

How universities manage open source licenses today

The scenario described above has been playing out for years with software that's created on university campuses. Most software written by university faculty and students is open sourced by its creator. University patent offices have long co-existed with on-campus software developers, sometimes comfortably and sometimes not-so-comfortably. Open sourcing software remains a grey area in university intellectual property (IP) policy since it is does not

financially enrich the code writer, nor does it violate university norms of intellectual freedom and research integrity.

The software developer chooses an open source license to freely share the software in various ways with her peers, not to make money from it privately. University faculty or students that create software applications, tools and algorithms don't perceive a software patent as a major career-booster, nor as a critical tool for successful commercial use. More immediate career rewards come from increasing their visibility in the user community. There's little financial incentive as the commercial life expectancy of software is usually shorter than the life of the patent.

Universities usually do not actively prevent their students and faculty from using open source licenses . Revenue gains from patenting and commercially licensing the software are unlikely, and would not justify the university's time and effort. Instead, universities deal with the conundrum by writing (but not stringently enforcing) policy that requires the software creator to first disclose the software to the patent office so it can be evaluated for commercial potential. If the software is deemed of low commercial value, then it will be cleared, and given back to the developer who is free to open source it.

Pragmatic University vs Enforcement University

Let's return to our future scenario, where open source hardware licenses are widely used by both researchers and product development companies. How should future universities manage these alternative licensing modes available to their inventors? Let's examine the strategies embraced by two hypothetical universities: Pragmatic University and Enforcement University.

Pragmatic University has accepted that most of its hardware and software patents are unlikely to ever be licensed. In fact, patenting raw university technologies that remain unlicensed costs most universities millions of dollars each year in administrative overhead. Therefore, Pragmatic U has embraced a de-centralized IP strategy that leaves inventors free to open source their inventions without requiring approval from a central office. If inventors want to file for a patent, they may work with the university's tech transfer office (or they may choose their own commercialization third party agent — see the free agent model). If inventors feel an open source license is the better vehicle to blast their work into widespread use, they can select from a variety of open source hardware and software licenses.

Pragmatic University's open source policy is based its on Stanford's open source software policy, which is absolutely gorgeous, realistic, and user friendly. And breathtakingly simple. (Yes, this is the same Stanford whose legal battle with a pharmaceutical battle over patent rights reached the Supreme Court where Stanford lost.) The bracketed words in the sample policy below were added by me to illustrate how the open source software policy could be extended to cover open source hardware.

1. Was the *<machine, circuit, chip design, etc.>* developed under a sponsored project, or some other sponsorship that would encumber or cause Pragmatic University to "owe" the *<invention>* to another entity? Did you incorporate anyone else's *<machine design or patent>?*
2. In order to open source the *<hardware design>,* you must be certain you have the right to do so. (All the contributors should agree on whether or not to open source the *<design>.)*

3. If you wish to open source *<the designs for your hardware>*, you must be careful that you are only open sourcing Pragmatic University *<designs>* and no other third party *<design>* or software code or patent is embedded in the *<invention>.*

4. [Number 4 is my addition] If you intend to sell consulting services involving your open sourced invention, you must provide full and up-to-date documentation to establish a level commercial playing field.

In contrast, our other hypothetical university of the future, Enforcement University has chosen another approach.

1. Require that the inventor disclose their invention or software for commercial appraisal from a centralized technology transfer office. Set a high bar for giving approval for open sourcing; take months to decide.

2. Set up regular "audits" of university inventors and software developers that require them to list anything they have open sourced in the previous year.

3. Stiffen the campus IP policy to make unapproved open sourcing a direct violation that puts the inventor's good standing at risk.

Who, exactly, is the intended beneficiary of Enforcement University's approach? Not the university's revenue streams. Not the inventor or software developer. Nor the research community or the tax-paying public. Instead, Enforcement University's open source policy has inadvertently set up an uneasy game of cat-and-mouse that pits the technology transfer office against its university inventors.

Open source does not mean anti-commercial

Most universities have not yet embraced the simple beauty of Stanford's approach to open source software licenses. To my knowledge, none have created a policy that directly deals with the open sourcing of hardware inventions. However, small stirrings are afoot in the university inventor community. It will be interesting to see how university administrators react as they catch on.

The university example of freely shared hardware designs that I'm most familiar with is that of the 3D printer. Freely shared machine designs enable inventors to tinker with their own enhancements; inventors are free to patent their enhancements and to sell open sourced machines and related services. Schools and STEM educators can build their own machines from detailed blueprints as a classroom exercise.

For example, the University of Bath open sourced designs for its 3D printer, RepRap. Commercial companies like RapMan and Makerbot created enhanced 3D printers based on the original RepRap design and in turn, open sourced their own enhancements. These companies run a brisk business manufacturing 3D printer parts and making user-friendly kits for hobbyists who want to assemble a 3D printer themselves, at home or at school.

At Cornell, the Fab@Home team has open sourced their core 3D printer design. A business in Philadelphia called NextFab Studio sells kits for Fab@Home printers and runs a "gym for inventors," where for a fee, visitors get access to 3D printers and other prototyping equipment. I'm certain there are more examples of open sourced university hardware designs and business models– hopefully readers will describe them in the comments area.

Proponents of open source hardware are not anti-commerce. On the contrary. Many own businesses, and their goal is to create a

vibrant, pro-business ecosystem, where machine designs can be freely and safely shared in a known context. In addition, the proposed terms of the open source hardware definition make it clear that it's ok to commercialize modifications built on top of the open sourced design. The money is made in selling enhanced versions of open sourced designs, patenting add-on modules, and selling services. In fact, open sourced designs actually make it difficult for an inventor to have her invention "stolen" by a corporation that has deeper pockets for legal fees.

Conclusion

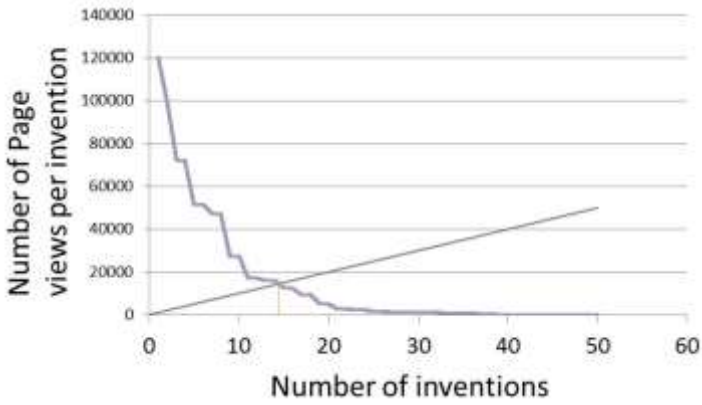
Which university is a better steward of our nation's federally funded basic research? Pragmatic University or Enforcement University? Change is coming. Ten years ago, software companies were confounded by open source software. Since then, new business models have emerged that most people could not foresee at the time.

Open source software licenses already offer university software creators an alternative to the university's patent + license commercialization model. Open source hardware licenses are next. University intellectual property strategies will need to learn to peaceably learn to co-exist with open sourced hardware licenses. A centralized, enforcement-flavored intellectual property strategy is not going to work. Nor will university policies that blindly favor hardware patents at the expense of alternative methods of sharing design information.

Moving away from bricks and mortar tech transfer

University technology transfer methods are ready to meet the Long Tail. What's the Long Tail? It's a concept borrowed from statistics; if you imagine a bar chart with a few tall bars followed by a slow curve downwards, that's a long tail curve. A bar chart that ranks sales of book titles at amazon.com, for instance, displays a classic long tail pattern: a few books sell a lot (the long bars) and a lot of books sell fewer copies (the gradual curve downwards). However, if you add up sales revenue from the more esoteric (i.e. not the New York Times bestsellers) books, their combined total revenue equal a pretty good chunk of income, almost as much as the revenue from the big best sellers.

Back when I worked in a tech transfer office at a large research university, I wanted to see which of our technologies were the " greatest hits" on our web search engine and which ones were less popular. Using the number of page views per technology from our web analytics tool, I ranked the popularity of the inventions.



Does this curve look familiar?

I didn't know it at the time, but I had stumbled upon the long tail of technology transfer: a few technologies got a lot of page views, but after the top 3 or so, page views of the rest of the IP portfolio trailed off slowly and gradually.

I was thrilled with this discovery. After all, didn't it demonstrate that a sensible way to prioritize marketing efforts would be to look at what's "selling" (technologies with high page views, or "head" technologies), and put extra marketing resources behind those few. (This differs from the much-reviled "home run" approach to tech transfer because it's not based on guess work but on proven user behavior.)

Here's where the fun ended. I presented these findings to licensing colleagues and the unit director at a staff meeting a few weeks later. Their response was strikingly reminiscent of that of brick and mortar retailers in the early days of ecommerce. "It will never work." "These numbers don't mean anything." "How we do it now is working just fine." "A computer can never replace the wisdom and judgment of a human being." And most confusingly, "this info isn't relevant – it all happened in the past." (No, I still haven't figured out the logic behind that one). I left the room that day deflated, yet determined to find gold in this data.

I found the goldmine when I read Chris Anderson's (editor of Wired magazine) book *The Long Tail: Why the Future of Business is Selling Less of More.* It's a great book. After I finished, my mind went back to that intriguing bar chart of web site hits I had pulled almost a year ago and it dawned on me. Demand for new technologies follows the law of the Long Tail. Web technologies can unlock the long tail of early stage, niche university inventions and technologies that are at risk of languishing in obscurity. Yet, we use a pre-1980s bricks and mortar approach to technology transfer.

In an exchange on a popular online discussion board where people discuss tech transfer, Darren Cox describes his perception of the standard marketing process for university technologies:

> *"…the tech transfer industry, as a whole, hasn't kept up with the staggering advances in electronic marketing techniques and search engine optimization strategies, over the last decade. The only viable option for transferring the latest technology to someone who can turn it into jobs, growth and money for your university, lab or hospital, is sending more emails and making more phone calls and hoping that serendipity smiles upon your efforts; leaving one hoping that the new technology is at the perfect intersection of innovation, need, ability, resources and the right person actually knowing the other right person, so they can engineer a meeting. "*

Compare Cox's description to your most recent investigation into something you wanted to learn about or buy (outside of work, in your private life). You probably searched Google and a few major ecommerce sites (if it was a commercial product). Your web search likely unearthed information about available goods and services from all over the world. The sheer overwhelming chaos of available resources was controlled by user reviews of the item, and user reviews of the object and the seller.

You probably also found ways to figure out which items/services were purchased by the most people and what items/services were similar. If you decided to buy whatever is was you were looking for, you probably did not pick up the phone to start negotiating with the buyer over the price, terms and conditions. Instead, you clicked a button (no registration required) to "get in touch with me," or you walked thru a simple online license (no negotiations, all transparent) and paid with your credit card.

An efficient and user-friendly way to browse, buy and review products enables the long tail model of online retail. It's not going to

be easy for universities to catch up to modern retail models and apply e-commerce techniques to the marketing and licensing of their patent portfolios. Early stage inventions aren't simple commodity items. Click-thru purchase agreements won't always work. Customer reviews won't matter, especially if a company desires confidentiality.

Intellectual Ventures and university patents

While undergoing scrutiny in a recent court case, Intellectual Ventures revealed its list of major investors. On it were several major U.S. research universities and research organizations.

- Brown University
- Cornell University
- Grinnell College
- Mayo Clinic
- Northwestern University
- Stanford University
- University of Minnesota
- University of Pennsylvania
- University of Southern California
- University of Texas

You may be asking yourself, so what's the big deal about a university investing its endowment in Intellectual Ventures?

After all, according to conventional dictates of what constitutes as "good investment," Intellectual Ventures (IV)is a real and legitimate company led by a famous and well-established executive team. In fact, over the past decade, IV has raised $5 billion from investors and has grown to employ 650 employees and at last count, has accumulated a patent portfolio roughly the size of IBM's – 30,000 active patents. Sure, the company is the target of controversy and criticism due to its business model, but that hasn't stopped universities from investing their endowments before (remember the public controversies over university investments in Nike, and South African mines, Big Tobacco, Big Pharma, etc.?).

Setting aside the legitimate and important debate about university investment ethics, to me, the revelation that U.S. research

universities are major investors in Intellectual Ventures brings up another interesting issue to ponder. U.S. research universities and Intellectual Ventures have something unexpected in common: both own large patent portfolios. Both license their patents to external organizations in exchange for fees, a practice that lawyers call being a "non-practicing entity," or NPE. But wait, there's more! Dozens of universities worldwide have licensed their patents to Intellectual Ventures. In exchange, universities receive an upfront payment and Intellectual Ventures pays for any remaining patent costs and in some cases, gets a share of any resulting revenues from product sales.

Now we know the names of the ten U.S. universities that are major investors in Intellectual Ventures. It would be interesting to also learn the names of the universities that have entrusted their patents to Intellectual Ventures. Unfortunately, perhaps because of the controversy surrounding Intellectual Ventures, most universities appear to be reluctant to reveal any patent licensing deals with the company. As a result, patent deals between universities and Intellectual Ventures have been driven underground, where they can't be intelligently discussed or learned from.

Intellectual Ventures and the emerging IP marketplace

Who is Intellectual Ventures and why is the company controversial?

Intellectual Ventures was founded ten years ago by former Microsoft CTO, Nathan Myhrvold. In a nutshell, Intellectual Ventures buys or licenses patents from universities, individual investors and companies that have gone bankrupt. As an NPE, it does not develop the patents it owns into a commercial product. Instead, the company licenses its patent pool to external companies. It makes its money by

charging fees to companies that want the right to use a patent without the fear of getting sued by Intellectual Ventures for patent infringement. Recently the company set up its own in-house research lab that employs about 50 employees and has applied for over 500 patents. However, Intellectual Ventures generates about 90 percent of its revenue from licensing its enormous patent portfolio to external companies, not from developing its in-house patents into commercial products.

While it could be described as a conventional patent broker, Intellectual Ventures does a few things differently. One, companies buy a license to get rights to Intellectual Venture's entire patent portfolio (sort of like a membership fee), instead of licensing rights to a selected few patents. This way, subscribing companies reduce their risk of infringing one of Intellectual Venture's tens of thousands of patents. Intellectual Venture markets this service as one of helping companies close their "invention gap," or the high-risk gap between the invention rights a company owns vs. the IP assets it's actually using. Unfortunately, the fact that Intellectual Ventures is charging companies money to guarantee they won't get sued for by Intellectual Ventures sounds to many like a shake-down for "protection" money. Maybe not surprisingly, critics of the "invention gap" service describe Intellectual Ventures as the world's biggest patent troll.

A second unique and controversial aspect of Intellectual Venture's business strategy is that it offers its member companies IP protection against other companies. Once a company signs a license with Intellectual Ventures, that company is not only protected against the legal threat imposed by Intellectual Ventures, but is also protected in case one of its rivals infringes key patents that belong to Intellectual Ventures' patent pool. In other words, if a company

builds its products on patents licensed from Intellectual Ventures and a competitor infringes those patents, Intellectual Ventures will defend its patent rights. Having Intellectual Ventures' legal team and deep pockets on one's side can be a powerful negotiating tool for companies that get involved in a patent dispute.

Given the core role of potential and real litigation in Intellectual Ventures' business strategy, it's tempting to fall into quick and easy condemnation of Intellectual Venture's approach, which has already been soundly and publicly condemned for its activities. And it gets worse. According to research firm Avancept, Intellectual Ventures has created over 1000 shell companies that critics believe are a PR cloak to disguise patent infringement lawsuits against technology companies. Last December, Intellectual Ventures confirmed the fears of technology-based business people and finally publicly kicked off its first direct patent lawsuits, suing several tech companies for alleged patent infringement.

Yet, in the spirit of stretching to understand someone's unpopular actions, is there anything good that could result from what Intellectual Ventures is doing? Interestingly, Myhrvold sees himself as the invention "good guy," an advocate of the value of the intangible hard labor of inventing. In an interview with the New York Times, Myhrvold believes his business model rubs people the wrong way since it places monetary value on what companies are used to getting for free; in Myhrvold's mind, the big technology companies are free riders whose corporate culture is used to "intentionally infringing patents or turning a blind eye to potential infringement." He claims to be on the side of the inventor.

Intellectual Ventures and university patent portfolios

It's difficult to figure out which universities in the United States have made licensing deals with Intellectual Ventures. To find the names of U.S. universities that publicly admit to doing deals with Intellectual Ventures, I dug through a lot of old news articles and press releases — kudos to these universities for admitting their relationship. However, the list below is way too short. Consider the fact that over the years, at least 80 universities worldwide have made patent licensing deals with Intellectual Ventures, yet finding out about them is like digging for a needle in a haystack.

- Rutgers
- CalTech
- New Jersey Institute of Technology
- University of California at San Diego (UCSD)
- Stevens College

According to Intellectual Venture's web site, the company has collaborated "with over 3,000 inventors at more than 300 universities, research institutions, and companies in seven countries worldwide." Why don't more universities want to publicly admit to doing licensing deals with Intellectual Ventures? Do they fear public condemnation?

Here's how the relationship between universities and Intellectual Ventures works, as described by an Intellectual Ventures staff member.

> *"The arrangement is for the university…to send us invention disclosures from time to time as well as allow us to directly work with professors we have identified to partner on brand new inventions…The arrangement is not exclusive and the university is free to pick and choose which inventions it gives to us and which it doesn't. [Intellectual Ventures] pays a fee once we decide to actually accept the invention from the university and we pay all*

associated patenting fees. It is important to note that we are not purchasing these inventions, we are exclusively licensing them."

We're past due for a thoughtful and public discussion of whether university-owned patents should become part of Intellectual Venture's patent arsenal. It took years of speculation and a lawsuit to find out that several U.S. universities are investing in Intellectual Ventures. What would it take to learn more about which universities have licensed their patents to Intellectual Ventures? University administrators for the most part, don't trumpet their deals with Intellectual Ventures. The staff at Intellectual Ventures aren't talking either. Intellectual Ventures never responded to a direct email request for a list of publicly available university licensees.

Conclusion

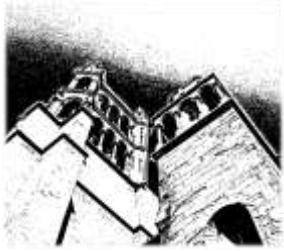
In the spirit of looking at both sides of the issue, consider the stated benefits that universities get when licensing their patents to Intellectual Ventures:

- Intellectual Ventures has bigger and better funded marketing channels than does the university technology transfer unit
- Intellectual Ventures can aggregate patents across several universities
- University inventors get additional exposure to core industry technology needs

Of course, like many people, I too have my doubts about Intellectual Venture's business model. After all, their revenue is based on threatened or actual patent litigation, not to mention the disquieting fact that Intellectual Ventures likes to fly under the radar by creating more than 1000 shell companies to carry out its litigious activities.

Chapter 4

Startups and entrepreneurship



Health insurance for university startups: the ultimate regional economic development

I've watched many a promising startup sprout in a university research lab. Most startups languish in the "great idea" phase — their founders graduate or get busy with something else. Some, however, actually thrive. The graduate students finish their dissertations and then become full-time entrepreneurs. One of their biggest challenges may surprise you. It's not coming up with a business plan or understand their target markets. It's getting good health insurance.

It's a strange and unfortunate fact of life in the U.S. that without health insurance, your financial future (not to mention your health and well-being) is at risk. Even if you are perfectly healthy but are hit by the proverbial bus while uninsured, the resulting medical bills would mean financial catastrophe. It's possible to purchase health insurance on the open market but if you're a solo entrepreneur trying to launch a small business or a cash-strapped startup, health insurance is prohibitively expensive.

This is why universities should help cover health insurance costs for startups based on university research that sign a contract for use of a university-owned patent. Now is the perfect time to do this. The U.S. Congress has passed the Patient Protection and Affordable Care Act (PPACA) and health care reforms are underway.

Before health care reform, solo entrepreneurs or small businesses did not have the negotiating power enjoyed by large organizations, hence their health care plans have tended to not be as good. As a result, startups have had trouble competing with bigger companies for good employees. Yet, good health insurance remains a make or break factor for prospective employees in choosing their employer.

In Geekwire, Marcelo Calbucci writes:

> *"As someone who has interviewed dozens of people over the last few months, I'm surprised how many candidates really care about the healthcare coverage we offer. Unless the candidate is unemployed, he or she has some kind of healthcare coverage, and although you can convert any kind of health insurance into a dollar value, some people feel the downgrade in health plan is a significant turn-off, even if the job includes better salary, bonus or a stock option plan with significant upside."*

That's where universities and states come in.

The PPACA covers lot of ground. Much of it is controversial. It's a broad and sweeping act that will expand Medicaid coverage, mandate that big chain restaurants publish the caloric counts of their entrees, mandate that health insurance companies cover the cost of contraceptives and more. It also mandates that states set up a health care exchange to make it easier for people to compare and contrast the features and costs of different plans.

Not all entrepreneur and small business communities are optimistic about the Act's new mandates. One of the most

contentious mandates of the Act is a requirement that any company with at least 50 full-time employees must provide its employees with health insurance to staff or pay fees.

The reality is that most new university startups won't be affected by the mandate to provide health coverage — they're just too small, nowhere near 50 people. In fact, smaller businesses, those with fewer than 25 employees, seem to be more optimistic that health care reform is good news. The Act will offer very small businesses tax breaks and other provisions that may make it easier for entrepreneurs and startups to buy reasonable health care for their employees and families.

Make being local a good thing

It's clear that entrepreneurs and startups would benefit from some help paying their health insurance costs. What's in it for the universities?

First, states already look to their regional universities to pitch in to help build the local economy. Startups headed by graduate students to bring university research to market are a cornerstone of many regional economic development strategies. Second, startups need health insurance. Third, startups will flock to regions that offer better health insurance plans.

Health insurance benefits are very local. Doctors, hospitals and prescription plans are handled near where the health insurance subscriber lives. Entrepreneurs and startups will gravitate to regions that offer entrepreneur-friendly health care plans and resources. In fact, just being able to give employees a good deal on health insurance will not only keep startups in a particular region, it will help them attract talented more workers and high quality jobs to the region.

How much would this cost?

All this sounds great, but like any wonderful plan, it involves somebody else's money.

How much money are we talking here? First, let's look at how much health insurance costs if you're not snuggled into the warm and secure embrace of a large organization. Of course monthly payments vary by a person's age, pre-existing health conditions, location and family situation. But on average, a solo entrepreneur can expect to pay about $500 a month (and much more if she or he has any complicating factors such as lots of children or a pre-existing health condition).

This adds up fast.

How about the health insurance costs for a startup with ten employees? At $500 a month per individual employee, $5,000 a month total, a ten-employee startup would have to pay roughly $60,000 a year to cover everyone's health insurance.

For a 20-person startup, at $500 a month per person, the total monthly bill to cover everyone would be $10,000 a month. Typically, most small employers pay 80% and let their employees pick up the remaining 20%. So a 20-person startup burns through $8,000 a month just paying for health insurance. It would have to come up with $10,000 a month if it were to cover 100% of insurance costs. That's about $96,000 a year if the startup pays 80% of the cost, or $120,000 if it pays the full bill.

Ouch. These are steep bills for small — sometimes tiny — tech companies that are just getting started. It's pretty clear that startups would benefit from university help. But here's where things get tricky: where is the university going to find an extra hundred thousand dollars a year to do this? …crickets…

Funding this

If I were the person setting this up, here's how I would do it. The first tough decision would be to set some parameters. I would start small. The university startups that would be first in line for health insurance funding would be the really small ones, say those with five or fewer employees. Next, I would set a time limit of two years total support.

To pay half the health insurance costs of ten five-employee startups a year, the total annual bill to the university would be about $150,000 a year. It could be lower if startups have fewer employees, or it's a slow year for the launch of new startups.

Here's how I calculated this. A startup employing five people would have to pay a total of $2,500 a month to take care of everybody's health (assuming it's $500 a month per employee). The annual bill for five people would be $2,500 times twelve months, or $30,000 a year. If a university were to subsidize half a startup's health insurance costs, the resulting bill for a year of coverage would be about $15,000 a year.

How many new university startups are there each year? With the exception of a few outliers on either side of the curve, a typical research university spins off about five to ten new real startups a year. Let's assume that half of these new startups employ five or fewer people, hence would qualify for this wonderful new program. So each year, the university would cover costs for five new startups, plus continue to fund five of last year's startups.

Looked at another way, the costs of paying half the health insurance costs for new university startups is about as much as the annual cost of paying salary and benefits for a senior-level, full-time university employee. If a university decided to go big and cover all of the costs of health insurance for ten small startups, the annual bill

would double — roughly $300,000 a year. That sort of money would be harder to find.

The good news is that many universities and states already spend money or offer resources to help local university startups grow. Some universities give new startups web support and legal services. Many universities give local startups low-cost office space in a university incubator. Business plan competitions that offer winners small cash prizes are another staple offering on the entrepreneur circuit.

Sometimes the offerings involve real money. Some states offer small businesses fund matching if they get a federal small business grant. Other states and university actually invest real money, either in exchange for equity in a startup, or just to be helpful. The state of Arizona and Arizona State University plus some other partners just launched a startup accelerator program that offers startups built on university technology a package of $50,000 in cash and services. This is a bold step. Imagine if programs such as these were to add yet another option to the package: $15,000 worth of health insurance support per startup.

How many would-be entrepreneurs stay in their secure jobs in large organizations for the health insurance? The big leap into a startup involves not just giving up a secure paycheck, but can mean putting your life (and your family's lives) on the line. Literally. It's laudable that so many universities are building new programs to help local startups thrive. Why not offer startups the ultimate incentive? Some funding to help pay for health insurance.

Easing the contractual burdens of university startups

The vast majority of startups with roots in a university are formed by alumni or former students, similar to the process that was depicted in the movie The Social Network. The Zuck had it easy. Since Zuckerberg was a Harvard undergraduate student, not an employee, the university could not lay claim to an ownership stake in Facebook. Had Harvard owned a patent for a core component of Facebook's technology or business method, the plot of The Social Network may have been different. Imagine the following:

- Zuckerberg works for Harvard
- Zuckerberg uses a Harvard computer, network, and proprietary photos of students from Harvard's various residence halls
- Zuckerbergs files his invention, as required by his employment contract, with Harvard's technology commercialization office
- Harvard files for a patent which costs Harvard $30,000 and lots of staff time and overhead
- Zuckerberg decides he *must* launch Facebook commercially, and he and his co-founders approach Harvard's patent office to see what their options are

Obviously, the movie followed a different course. However, what happens when a would-be entrepreneur wants to build a startup, but must first license the patent from a university? This article is about a special type of startup: one that enters into a formal patent licensing agreement with a university. Getting federally-funded, cutting-edge university inventions to market via a startup sounds like a great idea. It is. The challenges arise if universities inadvertently burden fledgling companies with well-intended, but weighty contractual obligations that may handicap the

startup later, as it tries to find investors, hire staff, and form product-development partnerships with other companies.

Universities do not intentionally set out to handicap their startups. University technology transfer staff do their utmost to help startup founders get thru the process. Most universities take their economic development role seriously, and work hard to license university-owned inventions to new businesses on fair terms. In fact, some would say that universities are generous. They believe in their startups, despite statistical evidence that the vast majority of startups never reach profitability, never find investors, go public or get acquired. Universities offer elaborate workshops, advisory services, even invest from a university-owned seed fund. Then what's the problem?

A root cause of the problem is that startups have no money, and somebody's gotta pay for the cost of a patent, which these days, can cost up to $40,000 for U.S. protection, and much more for international. In fact, before the 1990s, most universities preferred not to license university inventions to startup companies since they knew they would likely never recover patent costs, receive license fees or earn lucrative product royalties later down the road. Starting in the 1990s, however, universities started taking partial ownership in exchange for waiving the startup's license fees, and delaying its payback schedule for patent costs by a year or two. Today, about 75% of U.S. research universities are willing to take equity.

A second problem is that universities weren't designed to form new companies. Investing in, and building strong startups is a grueling, more-than-full-time, highly paid specialty. In addition, universities must honor their non-profit status (avoid conflicts of interest) and be responsible for making sure that publicly funded

inventions don't get into the wrong hands. Politics can come into play. A university that's too generous in letting startups license university-owned patents for cheap will be in big trouble if they end up licensing to a Google, and everybody will ask why the university didn't grab a big chunk of equity early on, when it held all the cards.

Another challenge is that universities and startups make for strange bedfellows, a bit like a March-December marriage. One side gets someone who's established and owns lots of nice things; the other side gets someone frisky and with a lot of growth potential. So far, so good. However, unlike a March-December marriage where March's youth and beauty make for strong market value, there's a pronounced power imbalance between the cash-strapped startup and the geriatric rich guy (or gal). The startup needs the university-owned invention more than the university needs the startup. As a result, a university's contractual requirements for a startup are more likely to protect the universities interests, and provide the startup what the university thinks the startup needs, not what the startup's founders think they need.

One way to look at this situation is to ask whether university startup strategies are placing ballast into startups (good weight), or unintentionally inserting dead weight (bad weight). Ballast is defined as "a heavy substance, placed in such a way, to provide stability and control (as in a hot air balloon or submarine) and then if necessary, quickly discarded." Ballast is laid into place with a lot of careful testing for optimal placement. More critically, ballast is quickly and efficiently shed when the vehicle or object needs to quickly rise or move forward.

Here is a *very* brief list of some university startup practices that could be either ballast or dead weight, depending on whom you ask. It's important to note here that not all universities follow these

practices, and many have a policy of bowing out of these requirements if a startup receives a large chunk of funding.

Practice 1: Requiring that the university be given a chunk of equity ownership in a startup as part of the license deal

> **Ballast (good weight):** Patents are expensive and if the startup can't pay, the university will front the costs in exchange for partial ownership. Some believe that if universities own equity, they will treat the startup better and be more invested in its success. For big-name universities, if a university is a shareholder, that brings legitimacy and cachet to the startup.
>
> **Dead weight (bad weight):** On average, U.S. universities require 10 – 15% equity, despite the fact that startups need every scrap of equity they can get. Further down the road, potential investors shy away from startups where a large chunk of equity (more than 10%) is held by an entity with no "skin in the game" such as a departed founder or a university. Also, the more a university takes, the smaller the remaining pie for future employees. Universities are not VCs and though many try to make money from spinning off startups, it could be considered a conflict of interest for a university to stake claim to large chunks of equity as a requirement of getting access to a university patent. Oddly, university policies on conflict-of-interest for faculty holding equity are elaborate, but I've never seen a conflict-of-interest policy for equity ownership fo**r a university administrator.**

Practice 2: The university's chunk of equity enjoys anti-dilution protection

Ballast (good weight): Unscrupulous future investors can issue huge numbers of new shares in a company and shrink (or dilute) everybody else's slice of the pie. If such unscrupulous behavior occurs, universities need to protect themselves from ending up with an **unfairly small fraction of what they put into a startup.**

Dead weight (bad weight): Anti-dilution protection and liquidation provisions are typically reserved for the big investors. In addition, future investors can be put off if previous investors have the option to maintain the same proportion of startup shares as the value of the startup grows and everybody else's percentage shrinks. Many believe that the university should not be in the business of making money from federally-funded research at all. If a startup pays back its patent costs, shouldn't its obligation be fulfilled? If universities are to be stewards, not profiteers, perhaps they should not enjoy special, VC-style anti-dilution or liquidation provisions.

Practice 3: University officials taking a seat on the startup's Board of Directors

Ballast (good weight): The thinking behind this one is that if a university is entrusting a new company with precious university resources, then somebody from the university needs to keep an eye on things and have a say in startup activity.

Dead weight (bad weight): Unless the founder directly invites the university person, it's not clear what their value is, and in fact, having a university staff member take a Board seat seems a strong conflict of interest, particularly if that startup

gets preferable treatment and sweetheart deals. Most Boards of Directors are between three and five carefully selected people.

Board seats accompany big investments and Board members are carefully chosen by founders and investors to make sure everyone's vision is represented. Board members are a critical source of industry expertise and networking. Unless the university person gracefully exits the Board upon request, their presence may be a barrier to later putting together a high-performing, expert Board.

Practice 4: Imposing university "reach thru" rights onto additional products that do not directly involve the university's patent

Ballast (good weight): Some universities feel that if a patent for a research platform or a particular method results in profitable downstream products (even indirectly), a startup should also pay the university royalties on these resulting products.

Dead weight (bad weight): Critics of reach thru clauses believe that universities cripple a young company by imposing far-reaching claims to future products. Consider how nebulous this can get if a university tries to lay claim to products invented and made by the startup, but that have an indirect, technological relationship to a broad, university-owned patent. Investors do not like to see royalty obligations attached to future products. Reach thru clauses again call into question the university's ultimate motivation: making money or getting federally-funded university inventions into play.

The list goes on. For example, universities require detailed progress reports on a regular basis. They impose steep sublicensing

fees and milestone schedules, and other mandates that limit the fledging startup's business flexibility. While these requirements were originally intended as protective ballast, at some point, they risk crossing the line into burdensome dead weight.

Conclusion

Everybody that's got a stake in spinning out companies from federally-funded university research is groping for the answer. Like most of the issues around university innovation strategy, there are no good guys and no bad guys. Some universities are experimenting with simpler measures, such as transparent express startup licenses, or offering startups an informal "option" period, in which a startup can test the commercial waters at no cost. On at least one campus I know of, university inventors are actively organizing to push administrators to reconsider policies that had a purpose early on, but have evolved into unrecognizable thickets that entangle the honest and dishonest alike.

When university startups patent their R&D like big companies

Startup patenting strategies have become as sophisticated as those of incumbent companies and startup patenting costs have reached new heights — the average reported cost of a single patent was $38,000. (See the Kauffman-funded "Berkeley Patent Survey of 2008," by Stuart Graham, Tech Sichelman, Robert Merges, and Pam Samuelson). The Survey data on startup patent strategies offers insight into our current university model of startup formation.

US universities spin off hundreds of new startups each year and spend millions of dollars to help their startups get patents. By way of background: a university startup takes shape when an entrepreneur with a passion for the university-owned technology – typically the faculty member or student who invented the technology — licenses it from the university.

New university-based startups, like most startups, want patents but don't have the money to pay outside attorneys. To help their fledgling startups develop into mature technology companies, universities pay their patent costs with the contractual understanding that they startup will later pay them back. Payback can take the form of an IOU for cash plus interest, or at some universities, the startup agrees to give the university a chunk of equity in the company.

Berkeley Patent Survey data indicates, that rightly or wrongly, startup patent strategies run the gamut from protecting core IP to locking up ideas they don't plan to use, but don't want others to get their hands on. Universities are not VCs; as the IP strategies of startup companies become increasingly expensive and sophisticated, universities face new challenges. One, from a purely fiscal

perspective, speculative patent payment is risky and expensive. Two, it's very difficult to figure out which startup is going to earn enough money to later pay back its patent costs. And three, unlike VC investors, it's not clear whether universities should pay for startup patents that some would consider unethical, e.g. paying to file broad patent claims on ideas that the startup will likely never develop into a product.

Startups are as sophisticated as larger firms in their patenting strategies

Survey data indicates that the most important reason for getting a patent, even for software startups, is to prevent others from copying their idea – pretty much the classic old-school purpose of getting a patent (this held true across all industries — biotech, medical devices, software and hardware). What many people don't realize, however, is that startups get patents for a whole host of other reasons. Startups get patents to improve their negotiating power, as a marketing tool, as red herrings to lure competitors off the scent of their product strategy, and to obtain "squatters rights" on ideas they may never use in a product.

This has a few implications for university startup strategies. First, what constitutes "appropriate" and "inappropriate" patenting is no longer as simple as it once was. In other words, even innovation-oriented "good guys" such as technology startups execute patent strategies that go beyond just protecting their core product ideas. Second, if university startups are going to compete with their rivals that use patents to lock down market turf or to bully competitors, universities need to get comfortable with the idea that startups in their care will need strategies that go beyond just getting a patent to block rivals from copying a product idea or method.

Startup patent costs are high

Available funding is key to a startup's patenting strategy. Startups reported that the primary reason they don't get patents, across all industries, was the prohibitive cost of getting them and the cost of enforcing them. Perhaps not surprisingly given the shoestring nature of most startup budgets, a whopping 76% of the startups surveyed said they held no patents.

Many on-campus entrepreneurs feel that coverage of patent costs is the most valuable service universities offer their early-stage, cash-strapped startups. Typical on-campus offerings intended to help startups bridge the so-called "Valley of Death" such as VC showcases and entrepreneurship workshops simply are not as useful as cold, hard cash to cover patent costs. VC-backed startups are significantly more likely to build a patent portfolio. The Berkeley Survey didn't call out university startups as a unique category, but I wonder whether university-backed startups are also more likely to file for patents than those who receive no external funding.

Who gets the new shoes?

The Survey confirms what most of us already feel to be true: biotech and medical device startups perceive patents to be critical strategic tools to block others from copying their products. In contrast, although software startups filed for patents primarily to protect their idea, software startups ranked patents as their least important strategy for attaining competitive advantage. For software startups, first-mover advantage is the most important, followed by having interoperable or proprietary products, then trade secrets. Software startups value copyrights and trademarks more than patents, but less than time to market, product innovation and secrecy.

It's a tough decision for a university licensing person to decide which startups need patent funding most. All startups, if they can afford them and to different degrees, value patents. Particularly as a vehicle to signal value and intent to the marketplace and to potential investors. While VCs investing in biotech and medical device startups value patents more, VCs backing software and hardware startups value patents as well. Biotech startups said that 97% of the VC firms that invested in them said that their patent portfolios were important in their decision; 59% of VC-backed software and Internet startups reported the same.

Better screening methods are needed, but what?

Venture firms manage large portfolios of startups because it's darn hard to figure out which ones are going to make money. As my friend David Anthony likes to say, "If we VCs knew exactly what we were doing, we wouldn't have 40 startups in our portfolio. We'd have one or two."

Clearly, there needs to be some sort of orderly process in place for someone to walk out of the door with a startup license and some of the university's money. Based on my own experience and confirmed by research conducted by the RPX Group, many universities require would-be entrepreneurs to write a business plan in exchange for receiving a startup license which must address the following: the timeline for receiving funding, names of the desired management team and timeline to get them into place, and planned activities to develop the technology, including specific market opportunities and resources available to implement the commercialization of the technology.

While the required business plan provides a necessary paper trail and operational procedure, even the best-written business plan

is not going to successfully guide a university licensing person to the right startup that will eventually pay the university back. No person or no plan can predict which startups will earn money, hence are worth investing in. Perhaps the real value of the required business plan is to indicate how serious a faculty member or student is about the startup. Another unstated benefit of the business plan is that, like a written essay exam, it demonstrates which would-be entrepreneurs are capable of thinking clearly enough to successfully navigate the treacherous waters ahead of them.

A handful of universities are experimenting with "express licenses" to make the startup formation process as quick and painless as possible. However, even a transparent and upfront standard set of licensing terms and a clear "no surprises" approach to a payback schedule, license fees, equity taken, and product royalty rates are based on the idea that the startup will eventually become profitable. A public and straightforward license does not solve the very difficult problem of how to get patent costs reimbursed by a cash-poor or failed startup.

Should universities pay for "inappropriate" patents?

Universities are not VC firms yet their startups must play in the rough and tumble real world where a startups' patent portfolio plays a critical role in its business strategy. In theory, at least, the reason universities are permitted to own patents on federally funded research is to serve the greater good. At what point does a startup's patent strategy veer away from protection (appropriate) and into the realm of hindering the potential of other technology-based startups?

Appropriate use of patents, most would agree, is a straightforward cordoning off of a novel, useful and non-obvious

idea that a company plans to build into a marketable product. Inappropriate patenting, in contrast, would be for a company to obtain patents, sit on them and ambush unsuspecting companies for violating its un-used patents (e.g. patent trolls). This gets tricky when universities venture into paying for what some would consider inappropriate patents, such as a patent that makes very broad claims over an area of basic research.

Conclusion

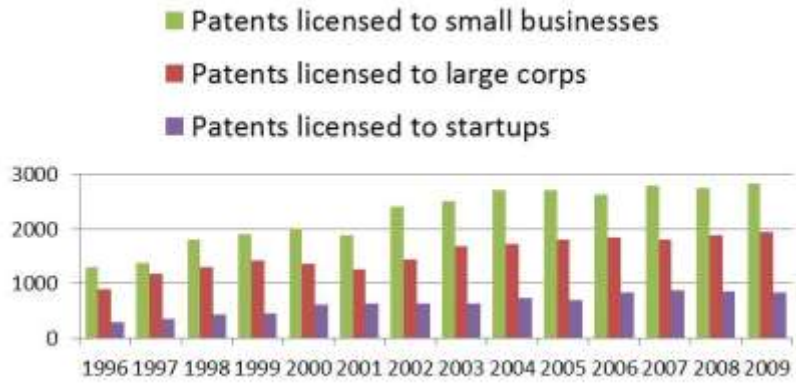
True, a number of issues are raised by the current practice of universities speculatively paying the patent fees of their licensed startups. However, with all the criticism of university strategies for startup innovation and entrepreneurship, universities do not get enough credit for the simple fact that they put their money where their mouth is. As players in our innovation ecosystem, universities remain willing to gamble on cash-strapped startups. At the end of the day, who else is offering to pick up the tab to pay patent fees for startups who will likely never earn a dime?

Universities are one of the few organizations out there who have deep pockets but are not profit driven, are not held to a firm bottom line, nor made accountable for return on investment (how many "former VCs" do you bump into these days at conferences?). Warts and all, as startups must compete with other startups in a big patent arms race, universities continue to foot the bill to pay patent costs for startups that will likely never be able to pay them back.

University patents and our nation's forgotten entrepreneurs

One of the lessor-known original intentions of the Bayh-Dole Act of 1980 was to make federally-funded U.S. university research more

readily available to small businesses. It worked. Today, three decades later, universities do a brisk business licensing patents to small, technology-based businesses. Each year, roughly half of the patent licenses that universities sign are to small technology-based firms managed by regional entrepreneurs. These small firms employ fewer than 500 employees, offer their regions high quality technology jobs, and transform early-stage university research into innovative products or services.



University patent licenses to small businesses, startups and large companies. Data source Association of University Technology Managers (AUTM).

What many people don't realize is that these small businesses are not the Googles or the "get rich quick" whiz kid startup that comes up with a radically new product, successfully navigates the shark-infested waters of venture capital, and then goes public in a blaze of fiscal glory a few years after signing its first patent license. No, most of the small businesses that come looking for university patents have been around for a few years, live nearby, will never end up on the NASDAQ or hone their elevator pitch at cocktail parties. These small businesses don't have equity to give to the university

since there's no "exit strategy." These small business entrepreneurs don't dream of big riches. They dream of being their own boss, making payroll, feeding their families, and spending their days doing something that matters.

In the rush to build a certain type of high-growth startup, it seems that our public dialog on entrepreneurship has forgotten the small business entrepreneurs who transform early-stage university inventions into commercial products, jobs and a revenue stream that grows moderately each year. It seems that every few months, universities, the government, and the private sector launch yet another program aimed at high tech startups. These programs offer advice, business plan competitions, seed funding, or incubator space to fledgling high tech startups with high growth potential (sometimes called "gazelle startups"). Highly publicized and well-resourced programs such as the StartupAmerica Partnership and 500 Startups are a great start, and should be applauded. But where are the programs, the investigations into business barriers, the funding, and assistance to aid these "other" small entrepreneurs who rely on university patents, and whose goals involve modest and sustained growth?

Just to play devil's advocate for a second: why does it matter if the entrepreneurship programs created by the powers-that-be overlook moderate-growth technology-based small businesses? After all, these forgotten entrepreneurs seem to be doing ok despite the paucity of bootcamps, networking events, business plan competitions, mentoring and other such standard fare that are regularly offered to their high-growth brethren. Given the large numbers of patent licenses, universities seem to be doing a good job getting inventions out to these low-profile firms. Does it matter that we know very little about the downstream impact of standard

university licensing terms on a small business's ability to move forward? Why bother to delve into the details of how universities structure their patent deals, or how much a university patent will cost a small, technology-based business?

Because maybe these small moderate-growth tech businesses would benefit from entrepreneurship programs custom-tailored for them. Maybe more small businesses would benefit from access to university inventions than are currently being served. Maybe universities need to evolve and update how they license patents to these small firms. Maybe universities can continue to build onto their success with small businesses and explore other sorts of innovation partnerships.

Here's why it matters

1. Small technology-based businesses outperform larger companies in generating innovative products and services

Small technology-based businesses are very productive when they license university-owned patents that originated in federally funded university research. On average, small technology-based businesses (including those that do not license university-owned patents) outperform large companies in generating innovative technologies. For example, businesses with fewer than 25 employees on average generate more patents per employee than do larger firms; the patents small businesses create tend to be of higher technological value and originality (see the Small Business Administration report by Breitzman and Hicks). Clearly, small technology-based businesses make productive use of innovative technologies.

2. Small technology-based businesses are more likely to work in high-growth, cutting-edge technology fields – the same fields that

federal research funding sponsors in university research labs. The same fields that the government wants to foster growth in.

In general, small technology-based businesses are more likely than large firms to specialize in high tech, high growth industries, such as biotechnology, pharmaceuticals, information technology, and semiconductors. These high tech industries form the foundation of our nation's high tech economy. In addition, small firms tend to cluster in the same innovative industries that receive the lion's share of federal funding that fuels the research in university labs. Technology-based small businesses gravitate towards the same research areas that end up going into the university's patent portfolio.

3. Universities may be missing some of the small business market that pays to acquire externally-produced intellectual property.

According to data from the Kauffman Firm Survey, technology-based small businesses spend on average, $110,000 a year on acquiring intangible property. On average, universities license patents to fewer than 3,000 small businesses each year – a fraction of the technology-based small businesses in existence that could be potential candidates to license a university-owned patent.

4. Venture capital and the high-growth startup game favors white males. Woman-owned startups are second-class citizens when it comes to attracting venture funding.

When we overlook the needs and contributions of the small regional firms that aren't aiming for big money, we also overlook the value and activity of woman entrepreneurs. Our nation's current programmatic focus on a very specific type of tech startup privileges activities associated with high tech startups, namely attracting venture capital. Today, an estimated 5% of VC investments are in

woman-owned startups (see the report "An Investigation of Women-led firms and Venture Capital Investment" by Brush, Carter, Gatewood, Greene and Hart). While VC investments in woman-owned firms have risen a few percentage points in the past decade, progress is slow.

It's true that venture funding tends to concentrate in industries such as computer software and hardware, and medical and biotech industries where there are fewer woman-owned businesses (according to the Small Business Association, 51% of female-owned businesses are in the service sector and 18% in retail). However, even correcting for the predominance of male-owned startups in industries preferred by investors, in an analysis that spanned 1957 to 1998, the report points out that women-led software startups received only 2.4% of total money invested while men-led software startups received 36%. Seems pretty unbalanced, but maybe I'm missing something. Data on VC investments by gender is scarce, and the data given here is several years old (btw, if anyone has more up-to-date data on VC investments by gender and ethnicity, I'd love to hear about; I couldn't unearth anything newer than this).

Let's get this conversation started

We need to start a new national conversation about small, moderate-growth technology-based businesses. Right now, universities and policymakers are largely focused on developing high growth tech startups. However, our nation cannot afford to underserve thousands of highly productive and innovative moderate-growth small businesses whose economic contributions include significant numbers of jobs and new products and services. Nor can we adopt a too stringent focus on high growth startups if the risk is that women and minority-owned businesses are pushed

offstage, despite the growing presence of female and minority business owners who are successful technology entrepreneurs.

We can start by learning more about patent licensing arrangements between universities and small, tech-based firms.

First, let's start by praising the university staff that have completed thousands of patent licenses to small, low-profile businesses. With that said, it's possible that our current university patent licensing method could be improved and updated to reflect changing times. For example, it's not well understood whether standard license fees and terms mandated by most universities have an impact on a small business's ability to form product development partnerships, adapt quickly to changing business conditions, and to operate efficiently in today's open innovation ecosystem. Frequently a university patent license will have a reach-thru rights clause that gives the university the right to collect royalties on any downstream products a small business may develop using the university patent. Another typical term whose impact is poorly understood is that of sub-licensing royalties that are several times higher than the percentage of royalties.

Second, let's give these small businesses a voice. While anecdotal evidence exists that small businesses are impacted by university licensing terms, fees and reporting requirements, exactly how are they impacted? Patent licenses aside, there are significant numbers of small, regional businesses that tap into university expertise via informal channels such as knowledge spillovers or grant programs such as STTR. In addition, there are thousands more technology-based firms outside the university ecosystem that are comfortable licensing externally-intended technologies, yet never approach a university as a potential innovation resource. Why not?

Finally, what do small business owners want? University patents appear to be intimately intertwined with the innovation strategies of small, regionally-based tech firms. These firms have demonstrated high levels of productivity and capacity for innovation. However, over the years, few universities have systematically collected and shared direct feedback from these forgotten entrepreneurs about their unique challenges, product development methods, preferred intellectual property strategies and budgets. Our nation's conversation about entrepreneurship needs to include more voices of people who own and manage moderate-growth small technology businesses.

Chapter 5

Measuring and comparing university performance

Measuring performance with the tech transfer health index

The technology transfer health index is a simple but powerful technique to quantify the impact and productivity of the entire long tail curve of technologies in a university's IP portfolio. Here's why we should adopt it. When I worked in a university technology transfer office, we spent a lot of time pulling together performance metrics. We had 14 different reports, each with its own subtle nuances and unique methodologies. Needless to say, despite our best efforts, our metrics didn't reconcile well over time and unintentionally gave the impression that our tech transfer office was somewhat, uh, creative in our accounting. The problem, however, wasn't just accuracy.

Our metrics missed the mark because they didn't reflect the whole story: we counted mostly technology activity in the head of the long tail curve of distribution – the high-earning technologies, new startups, and issued patents. However, most staff time was spent managing "tail" technologies – filing provisional patents, marketing technologies, keeping on top of licensees who weren't

paying their bills, putting on events, and processing all types of agreement-related paperwork.

Another limitation of our approach was that we counted all commercial licenses the same way, regardless of their associated impact or revenue (of course revenue is not a perfect proxy for impact, but lumping together anything with a signature on it created a meaningless and distorted depiction of our performance). Finally, we tallied metrics in our own, idiosyncratic way that was hard to explain to outsiders, so even our AUTM metrics could not be easily compared to those from a different tech transfer office.

Enter the tech transfer health index. I got the idea to create a tech transfer health index in a conversation with a faculty friend. I was describing the university commercialization RFI responses I've been reading. A common theme amongst responding universities is their quest for for performance measures that would

1) focus on more than just revenue from "big hits"

2) better convey the activity of their entire set of active licenses from the high earners all the way down the tail, and

3) indicate the large amounts of invisible and unheralded staff time and labor that's an essential part to marketing and managing an IP portfolio.

In addition, though not mentioned by university respondents, based on my experience, effective metrics should be hard for tech transfer offices to interpret in unique ways, or unintentionally "game;" watertight metrics would increase stakeholder confidence in the TTO's transparency.

Turns out that faculty have found a solution. Most universities now use a performance evaluation technique called the H-Index to measure the impact and productivity of their faculty's scholarly work. The H-index is most commonly used in the context of counting

the number of times a particular researcher's papers have been cited by their peers.

Before the H-index, tenure committees simply tallied up the total number of citations but did not consider their value and distribution. The H-index was created in response to flaws inherent in the traditional citation-counting method. Tenure committees discovered that (like a home run "greatest hit" technology), a researcher could claim a large number of citations, but not reveal they all came from a single paper, a "one hit wonder." Also, (kind of like counting large numbers of provisional patents or low-value license paperwork) a scholar with a lot of citations could be basing her count off of several papers that were cited only once or twice, a sign that while she wrote a lot of papers, none of them had a significant impact on other researchers.

The H-index can be applied to assess the health index of university IP portfolios. Calculating the tech transfer health index is easy. I'll bet you already have data on how much revenue each patent has earned over its lifetime. Use that data for your first health index analysis to evaluate how diverse and well balanced your licensing efforts are.

1. Dig up the spreadsheet that's floating around your tech transfer office that lists the revenue earned by each patent (patents are a cleaner data point than technologies since they're a finite IP unit).
2. Rank the patents by the revenue they've generated over their lifetime from largest to smallest.
3. Make a chart with the horizontal axis for patents and the vertical axis for revenue. Plot the patents by their revenue in units of $1,000. You should quickly see a long tail curve emerge.

4. When you're done plotting, extend a diagonal line out from the origin (where the x and y axes meet) through points (1, $1000), (2, $2000) .. (10, $10000), etc. — kind of like the straight grey line in the picture above.
5. Where your diagonal line intersects the nearest part of the curve, draw a line down to the x axis: the distance from (0,0) to where the vertical line hits the x axis is your tech transfer health index.

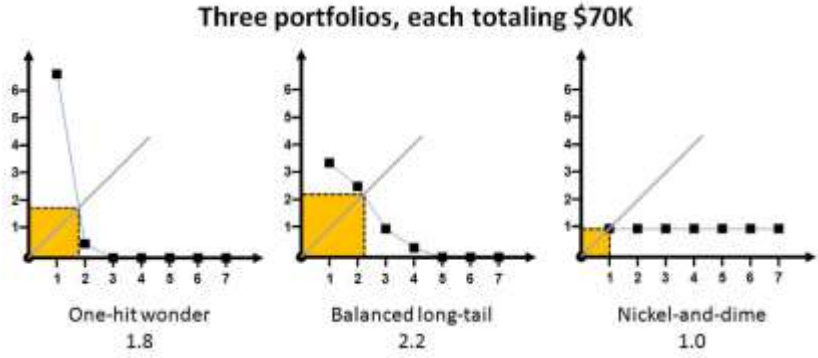
For example, in the diagram above, this tech transfer office's health index is three. So this office has three patents that each earned at least $3,000 over their lifetimes. Of course when you chart your own health index with real data, your numbers will likely be much larger.

So how are you doing?

If you chart your portfolio and discover a long tail curve that's very steep, your office is relying on a few patents that are earning most of your revenue. In other words, a low health index. Or, you may have a low health index if your long tail curve starts low and stays flat. A low flat curve indicates that your tech transfer unit is licensing a large number of patents but not getting a lot of revenue back from them. It's not necessarily bad to not earn much revenue (after all, getting technologies out the door and into use should be the ultimate goal). However, a low, flat curve indicates you may be spending a lot of time and money on paperwork. However, an upside of quantifying a low health index of this type is that you can prove that your unit is managing a large volume of essential but unappreciated long tail-related paperwork.

You have a high health index if — like a productive and impactful researcher — your long tail curve starts high and gently

curves downward. This means your office has found the right balance between impact (high earning home runs) and productivity (large numbers of low-income licenses). Congratulations!



Here's the value of using the health index:

- **Rewards real tech transfer activity, not just fees:** Conventional ways to increase revenue such as charging high fees or striving for a home run license will not improve your health index. Instead, the health index improves only with consistent and long term licensing activity over a broad spectrum of technologies.
- **Promotes true economic development:** Your tech transfer office will have better ammunition with which to convince university administrators that there's value in getting and maintaining a large number of low-revenue licenses from "tail" technologies. You can now quantify more than just high-revenue licenses.
- **Makes it possible to compare large and small universities:** Tallies discriminate against small universities. The tech transfer health index makes it possible

to directly compare universities that have very differently sized IP portfolios.

- **Gives credit to universities that have a well-rounded licensing portfolio:** Your health index will confirm that your office is doing justice to the entire long tail curve of available technologies. You can point out that the large volume of low-earning, low-visibility patents and licenses may not earn a lot of money, but your office is effective in meeting the essential purpose of the Bayh Dole Act, to get technologies out the door into use.
- **Can be applied to several other key performance indicators:** The health index is versatile. Instead of patents, on the horizontal axis, one could plot other finite IP assets such as technology disclosures or startups. On the vertical axis, instead of using dollars, one could use other values such as the number of web hits for technology disclosures, or for university startups, capital raised.
- **Can scale up or scale down.** The health index metric can be used to assess the performance of a single licensing officer, a group of universities, or an entire geographical region (innovation cluster), or an industry segment such as biotech or nano-scale manufacturing.
- **The metric is easy to share publicly:** If the names of the patents, technologies or whatever you're analyzing are removed, it's possible to publicly and safely share your unit's health index results.

- **Can also be used internally to assess operational efficiency:** You could use the health index as an internal management tool to figure out how efficiently you're managing various aspects of your operation-related activities.

In the unlikely event that someone were to interpret their metrics in a non-standard way, the health index would be harder to manipulate than standard straightforward tallies of new licenses, new startups, etc. However, realistically, no metric system is game-proof. For example, some faculty researchers once attempted to game the H-index by creating Citation Clubs where they set up fake "journals" with their friends and aggressively cited one another's low quality papers. If a university technology transfer director tried a similar technique to pump up their tech transfer health indexes, it would involve quite a bit of fabrication.

For example, consider how hard it would be to set up something like a Citation Club in a university tech transfer office. Let's imagine that a tech transfer director is desperate to create the impression that under his guidance, the tech transfer office has suddenly become a licensing machine. After a few sleepless nights worrying about his unit's low morale and rapidly declining performance, inspiration would suddenly hit: why not create a "Startup Club?"

Step one: make up some names and incorporate several "fake" university startups (kind of like sham journals) that are wholly owned by the university. Step two, this director could "negotiate" several licensing deal with himself (kind of like having his friends cite his articles) and put himself on the startups' board of directors (hooray, another award on the CV!). Step three, he could assign a tech transfer office employee to be CEO of the startup (despite the

fact there really is no startup, no revenue and no products). In fact, he could even have a staff member create a website for each startup.

Voila, in one fell swoop, this hypothetical tech transfer office would enjoy an increase in the number of new licensing deals (who needs to know that the license is to a sham startup). He would also create the public impression that he's a wizard of sparking the formation of new tech startups..

A simple metric for university patent licensing, startups and licensing speed

Peaking of performance metrics and transparency, if universities demand greater control over the inventions created by their faculty and grad students, they should also be required to publish more rigorous metrics that shed real light into how they are managing their invention portfolios. In other words, as one of my high-school teachers used to say, with privilege comes accountability. If universities wish to enjoy complete control over all the inventions created by their employees, each university, in exchange for the privilege of receiving federal research funds, should be required to commit to a transparent technology transfer process.

Now simple transparency is key. When I say metrics, I don't mean that the federal government should add new reporting requirements to over-burdened university tech transfer offices. Universities already struggle to manage unfunded mandates that accompany federal funding (see the Goldwater Institute article on administrative bloat in universities– a data-based and very interesting read by JP Greene, Brian Kisida and Jonathan Mills.)

Instead, we should implement a mandatory but simple system of checks and balances that's based on data that's already being tracked, or is easy to pull from the tech transfer office's in-house database. Today's software tools and database technology, combined with the Internet, make it simple to open a low-cost window into the inner workings of a university tech transfer office.

Here's how. First, ensure that nobody bites off more than they can chew. A crucial first step in ensuring that U.S. universities are good stewards would be to mandate that they re-write their IP policy: universities should agree that they will select inventions to

commercialize within a firm, brief decision period (such as a few months). This policy change could actually be done today at the university level, would still give the university the same share of revenue from resulting deals, and does not require any federal oversight.

Such an approach would still give the tech transfer office a first look at new inventions. If the tech transfer office was not interested in pursuing potential commercialization opportunities for the invention, ownership of the invention should be quickly and cleanly relinquished back to the inventor. At this point, the inventor could manage her own invention, or look for a 3rd party agent.

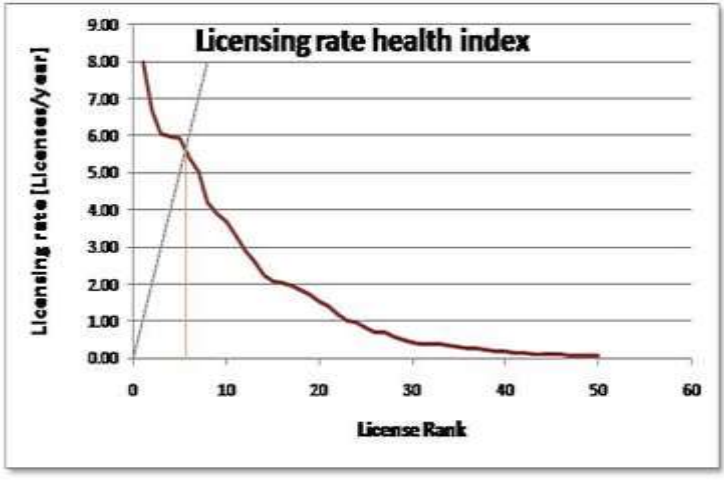
Next, to establish transparency and insight into the inner workings of a university's technology transfer efforts, university administrators should regularly collect, calculate and publish the following metrics.

1. A public customer satisfaction scorecard: Every university that receives federal research funding should set up a public scorecard to measure customer satisfaction with the university's tech transfer services. Queried customers would include university inventors and industry licensees. After all, university administrators keep an eagle eye on their faculty and lower-level staff's job performance, potential conflicts of interest, and external affiliations. But who's keeping an eagle eye on the integrity and performance of university administrators?

For the tech transfer office, customer satisfaction surveys would need to be administered by a third party and the results made public (similar to student teaching evaluations.) By now, customer satisfaction surveys have become a commodity item. No fancy consultants are needed to get this going, just choose a survey that is

geared towards a services organization and use the already existing infrastructure that campus Deans use to administer student evaluations on faculty teaching performance. Note, the tech transfer office cannot write and administer its own satisfaction survey. Instead, the survey must be managed by someone outside the TTO and scores and summary data must be posted publicly, just as faculty teaching evaluation scores are made available.

2. Use tech transfer health indexes to open the window and let the sun shine in: Alongside the customer satisfaction scorecard, university tech transfer offices should annually harvest and publicly post data in the form of health indexes. (To see more detail on the concept of the tech transfer health indexes, see the previous essay.) Health indexes assess and showcase the core components of a university tech transfer office's activities. Health indexes are charts the depict the impact and productivity of an entire portfolio, not just a simple tally of a single metric.

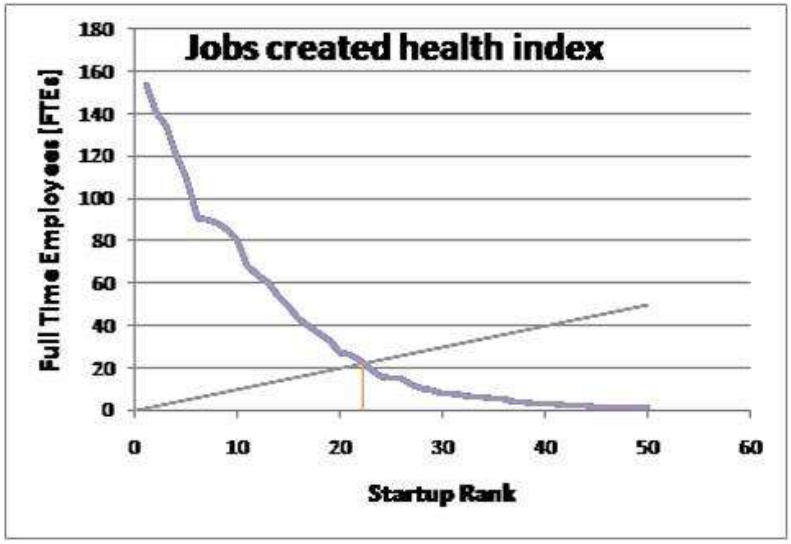


a. Licensing rate: a metric for how quickly inventions find productive use off campus. This health index demonstrates

how quickly a university tech transfer office is getting inventions into the hands of people who can use them. The steepness and height of the curve indicates how quickly a tech transfer office is finding licensees. The majority of invention disclosures will never be licensed and will taper off into a long tail curve of zero.

Here's how to calculate this: using the in-house tech transfer database, relate the past three years' worth of invention disclosures to licenses agreements and export the data. In a spreadsheet, calculate the licensing rate of each invention by taking the elapsed time period between disclosure and license execution (in months) and dividing the lapsed time into the number 12 (for example, a license that was generated in 3 months will have a rate of 4). Rank the inventions by licensing rate and create a chart with the y axis being the licensing rate and the x axis being ranked disclosures. Draw a diagonal line from the origin (0,0) thru (1,1), (2,2) until you meet the curve. Draw a line straight down to the x axis. The number on the x axis where the line hits is your licensing rate index.

b. Jobs created index: A metric for how many full time jobs are distributed across university startups. This health index demonstrates the distribution of full time employees at university startups. Right now, most university tech transfer offices count the number of full time employees at startups based on university technologies. If you don't query your startups, you can find a pretty good estimate at sites such as manta.com.

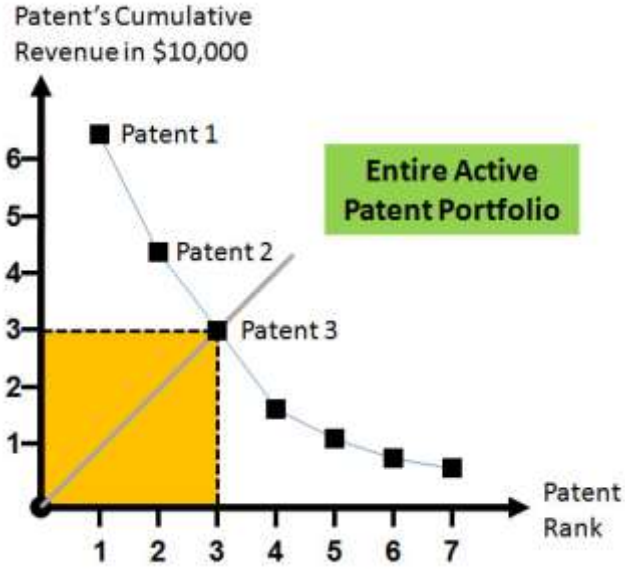


To calculate the jobs index, chart the number of full time employees on the y axis. Chart the startups on the x axis. Draw a diagonal line from the origin (0,0) thru (1,1), (2,2) until you meet the curve. Draw a line straight down to the x axis. The number on the x axis where the line hits is your startup health index. The names of the startups do not have to be published.

c. The health index of the earnings of the entire IP portfolio: This health index lays out the revenue earned per patent. This index helps stakeholders see the balance between earnings from "home run" technologies and the rest of the portfolio. Here's what a chart of a patent earnings health index could look like.

After all this, you may be asking why patent applications are not measured as a core indicator of the health of an IP portfolio. The reason I did not include patent activity data is because patent activity is not necessarily a reflection of performance or impact. Patent activity indicates productivity. For example, the number of provisional patents a university applies for is a function of how much

staff time and money it has available. Same for the number of issued patents. Rather than calculating patent activity as an end in and of itself, universities should use patents to represent an "IP unit" in the assessment of licensing rate or revenue distribution.



Interestingly, I noticed that most advocates of today's university technology transfer model begin their argument by pointing out that since the 1980s, hundreds of new tech transfer offices have popped up at U.S. universities. They follow that data point with the assertion that thousands of new patents have been issued to universities. However, neither the formation of new offices, nor the number of issued patents indicate value added; they simply indicate activity.

Hopefully, the people lobbying to give universities even more control over on-campus inventions will also offer up a corresponding strategy to demonstrate their commitment to transparency and accountability. Simple metrics such as these, using data that most tech transfer offices already have, will shed light into the good work

that our universities are doing in managing tax-payer funded university IP portfolios.

Who does it best? Comparing universities by number of papers, inventions and industry research funding

We need better metrics to measure a university's performance in managing its patent portfolio. However, just using metrics on the formal technology tnansfer process presents only part of a larger story. A university's ability to create and share innovative technology and know-how should be evaluated in a holistic way that includes both academic and commercial activities.

In this article I compare the innovation transfer activities of U.S. research universities in a new, multi-faceted way: by counting and mapping universities according to their ability

- To publish papers
- To generate new inventions and
- To attract industry research funding.

Why these three axes? A university's scholarly publishing equals its ability to share knowledge via traditional channels; its invention activity reflects faculty interest in, and whether commercialization activity is valued on campus; industry funding equals the value of informal interactions between university and industry scientists (I'll explain this one later). Combined, these arenas provide a holistic picture of a university's activity in generating and sharing new technologies and scientific know-how.

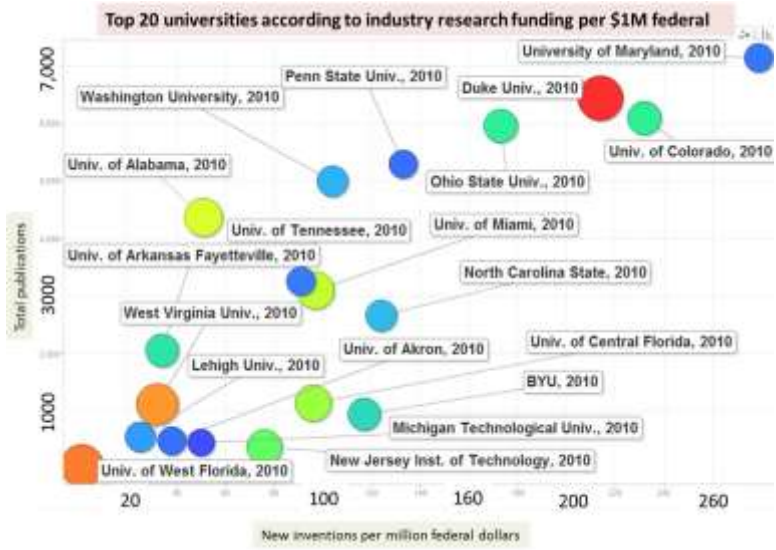
To visually depict these comparisons, I made four bubble charts. The first bubble chart maps the usual suspects — the top 22 best-funded large U.S. research institutions. The remaining charts look at a new playing field, one where universities are compared according to their performance per million dollars of federal research funding, a view that triggers the emergence of a refreshing new set of highly performing universities.

This analysis represents university activity for the year 2010. The data on publications comes from the ISI Web of Science database. The data on disclosures and industry funding come from annual metrics collected by the Association of University Research Managers (AUTM, 2010). (If you spot data oddities or omissions for your university, let me know.)

1. Comparing the top 22 research universities

This bubble chart compares the biggest U.S. research universities. Here's how to make sense of this chart:

- the vertical axis represents total number of publications for the year 2010
- the horizontal axis represents how many inventions university researchers disclosed that year
- the size of the bubble represents how much industry funding the university got that year



So, if a university bubble is high up on the chart, that university produces a lot of papers. If a university sits out to the far right, it creates a lot of new inventions. The bigger the bubble representing a particular university, the more industry funding that university received in 2010.

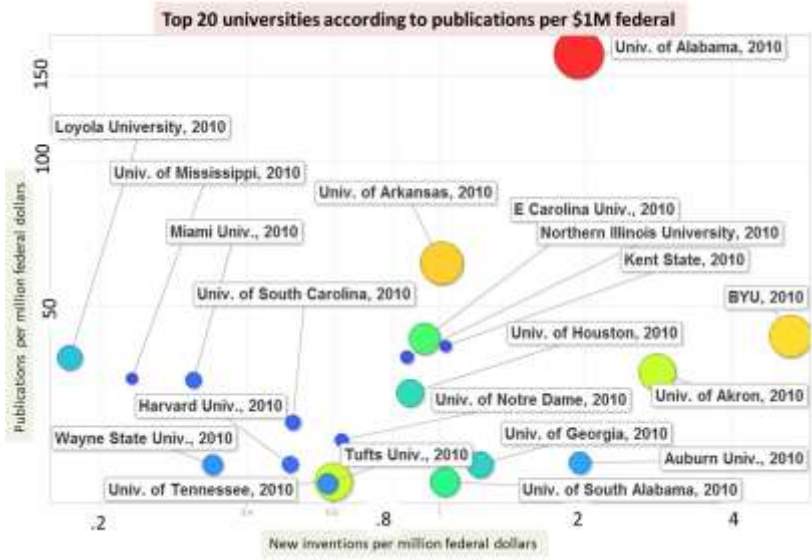
Not surprisingly, Harvard researchers publish a significantly larger total number of papers than those at other universities. Duke, University of Colorado and Washington University of St. Louis have high levels of research funding from industry sources. CalTech researchers are strong in both paper publishing and creating inventions: on average, for each invention reported by a CalTech researcher, six scholarly papers were published.

The University of Texas and University of California systems aren't depicted here for the simple reason that their numbers are so large they compress the rest of the university bubbles into a messy blob. If you'd like to imagine these two gargantuan university systems in this chart, visualize two bubbles roughly one-third larger than the big red bubble that depicts the University of Colorado floating in the upper right hand corner. In other words, when it comes to the absolute number (not corrected according to federal funding) of papers published, new inventions and industry research funding, Texas and California perform very well.)

2. Universities that publish the most papers per federal dollar

Scholarly publications, or what some people call "open science" remains the largest, most critical source of university research to industry product development efforts. For this chart, I set up a level playing field. To figure out a university's publication activity independent of the size of its federal research budget, I calculated

how many publications each university churned out per million dollars of federal funding. This way, a new group of universities emerge as top performers.



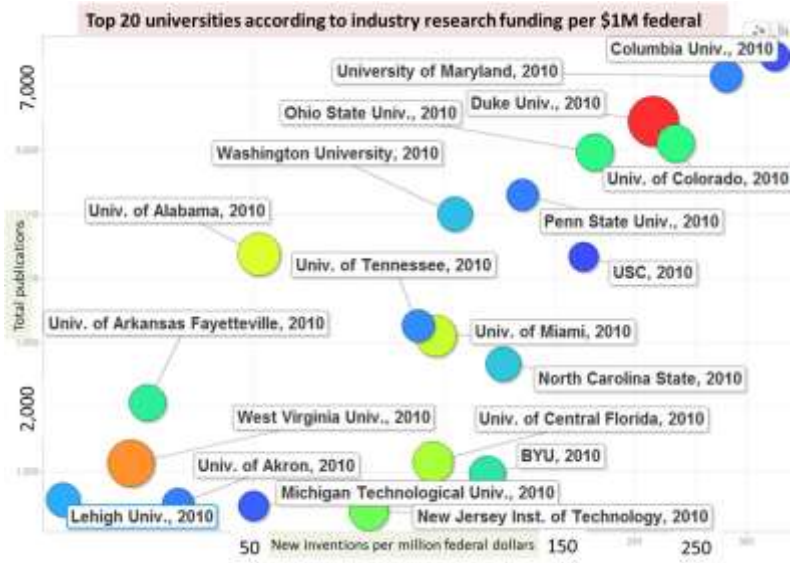
On this chart, the venerable Harvard shrinks in comparison to the Universities of Arkansas and Alabama. In fact, the number of publications from the University of Alabama was so large — 165 papers per million dollars of federal research, almost three times more than the next-up university — that I checked and double-checked the count in ISI's web of Science. (If this number is incorrect or deserves further explanation, please let me know or comment below. I can re-make the chart if needed.) The University of Akron and Brigham Young University appear to be a well-rounded universities as they rank in the top twenty according to publishing per federal dollar, and also dominate their its peers according to new inventions and industry funding.

3. Universities that attract the most industry research funding per federal dollar

To represent the informal interactions between university and industry scientists, I chose to map how much industry funding a university receives. First, I'll explain what went into this chart, then I'll explain why industry research funding represents the vitality and quality of the informal relationships between university and industry scientists.

To make the chart, first, I pulled out the 20 universities that attract the most industry funding per million dollars of federal funding. To do this, I divided their total 2010 industry funding by their 2010 federal funding. In other words, the universities depicted on this chart are high performers, attracting large amounts of industry funding for their size and amount of resources.

Next, I charted the top 20 universities in this group according to their publications (vertical axis) and invention disclosures (horizontal axis). In this chart, the size of the bubble represents each university's industry funding divided (or normalized by) how much federal funding it received in the same time period. The numbers of publications and new inventions on the axes in this chart, however, are the actual number generated by each university. The size of the bubbles represents how much industry funding that university received, again, a larger bubble representing a greater amount of money.



Out of this group, Duke receives the most industry research funding per million federal dollars. Next are the West Virginia University and University of Alabama. Out of this group of 20 well-funded universities, the Columbia and the University of Maryland generate high numbers of both scholarly publications and new inventions.

Quantifying informal knowledge exchange between university and industry scientists is notoriously difficult (for example, how would one measure conversations, consulting engagements, informal collaborations?). Yet, industry funding is a strong proxy that indicates the value and intensity of the informal interactions between a university's and industry scientists. Turns out that the amount of funding a university researcher receives from a company is likely to be the downstream result of having strong connections in the chimerical, yet widely acknowledged informal channel of university knowledge transfer. Why?

According to research described in a research article by Branco Ponomariov,

> *"We find that involvement in informal interaction is associated with higher probability of undertaking collaborative research with industry as well as with a higher allocation of research time to collaborative research with industry*."[19]

In other words, if individual faculty members are intensely and productively involved with their industry-based colleagues, they are more likely to eventually attract an industry sponsor for their on-campus research.

Interestingly, this research offers another compelling reason that university patents are not good measures of innovation. Ponomariov discovered that although active faculty partnered with industry scientists to bring a commercial product to market, these joint research projects did not involve university-owned patents. Nor did owning or working in a private company (e.g. a startup) increase the odds that a university researcher would have strong connections to industry.

4. Universities that invent the most new inventions per federal dollar

Finally, new university inventions. I selected this group of 20 universities by dividing their total number of formally disclosed new inventions by how much federal funding they received. Similar to the chart above, the vertical axis = number of publications per million dollars of federal funding; the horizontal axis = number of inventions per million dollars of federal funding; the size of the bubble = industry research contracts.

First, a disclaimer on counting new inventions as a measure of university innovation transfer: reporting a high number of invention disclosures is a laudable achievement. It's a good sign that university researchers trust and value their university's formal technology transfer process. However, keep in mind that the majority of university researchers (even those considered high-performing) disclose few or no inventions to their university's technology transfer office. Yet, university faculty and graduate students are keenly aware of how their research applies to real-world challenges, and they continue to perform cutting-edge research that makes tremendous contributions to industry innovation.

The reason I chose the number of new inventions a university generates each year as a meaningful measure of a university's innovation transfer ability is that new inventions serve as a significant indicator of a university's commitment to, and skill in commercializing research. For this reason I like new inventions more than patents as a measure of a university's innovation climate; patents tend to reflect local policy and the size of a university's patent budget.

Here's what I like about correcting for differences in federal funding: some of these universities actually disclosed a relatively small absolute number of total inventions. Yet, if you count invention bang for the buck, these small schools are actually turning their research into reported inventions at a brisk rate, e.g. University of Akron, Michigan Tech and South Dakota State.

Overall, Brigham Young University turns its federal funding into the largest number of new inventions, disclosing on average, five inventions per million dollars. Louisiana Tech, Auburn and the New Jersey Institute of Technology do well here too, although the

relatively small size of their bubbles indicates that they earn somewhat less in industry funding.

What's next?

Policy makers, university administrators and others spend a lot of time and effort trying to figure out how to track and chart a university's skill in generating and sharing new knowledge. Where they fall short is that most metrics today count contractual units of knowledge, for example patents issued, new startups and license revenue earned by university-owned patents. Instead, we need to expand how we measure how effectively universities translate federal research funding into new knowledge and new technologies by honoring channels that do not involve intellectual property.

Teaching, research, alumni donations … and accumulating patents

Most US universities maintain three core businesses that earn most of their revenue: selling diplomas, competing for federal and industry research sponsorships, and trying to crack open the checkbooks of wealthy alumni. Since the 1980s, universities have ventured into a new line of business: patenting inventions from university research labs and brokering these patents to businesses and startups.

Thirty years later, university patent holdings have swelled into the tens of thousands and larger research universities spend millions of dollars each year on filing for new patents. Yet, on average, over three-quarters of university patents are never licensed to companies for commercial use. Since US universities own 5% of our nation's patents, and a growing number of patents in cutting-edge fields such as nanotechnology and biotech, even on human genes, people get worried that needlessly "locking up" basic university research will stifle innovation and create a patent anti-commons.

U.S research universities have branched beyond their traditional role of innovation explorers (they generate knowledge) to become innovation merchants (they license their knowledge to other organizations). While not everyone agrees it's good for society for university's to own and broker patents, from the perspective of business strategy it makes sense if a university files for a patent at the request of company that plans to license the invention. What's is harder to understand, however, is what motivates universities to continue to file for patents when there's no licensee in sight.

Why university accumulate patents is a controversial, complicated and poorly understood topic. The debate around the topic brings to mind the seven blind men and the elephant. If you ask an optimist or a politician why universities continue to invest in unlicensed patents, they'll tell you that it's to incent companies to invest in developing a product, to motivate the faculty, and to make sure the university invention gets a fair shot at finding a home in the commercial marketplace.

If you ask a pessimistic or someone who's had a bad experience, they'll tell you that universities file patents willy-nilly based on the political pull of the inventing faculty member. Or that staff don't know what they're doing. Or worse, that universities have become genteel patent trolls, guarding piles of un-used patents and suing companies and researchers that made money on an unlicensed university invention.

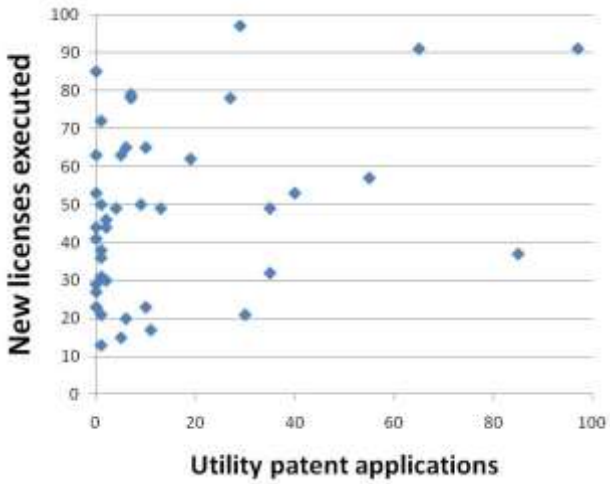
Some patent accumulation, perhaps, could be explained by the motivations above. However, the real reason universities end up with largely unlicensed patent portfolios is this: university patent accumulation is an unintended consequence of the inefficiencies inherent in our current university technology transfer model. The current tech transfer model creates a situation in which universities accumulate patents because they patent more inventions than they can license. Then, after a patent is issued, if there's still no licensee in sight, a university's technology transfer office is reluctant to let outside parties try their hand at finding a licensee in exchange for commission.

Patent accumulation by the numbers

Two indications point to the fact that university patent accumulation reflects underlying inefficiencies in our current tech

transfer model: one, data indicates that each year, university file for utility patents independent of that year's licensing activity. Two, when comparing patent and licensing activity across universities of similar size and resources, the numbers are all over the map.

In theory, if a university only filed a utility patent application at the request of a company wishing to license the invention, there would be no patent accumulation. Although some universities report that this indeed, is their patent strategy, in fact, AUTM data from the top 50 US research university says otherwise. Most research universities file new utility patent applications without the presence of a signed license.



If it getting patents was indeed a license-driven process, the chart below that depicts the number of utility patent applications vs. new licenses executive should look more like a line. (Other factors may be in play here: part of this seeming random filing could be that a single license covers several patents. Also, since a typical license takes 6-8 months to negotiate, some license completion may be spilling into over into the next year).

The only consistently demonstrated patent strategy across US universities was filing a provisional "placeholder" patent on new inventions to buy time to find a licensee and to figure out the potential commercial value and use of the invention. Across the board, most universities file provisional patents on roughly three-quarters of their new invention disclosures.

Perhaps since most utility patent applications are not motivated by company request, nor directly related to a university's three core businesses (teaching, research and alumni donations) AUTM data indicates that patenting activity between university varies wildly, even between universities of similar size, funding and technology transfer activity. (For a clearer picture, I pulled out the California and Texas systems since their research funding and number of new disclosures is significantly higher.) University patent-related activity is all over the map. For example, at leading US research universities in 2009

- A few universities filed zero utility patent applications; one filed more than 200
- Some universities filed 50 to 60 new provisional patent applications, while another university with similar resources filed more than 300 new provisional patent applications
- The percentage of provisional patents filed per utility patents filed was completely inconsistent across universities. For example, one university filed 145 provisional patents and not a single utility patent application. The same year, another filed 221 utility patent applications and only 134 provisional patent applications.
- Spending on patent-related expenses ranged from less than a million dollars at one university, to over $16 million at another

The fact that universities file for patents without a clear commercial license in sight is not necessarily a bad thing, despite legitimate concerns about the impact of patent accumulation on our innovation ecosystem. Nor is it necessarily a bad sign that across universities file for patents in such widely varying numbers and with no apparent underlying strategy.

As patent brokers, universities have the right to take an individualistic approach that reflects their own unique internal logic and is driven by local need and local mission. Extreme local variance could indicate an underlying strategy unique to that university's areas of research expertise. If patent filings reflect the number of high-potential new inventions that came in that year and are based on sound market research and an intelligent case-by-case basis, then cross-university variance may simply indicate diligence and adherence to a locally-defined patent strategy.

At the end of the day, a university's relationship with its patent portfolio is a complicated one. In comparison, a company's patent strategy reflects and is a tool to support its larger business strategy (see the fantastic Kauffman-funded report by Ted Sichelman and Stuart Graham). It's not so straightforward with university patent strategy. The current technology transfer method rests on a model in which universities attempt to be innovation merchants, despite the fact their core business is not brokering IP and the patents they broker have no relation to their core revenue streams.

- A hefty patent portfolio does not attract tuition-paying students and does not play a part in faculty advancement.
- Federal funding isn't allocated according to universities that own a particular type or certain number of patent.
- Companies bearing research sponsorships are typically drawn by faculty expertise and university research capabilities.

- Alumni donate money because they get their name on a bench. Or some other piece of campus infrastructure.

In other words, successfully licensing university inventions is an incredibly difficult task! Patent accumulation is not the fault of under-performing tech transfer offices, nor the malevolent master plan of greedy university administrators or faculty. Instead, it's much more subtle and complicated than that. Universities simply don't have the same incentives for filing and hanging onto a patent that companies and startups do. Nor do they have the same resources and business models that permit IP brokering companies to succeed (although even successful IP brokers accumulate patents and regularly go out of business).

Why do universities own significantly more patents than they can license? Well, for several reasons.

- Being a patent merchant is darn hard work and even the best IP brokers end up with more inventory than they can sell
- Patents that staff can't find licensees for are set aside and no longer marketed. Most universities are reluctant to permit third party agents to take over their commercialization process
- Picking out patents that may have future commercial appeal is nearly impossible given the fact that by design, most university research is early stage and covers a huge range of territory
- Releasing patents into the public domain or regional IP pools is scary and involves its own legal and political complications, given the fact that patents can costs tens of thousands of dollars, letting patents loose is difficult to fiscally justify
- Licensing unlicensed patents older than 2-3 years with non-exclusive, royalty-free, no cost, no terms, "go in peace"

license may not please some companies, but it may lure others out of the woodwork; again, hard to justify, may invoke resistance from inventors; politically risky

- Staff are given too many patents to handle; finding the right companies to invest in one's raw IP is time-consuming and sophisticated work
- Universities don't get to choose their patents or develop their portfolio in a particular direction, say becoming a "nanotech specialist; patents get dropped off at the door
- Universities don't need their patents to build up their core business; university technology transfer is a sideline at most universities, not a core function
- It's not unusual for patents to be pursued at the request of a faculty member, even though there's no commercial interest in the technology
- The number of patents issued remains a core "performance" metric at many university technology transfer office

We should turn the debate away from the supposed motives (both for good, and for evil) underlying university patent accumulation. That debate barks up the wrong tree and doesn't provide a solid foundation for stakeholders to rationally think about what to do next. Here's what comes to my mind. Does patent accumulation harm anyone? If so, whom and how? Is getting and hanging onto unlicensed patents worth the university's time and money? After 30 years of the current model, are universities effective innovation merchants? If you think change is needed, what, specifically would help? And finally, would the introduction of commercial free agents into the university tech transfer process help break up the back log of unused patents?

Canadian universities, the innovation gap, and leaping the landline

Many people view Canada as a less populated, snowier version of the U.S. That's just not true. For one, the average Canadian ice skates far better than the average American. Then, Canadians like their french fries dipped in a cheesy goop called poutine — no ketchup involved. But wait… here's a big cultural difference: on average, despite claims that Canadian universities lack a commercial focus, as a percentage of total research funding, many top Canadian universities attract as much — if not proportionately *more* — research funding from companies than their counterparts in the U.S.

Why is this surprising? Because Canadian universities are frequently (and unfairly) accused of being a contributor to a national "innovation gap" that prevents university technologies from flowing freely to companies, therefore stifling the development of the Canadian economy. According to this line of reasoning, Canadian universities — unlike those in the U.S. — lack a commercial focus and a clear set of national-level rules governing university research commercialization. As the CBC described it, "In the United States, the 1980s Bayh-Dole Act outlines a clear set of rules determining IP ownership early in the process of federally funded innovation. But in Canada, there is no set method for transferring technological research and knowledge from public institutions."

It's not really that simple. For a talk I gave in Toronto at the Ontario Centres of Excellence Discovery Conference, I spoke of the notion that there's no single right way to bring university research to market. In fact, the less defined national system in Canada, rather than being a weaker version of the U.S., actually enables Canadian

universities to test out innovative approaches that may actually be as (or even more effective) than those used by U.S. universities.

Comparing U.S. universities to Canadian universities

Wait, why should any university have a "commercial focus?" After all, isn't the purpose of a research university to well, do research? Yes, and no.

Most U.S. research universities today own a patent portfolio which they license to companies in exchange for royalties. These universities formally claim ownership to inventions that come from on-campus labs that were funded by tax-payer research. One way to look at it could be that the U.S. approach bears the evolutionary markings of a model of knowledge transfer that views university R&D as intellectual property.

For example, when they're hired, new employees at U.S. universities sign over their patent rights to their new employer and must disclose inventions to a central technology transfer office. Some universities claim ownership of inventions that arise from faculty consulting engagements, off campus, using company resources. (True, lots of university inventions flow through informal channels to industry, but to some, this grey market is not always considered a vibrant alternative model, but a "leak.")

In contrast, Canada never passed a national-level uniform policy that guided universities into a single direction. Instead, the decision of how to handle federally funded university inventions was left up to the individual university. Canadian universities have the option to take title to patents. Yet, despite this option, Canadian universities still exhibit quite a bit of diversity in how they bring university R&D to the private sector, and how they set up research partnerships with companies.

About half of Canadian universities have taken a similar approach to the U.S., requiring employees to disclose inventions to a central office and hiring staff dedicated to managing inventions, getting patents and seeking commercial patent licenses. Others, like the University of Waterloo, let university researchers make their own commercialization decisions on their research.

Like Darwin exploring the Galapagos

Today, after 30 years of different national policy and variations in local interpretation, like Darwin exploring the wildlife on different islands in the Galapagos, we have before us to two distinct, but similar living ecosystems. Now, the U.S. system has a lot of good things about it. And industry research funding isn't the whole story. For example, many U.S. universities have enthusiastically invested resources to help spin off faculty-led tech companies; according to data collected from universities, the result has been an increase in the number of tech startups based on university patents.

My goal here is not to claim that either approach is inherently superior. Instead, to me, the key takeaway is this: the U.S. model is too uniform. U.S. universities should borrow from Canadian ones and explore alternative modes of knowledge transfer not built on the notion that all companies prefer patents as the unit of transaction when working with university researchers.

The fact remains that Canadian universities manage to attract a hefty amount of industry funding for research. This indicates that perhaps not all companies want university patent rights to become a factor when negotiating university research collaborations. My sense is that in general, Canadian universities are less inclined to view university R&D as a potential revenue source. However, this attitude doesn't seem to impede Canadian university's ability to

work with company researchers. In fact, maybe Canada's more relaxed attitude about intellectual property ownership helps its university researchers connect with company research projects.

Running the numbers

I did a few simple back of the envelope calculations of performance data from the past 30 years to compare Canadian to U.S. universities. I selected three different metrics that represent three different facets of the university knowledge transfer process: each university's activity in inventions, publications and industry funding per million dollars of total university research funding.

- University-industry research partnerships: this is how much money university researchers are able to attract from companies to do research together on-campus (Source AUTM, 2010)
- Turning university R&D into inventions: This metric is the reported number of new invention disclosures submitted to a university's technology transfer unit each year (Source, AUTM, 2010)
- Traditional knowledge transfer: a university's total number of scholarly papers published per year (Source: ISI)

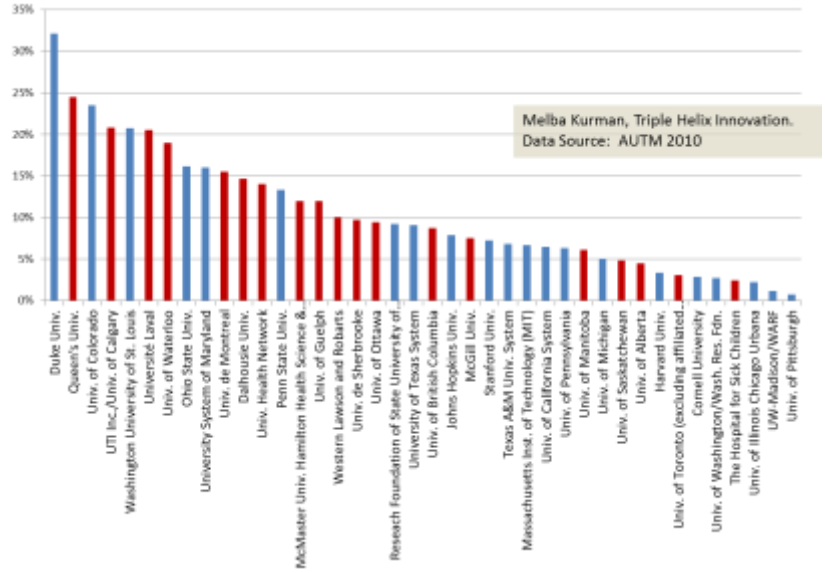
For this particular comparison that I presented at the Discovery conference, I selected the top 20 best-funded Canadian research universities and the top 20 best-funded U.S. research universities. Once I had my group of 40 U.S. and Canadian universities, I corrected to remove the distorting effect of differences in the amount of research funding received by each university.

(This is somewhat akin to an analysis on applied university innovation I did last year, using bubble charts to compare the knowledge transfer capacity of U.S. universities according to these same three axes.)

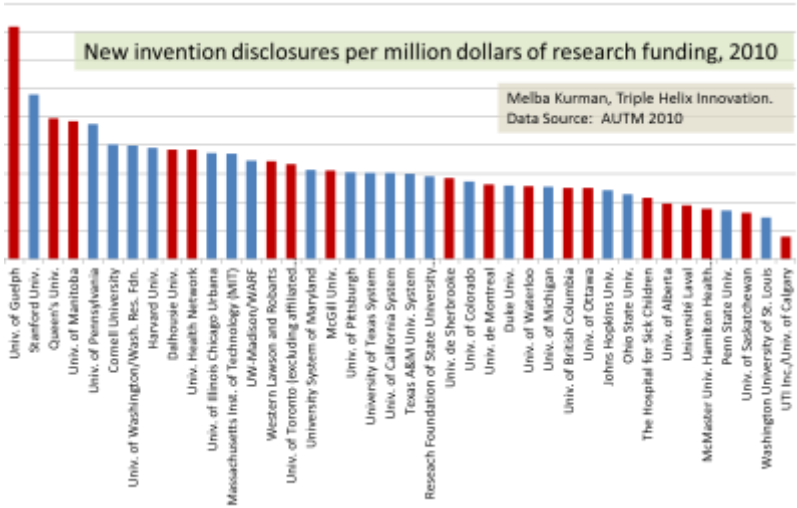
Here's what I found.

Industry funding

Five Canadian universities rank in the top ten when it comes to getting funding for industry research partnerships. This simple calculation opens the possibility that maybe the Canadian model, while less focused on patents and intellectual property clauses in research contracts, may be actually be very much in sync with company needs.



Recently the Canadian government shifted much of its research funding from basic to applied in hopes of closing this so-called "innovation gap." Time will tell, but I wonder whether the shift to fund less science and more commercially applicable research in Canadian universities is really necessary.



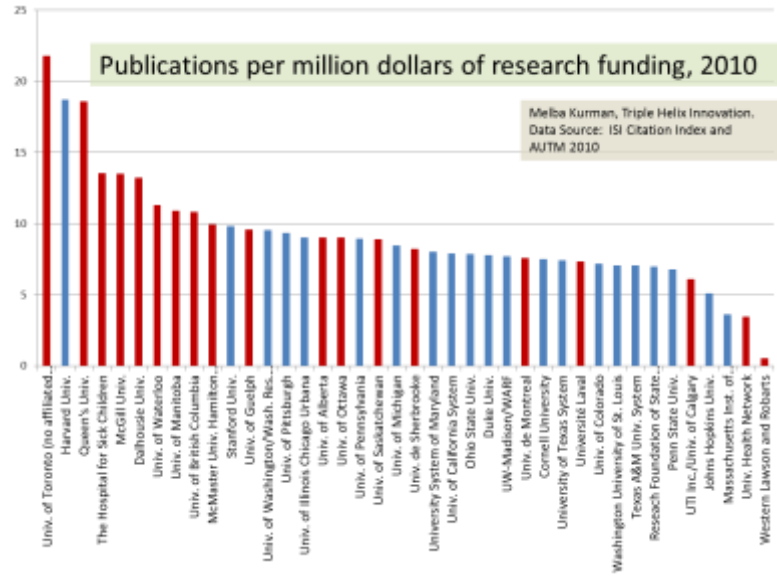
Invention disclosures

Next, I compared the number of invention disclosures per million dollars of research funding.

Another surprise here. Four Canadian ranked in the top ten in terms of generating inventions per millions of dollars of research funding. This insight is especially intriguing considering that only roughly half of Canadian universities (unlike the U.S.) require that their researchers disclose their inventions to a central technology transfer office.

Scholarly publications

Finally, scholarly publications per millions of dollars of research funding. Perhaps not surprisingly, Canadian universities do well here. Canadian universities take up most of the top ten slots in generating scholarly publications.



Some may wonder why scholarly publications are a performance metric for a university's ability to transfer knowledge to companies. Turns out that good, old scholarly papers remain one of the biggest conduits of university technology and know-how to company product development teams. Many industry researchers keep abreast of their university colleagues (in addition to mingling at conferences and hiring faculty as consultants) by reading scientific papers and articles.

Leaping the landline

What does this data tell us? First, it tells us that more investigation is necessary. These are quick calculations based on incomplete data and there are many unexamined variables in play here. Clearly, it's too early to draw solid conclusions. For example, U.S. graduate students are mostly funded indirectly through federal research grants which is reported by the university as research

funding. In Canada, graduate students get their funding directly from government fellowships. So we would need to pick apart what monies exactly, are reported by universities in both systems as total research funding.

It would be interesting to talk to the companies that sponsor research at Canadian universities and ask them to compare their experience doing the same thing in the U.S. Do they notice a difference in the process? What about VCs that want to fund a university tech startup? At universities where the researcher manages her own commercialization process, do they have better luck getting their research into commercial play? Why or why not?

It is important to point out that unlike the fairly evenly-sized islands that Darwin studied in the Galapagos, the U.S. and Canada are very different in terms of size and economy. The U.S. economy and population are roughly ten times as large as Canada's. As a result, Canada has far fewer large research universities and only a handful of native Fortune 500 businesses. Much of the Canadian economy has historically been built on its abundant natural resources. Canada has interpreted patent law differently, particularly around lucrative university biotech patents.

Public debate over how universities manage publicly funded research is a good thing. It means people care. The U.S. government made a bold back in 1984 by giving universities the right to obtain and license patents and much of the outcome has been positive. For example, many university researchers prefer the commercially-oriented U.S. model since — fairly enough — as inventors, they get a cut of company profits that come from their invention. For entrepreneurial faculty or graduate students, obtaining a patent or founding a startup is no longer viewed as a non-scholarly activity. Finally, (and this one matters perhaps less to most people, but a lot

to me), the U.S. model has enabled the development of a fascinating new field for people who are drawn to the challenge inherent in getting great university research from the labs out to the rest of the world.

However, what's interesting to me about the U.S. system is how little variation exists across universities. For example, U.S. universities do not *have* to claim ownership of university inventions or research – they just have the option to in case they decide to. The original federal legislation that was passed back in the 1980s was essentially a mostly-blank canvas that offered lots of room for universities to tinker with at the local level. For whatever reason, unlike their Canadian neighbors, U.S. universities have hesitated to fully exploit this blank canvas.

Leaping the landline

Like variation between species of tortoises or finches residing on different islands, neither the U.S. nor Canadian university research commercialization model is necessarily "better," just different. Yet, the world's economy continues to rocket forward and strategy must rocket along with it to remain effective.

The thought that came to my mind was that Canadian universities are too frequently still measured according to a U.S. oriented yardstick that measures success as revenue from patent licenses. Different measures suggest otherwise. Perhaps Canadian national university commercialization strategy has simply skipped over a few phases that now characterize the U.S. If diversity is the future, then maybe Canadian universities demonstrate an economic phenomenon called "leapfrogging." Leapfrogging, in an economic context, according to Wikipedia, is defined as:

> *"when companies holding monopolies based on incumbent technologies have less incentive to innovate than potential rivals and therefore eventually lose their technological leadership role when new radical technological innovations are adopted by new firms"*

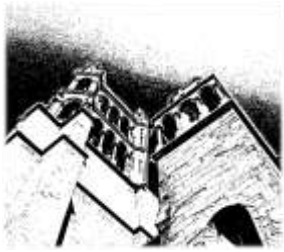
Examples of technological leapfrogging include skipping fiber optic cable and jumping directly into high-speed, wireless infrastructure (Eastern Europe). Or skipping gasoline made of fossil fuels in favor of fueling cars using ethanol made from sugar cane (Brazil). Freedom from previous investment in a single incumbent technology (or strategy) enables innovative technology (or strategy) to leapfrog the incumbent.

U.S. universities could be viewed as incumbents that have invested heavily in their current strategies and hence have less incentive to try out alternative, more innovative knowledge transfer strategies. Canada's approach, characterized by with several innovative strategies with no single one dominating, could be viewed as one that's poised to leapfrog forward. More investigation is needed but I wonder whether — like a telephone landline – U.S. universities remain too faithful to a once-useful but increasing antiquated method of transferring university research to the people and companies that need it.

Canadians already know quite a bit about the U.S. system. Yet, many very sharp and forward-thinking tech transfer practitioners in the U.S. aren't as familiar with Canada's national-scale "living lab" that demonstrates different models of university knowledge transfer in action. If flexible, regionally defined and less patent-oriented knowledge transfer models are the future, perhaps more of us in the U.S. should journey up to points North to see what we can learn.

Chapter 6

Innovation Strategy



Incumbency, innovation, and the tablet wars

Incumbency can be like a gift from a wicked fairy godmother, one that sounds like a good thing at first, but if poorly managed, can turn deadly. In particular, incumbent tech companies, after they achieve market dominance, have a peculiar tendency to asphyxiate their once innovation-oriented culture. I speak of Microsoft and RIM and their ongoing struggles to master the tablet market.

Once as a conference gift I received a Blackberry Playbook, RIM's answer to the tablet wars. Not the disastrous first version of the Playbook, but the latest upgrade. Then as if on cue, Microsoft just announced that after years of sitting out on the exploding tablet market, it will finally dip its gigantic toe into the waters. Microsoft will launch a hybrid tablet/laptop called "Surface" that will run Windows 8 and compete with Apple's iPad.

Unlike the RIM Playbook, no one has yet been kind enough to give me a free Surface. The Surface looks quite lovely — a thin tablet with a snap-on keyboard. But I love my new Playbook. It's gorgeous — sturdy with a high-res screen that glows like a jewel. The wireless hurries along. The frame is just heavy enough to feel snug and

strong in your hands. (I confess that I'm old school in that I'm prejudiced in favor of slightly heavier gadgets; like old, metal kitchen appliances, I associated heft with high quality.)

I have an iPad, which is no doubt also an impressive piece of technology engineering. But I like my new Playbook more. And that makes me sad.

It makes me sad because becoming attached to my new Playbook may be like becoming attached to someone who has a terminal illness. I hope common wisdom is wrong, but common wisdom has it that the Playbook and by extension, RIM, don't have much longer to live. Why?

RIM launched the Playbook too little, too late. As a result, the Playbook, unfortunately, though it's an appealing product, will likely fail to gain much market share. In a vicious feedback loop, a small market share will mean that app developers don't want to spend their time writing apps for the Playbook. Fewer apps will attract fewer users. Eventually, the Playbook's user base will slowly shrink to the point where it's no longer profitable and the product — and perhaps the entire company — will be discontinued.

People have written volumes about RIM's demise as a company, how it failed to take advantage of faster data networks and new software development models. But the underlying reason isn't just changes in the environment — RIM used to handle new markets and new technologies just fine. The deeper underlying reason is that like so many once-dominant companies, RIM got caught in the big sleep that can be the hidden cost of market incumbency.

According to dictionary.com, an incumbent is defined as someone (or something) that

1. holds an indicated position, role, office: e.g. the incumbent officers of the club.

2. is obligatory: e.g. a duty incumbent upon me.

3. (Archaic) is resting, lying, leaning, or pressing on something: e.g. incumbent upon the cool grass.

What happens when you blend "indicated position," "obligatory," with "resting on something?" You get an organization whose primary focus is on defending or maintaining its dominant position, using its lack of forward movement as the weapon of choice.

Is Microsoft's Surface similarly doomed? I hope not. I am an ardent Windows fan. I have a Windows laptop now and want my next one to be Windows. Early sales data indicates that the Surface is enjoying some modest sales, but nowhere near those of the iPad.

Microsoft's Surface tablet, like RIM's Playbook, may not get the opportunity it deserves to enjoy a long and healthy life. The Surface's longevity will depend on whether it can capture a good chunk of the iPad's market share, hence developer attention. Unless the Surface takes off, if I buy myself a Surface and get attached, I may be inviting slow, painful bereavement into my future. There's a cautionary tale unfolding in the tablet market.

The danger of market incumbency — regardless of whether it's induced by state protection, deep pockets, huge cash reserves or a strong brand name — is that having control of a market or service makes it too easy for an incumbent organization not to respond promptly to what its customers want. As a result, incumbent companies falter if they spend their energy and resources on protecting their kingdoms rather than developing and investing in new strategies.

Companies who fall prey to the gift/curse of market incumbency stop launching new products. Or their new products are so darn weird, late or dysfunctional it makes you wish you could have been a

fly on the wall during planning meetings. Customer service falls apart. Bewildering discussions with an incumbent company's customer service "team" can make you wonder whether you're being used as an unwitting pawn for an employee who plans to make a series of hilarious YouTube videos.

Formerly innovative organizations can quickly become incumbent organizations, which can quickly become faltering, no-longer-incumbent organizations. Having a track record of creating excellent technology doesn't immunize a company against the negative effects of poorly managed incumbency. After all, not that long ago, RIM was *the* company for innovative, user-oriented smart phones. RIM's Blackberries used to be so popular and addictive they were called "Crackberries." Almost everybody had one. I had one until I reluctantly switched to the iPhone two years ago. Blackberry smart phones were awesome.

People make fun of it now, but Blackberries had a physical keyboard that helped those of us with clumsy paws type better, plus a nice little rolling trackball. Unlike Apple's iPhones "built to shatter" engineering strategy, Blackberries were tough. A friend of mine literally ran over his Crackberry with his car. Its case cracked and the belt clip fell off. But the Crackberry survived intact and hasn't complained once. Though I won't put it to the test, I'll bet my new Playbook could also survive being run-over: its frame feels so wonderfully solid.

Perhaps near-failure is the best cure for a incumbent company that has given in to the siren's song of complacency. IBM doesn't get enough credit for being a company that has continued to re-invent itself for nearly a century. IBM defeated a near-terminal illness a decade ago and now is alive and well.

Like IBM, Apple, the very same company that's now crushing RIM and maybe Microsoft was very nearly the victim of its early success in the fledgling home computer industry. A few years ago, Apple faced an uncertain future as fewer and fewer people bought Macs. The iPod and its follow-on dynasty hadn't yet come into being.

During those years when Apple was staggering against the ropes, I was working at Microsoft. Tucked away on the edge of campus was a sleepy little division called the "Mac BU" (business unit). A small team of developers worked in MacBU's corporate Siberia, adapting Microsoft software to run on the Mac and vice versa. The Mac BU was regarded with benign disinterest. Some Microsoft employees speculated that perhaps keeping the Mac BU around — despite Apple's poor prospects — was an act of charity. After all, Bill and Steve had once been twenty-something software tycoons together.

Nobody would have predicted what would happen just a few years later. Today, Apple has fought its way out of the grave and has innovated its way back into market dominance with an unrelenting onslaught of iPods, iPhones and most recently, iPads. It's once domineering frenemy, Microsoft, is now borrowing some of Apple's moves to crack into the tablet market.

Being an incumbent organization can be dangerous. State support can disappear. Technology and culture change so fast that what once was a wonderfully solid market position can quickly crumble to dust. A company's market incumbency — both a gift and a curse — can quickly erode after just a few years if a company falls under the spell of organizational bloat and misshapen, politically-tainted product strategies.

I hope that RIM and Microsoft will live long and prosper and that their tablets will thrive. As someone who never identified with

the whole white Mac and grooving along while wearing ear buds ethos, I want RIM and Microsoft to continue to offer an alternative to Apple products. The clock is ticking, however. Then again, maybe, if we just wait long enough, Apple will again succumb to the curse of poorly handled market incumbency. If that happens, the life cycle will begin anew and we will witness a fresh generation of hungry and innovative companies to fill the void.

Fair trade electronics: responsible innovation

We should consider a new certification program for innovation consumer electronics: Fair Trade Electronics. Do you have a cell phone, TV, iPad, GPS or laptop? Odds are good that most of your gadgets are the fruit of an elaborate, global supply chain hired and managed by big, brand name tech companies as HP, Dell and Apple.[i] Behind most sleek, cutting-edge consumer gadgets is a chain of good, old-fashioned human workers. Like Fair Trade coffee, Fair Trade Electronics would push technology companies to be more transparent about the hidden costs of pollution and human suffering that underlie the production of mainstream consumer electronics.

It's not news to most people that the majority of consumer electronics we deem "innovative" are manufactured in low-wage countries, most notably China. The process of creating innovative technologies is not a clean, bloodless one. Innovative electronics are messy to make. They involve the processing of toxic raw materials. A recent series of New York Times articles describes current working conditions as "bleak" at factories manufacturing products for Dell, Hewlett-Packard, I.B.M., Lenovo, Motorola, Nokia, Sony, Toshiba and others. Detailed reports put together by China Labor Watch, an independent not-for-profit organization based in New York and Shenzhen document squalid dormitories and 12-hour days of breathing toxic chemicals — and no, there's no overtime pay.[20]

Yet, we all take part in this, willingly or not. Unless you live in an isolated hand-built cabin in rural Montana, grow your own food, wear couture or vintage clothing and use decades old household products, you're buying offshored goods. For the book I'm writing on 3D printing, I've been digging into research about the interplay between jobs and the manufacturing supply chain. Apple, for

example, has 700,000 people all over the globe working in its global supply chain, engineering, building and assembling iPads, iPhones and other products. Just try to buy a cellphone or laptop that bears the "Made in the USA" label. I haven't been able to find one. Have you?

Despite their disturbing findings, China Labor Watch (and Chinese workers) make it clear that simple scapegoating is not going to make anything better. Their report states that "scapegoating is unacceptable and irresponsible behavior… Holistically improving working conditions is the responsibility of both multinational brand companies and their suppliers." I agree. After all, the US was once in the same position, complete with child labor and forced overtime. The Great Lakes are still contaminated with toxic levels of mercury from previous decades of industrial manufacturing.

How Fair Trade certification would work

Fair Trade electronics would work the same way as other Fair Trade certifications: consumers would elect to pay a few more dollars to purchase a certified Fair Trade electronics product. Corporate participation in Fair Trade Electronics certification would be voluntary. The certification process would be managed by a non-profit auditor funded by a government agency. The Fair Trade auditor would conduct product tear downs to identify individual electronic components. Auditors, armed with the information from component teardowns, would inspect and document the working and environmental conditions in every mine, factory and company that contributed raw material, components and labor to the final product. A product would qualify as Fair Trade only when pre-specified working conditions and environmental standards were met by every supplier in the supply chain.

What, exactly would qualify as a Fair Trade product? From Wikipedia (for brevity, it's my text inside the brackets)

"Fairtrade certification [applies to goods made in companies that ban] child and slave labour, guarantee a safe workplace and the right to unionise, adhere to the United Nations charter of human rights, [and are sold] at a fair price that covers the cost of production and facilitates social development, and protection and conservation of the environment."

It's not just more humane, it would align domestic and offshored manufacturing wages

Why should those of us interested in innovation strategies care about Fair Trade electronics? First, for many of us, a large part of our interest in innovative technology is that it can make our world a better place for everyone. A Fair Trade Electronics certification would motivate big brand name technology companies to deeply examine their supply chains and ensure that the humans who mine, make and assemble our beloved consumer goods are not being treated as disposable slave labor. I've observed that many corporate employees, if given the chance, would be happy to identify ways to make their manufacturing processes less exploitative and more environmentally friendly — they just need the green light from top managers. Second, we all live on the same planet and extreme pollution in a remote offshored factory ultimately poisons all of us. And three, for economic reasons.

In his recent State of the Union speech, President Obama spoke of taking measures to bring manufacturing jobs back to the U.S. Sometimes people are surprised to learn that the cost of wages for factory workers that assemble electronic products are a fraction of the cost of materials. According to a product teardown by market research firm iSuppli, the cost of Chinese assembly line labor for an

iPhone 4 is only an estimated $8 per iPhone; in comparison, the cost of materials is $188. If Fair Trade electronic certification were to become the norm, working wages for Chinese factory workers would (at least in theory) rocket from $8 per iPhone to $28. Greater parity in worker wages removes at least one incentive to offshoring supply chains.

Fair Trade Electronics certification would help level the playing field between domestic vs. offshored electronics manufacturing. But alone, it won't assure the return of decent-waged manufacturing jobs to the U.S. There's still more to go. According to another estimate cited by the New York Times, it would take an additional $65 tacked onto each iPhone's retail price to pay American-level wages.

It will take a lot more than healthier supply chains to create high-value jobs in the US. As the New York Times article skillfully points out, it's not just lower wages that China is able to offer. Low-wage countries can assemble thousands of eager workers on short notice. It's possible to erect a new factory wing in just a few weeks without having to get permission from a zoning board or conduct an environmental impact study. Safety regulations are not enforced and unions are illegal. Factories can dump pollutants into nearby rivers without little or no consequences.

But why not start small and start somewhere? A Fair Trade certification for electronics, for a modest price increase, could ease some of the worst existing labor and environmental challenges in global supply chains. Of course the complicated thorny tangle of US job loss still needs to be addressed. But given the confusion around what to do and the current dearth of existing solutions, Fair Trade electronics offers a small step in a better direction.

Making humane innovation a part of innovation strategy

Perhaps the more realistic and shorter-term benefit of a Fair Trade electronics certification would be to provide multi-national corporations with a hard, bottom-line incentive to make a transparent and clearly documented supply chain a central part of their innovation strategy. Big technology companies, under tremendous pressure from shareholders, have discovered that they can reap record profits as long as everyone looks the other way when it comes to the state of their global supply chains. Failing to qualify for a Fair Trade electronics certification would place profits at risk.

The beauty of a Fair Trade certification for consumer electronics is that:

- It doesn't point the finger at a specific "bad guy." Instead, it acknowledges the complicated interplay between companies, factories and consumers across the entire global supply chain.
- It's not a mandate. Instead, consumers elect to pay a bit extra to purchase an electronics product they assume is in line with their social and environmental values.
- Fair Trade certification is a grassroots movement. Unlike trade sanctions, tax penalties or elaborate diplomatic talks, fair trade labeling comes from the bottom up — consumers can have an impact, no matter what DC and state politicians say.

Fair Trade awareness has already hit the garment industry, motivating brands such as Timberland and Nike to clean up their supply chains. The pieces needed to put together a watertight Fair Trade Electronics certification are already in place and just need to be organized and pulled into a coherent whole. Many major companies, under growing public pressure, already report their

suppliers. Apple recently has been under fire, and in response, has started to take baby steps in the right direction. Apple's Progress Reports are an effort to document and improve working conditions and pollution problems along its notoriously deadly supply chain.

Wal-Mart, the corporation with one of the largest, most tightly managed global supply chains in the world, is beginning to openly strive to improve its carbon footprint and to accredit and inspect companies that supply its goods. Wal-Mart audits its direct import suppliers; they require all suppliers of private label and non-branded products to provide the name and location of every factory they use to make the products that Wal-Mart sells. In 2010, Wal-Mart reported that it had conducted 8,322 audits on 6,722 of its direct supplier factories.

However, these corporate-provided self-analyses aren't enough. According to the New York Times, self-reporting gets murky when it comes to assessing and reacting to working and environmental conditions in second-tier and third-tier suppliers, or the "supplier's suppliers." A third-party Fair Trade certification organization would do a better job of digging deeper, of inspecting and documenting conditions in the lower-tiered suppliers.

Conclusion

Research and an innovative corporate culture are the first steps in creating new technologies and new industries. However, innovation creates substantial numbers of jobs only after people figure out how to manufacture a product at a cost lower than what people will pay to buy it. Ideally, hefty product profit margins should equal hefty company profits that would result in a well-paid workforce able to live a reasonable middle-class lifestyle. But with clandestine, poorly understood global supply chains, the link

between corporate profits and decent wages is broken, both in the US, and in offshored factories.

Motivating and retaining innovative employees in a bureaucracy

Bureaucracies are tough places to work. A cynical and sluggish work environmental does not attract, motivate and retain high-performing employees. Aside from government agencies, universities are notoriously bureaucratic places to work. Not much attention is paid to the people who manage the university's day-to-day operational details.

I don't mean faculty – they've got it good. Faculty enjoy tenure, freedom to set their own agenda, and advancement opportunities galore. No, where things get tough is for non-executive administrative staff, the 9-ti-5'ers, the unknown soldiers who spend their days hunkered down on the frontlines of the great divide between the university and the rest of the world.

University staff employees don't get much recognition. Professional advancement opportunities inside the university's patent office are limited. If universities want to play effectively in an era of open innovation, they're going to need to learn to attract, keep and inspire the people most allergic to slow-moving, rule bound, dead-end university staff jobs.

During my few years working in a university, I observed that the people who had the most productive capacity were also the ones who suffered most. In my former unit, staff turn-over was astronomical: roughly 60% of staff left in just a few years. This isn't a good thing. In fact, high staff turn-over has been identified as an organizational barrier to improving the current university technology transfer process (Siegel, Waldman and Link, 2003).

Perhaps this is why some employees who dreamed of bigger things and bigger paychecks used their tour of duty inside the

university to springboard into more lucrative and interesting work somewhere outside the university. Tax attorneys and financial analysts do the same thing, when they spend a year or two working for the IRS or the SEC and then enter private practice.

Bureaucratic organizations have their value (they offer tradition and stability). I respect the fact that some productive and intelligent employees prefer the routine and predictability of working in a bureaucracy – there's nothing wrong with punching out at 5 pm to go live your "real life." However, if universities are going to add value to an innovation-based economy, those in management positions need to learn to set up office climates that also attract, retain and motivate the staff that would otherwise seek greener pastures, the staff who are *not* comfortable with a stagnant bureaucratic culture.

Unfortunately, despite the presence of individual university administrators who buck the trend, on the whole, university personnel management structures are slow to change and are stymied by a medieval employee caste system, where non-faculty staff are planted firmly at the bottom. Non-profit organizations are particularly un-incented to learn to motivate employees because the downstream costs of unmotivated employees don't directly hit the bottom line, at least not in the short term.

Another contributing factor was that unlike some corporations where employees review their managers, university administrators are not subject to bottoms-up performance reviews to gauge employee morale. Nor are high absenteeism or high turnover rates – two widely recognized indicators of an under-performing and poorly managed unit — factored into a unit manager's performance review. Of course there are managers of university units that are progressive thinkers and fantastic motivators. But even adept managers can find

it hard to build a productive culture when surrounded by a larger hierarchical, rule-bound organization.

Carrots and sticks are only partially effective

Some university administrators claim that since they're limited in their ability to reward and fire, they can't get the best performance out of their employees. Money or punishments are motivators at work, but it's not as straightforward as you think.

True, bonus pay can be a good motivator. One study found that a few universities (mostly private universities) use bonus pay to motivate their technology transfer staff generate, on average, about 30-40% more income per license.[21] However, these researchers also found that incenting staff with bonus pay had no significant effect on the number of licenses generated, only the income earned per license.

Higher income earned per license might indicate increased employee motivation. However, bonus pay for garnering patent licenses would not be effective for most tech transfer employees given the fact that the vast majority of the day-to-day work in managing a university's intellectual property portfolio does not involve closing deals on revenue-earning licenses. As a result, bonus pay can only go so far in keeping staff motivated the rest of the time. In addition, the majority of public universities are unable to offer performance bonuses.

Other research indicates that the traditional carrot and stick approach is actually less effective for motivating and retaining productive employees in work environments where the nature of the work is non-menial. There's a great video on this topic called "Drive: the Surprising Truth about what motivates us." The video was

created by RSA Animate (their web site has lots of similar videos on interesting topics).

The video summarizes a number of studies on employee motivation and concludes that the greater the sophistication of the work and the worker, the less effective are simplistic carrot and stick management methods. For simple, straightforward tasks that have simple rules and a "right" answer, monetary rewards and punishment work. When a task gets more complicated and requires conceptual and creative thinking (e.g. managing intellectual property), rewards or discipline don't work as well, if at all. As far as the motivating effect of pay goes, the sweet spot is to pay people enough so they don't have to worry about money. After that, intangible rewards become more effective.

According to the RSA video, three intangible factors lead to better performance and personal satisfaction at work.

1. **Autonomy:** Employees want to be self-directed. Traditional notions of management run afoul of this. If a manager wants engaged and productive employees, she needs to hire self-directed employees and then stay out of their way.

2. **Mastery:** people want to get better at things. Employees want to improve their skills, even when there are no direct, short-term rewards for doing so.

3. **Purpose, or making a contribution.** Both employees and organizations need some kind of transcendent purpose. When an organization's sole purpose becomes profit, the work becomes meaningless, "working for the man." When a workplace climate gets foul, employees suffer. Unhappy employees leave, provide poor customer service, have high absenteeism rates and are less willing to go that extra mile.

Intangible rewards are powerful but hard to manage and measure

One of the leading thinkers on human motivation, Frederick Herzberg calls the process of enriching a job "job loading." He describes two ways that managers try to make employee jobs more motivating: horizontal job loading and vertical job loading. Horizontal job loading consists of typical management techniques to "challenge" employees by adding more tasks to their daily routine without adding more autonomy, offering recognition, or providing them input into the process. A good example of horizontal job loading is to give an employee additional responsibility without additional authority, or by closely measuring their work with crude inputs, such tallying up keystrokes or keeping close track of their physical whereabouts. Bureaucratic managers tend to prefer horizontal job loading.

The other way to enrich a job, vertical job loading, seems like chaos when introduced into a traditional top-down centralized organization. Vertical job loading involves removing controls, increasing employee accountability, and giving an employee end-to-end control over a natural unit of work, such as having decision-making authority over an entire product or process. Vertical job loading involves introducing new and more difficult tasks, and assigning individuals specific or specialized tasks so they can become experts. Vertical job loading involves granting employees freedom in their job, and implementing a culture of greater transparency. For example, permitting staff to directly share information amongst one another rather than having a manager filter the information.

Conclusion

Intangible rewards are better motivators when the nature of the work requires skill and creativity. Traditional carrot and stick approaches work in lower-skilled environments, but their benefits taper off as the work becomes more abstract and complex. However, a culture that offers intangible rewards involves loosening the net. Creating a culture that relies on intangible rewards is risky to implement, requires real leadership skill and paying attention to staff needs, and is difficult to measure. Many managers and administrators, particularly those who have made managing bureaucracies their career, are loath to give up the control that would make their employees do their jobs better: autonomy, the ability to learn and grow, and connecting the work to a larger and greater purpose.

What are they guarding? Why people resist change

Have you ever lingered in a colleague's office after a particularly frustrating staff meeting, dissecting your boss's most recent veto of a potentially beneficial innovative new process or product? Did you and your co-worker wonder out loud why the powers-that-be were so resistant to change, even good change? Did you conclude the conversation by saying, "well, I guess we'll just have to tough it out til <insert name of boss or turf-owner of service or product> retires or leaves for another job. Then maybe the next <person or boss> will be more open to new things…"

Why do good organizations and smart people resist change? If you're the would-be innovator trying to change your organization's culture, how can you move beyond frustrated post-mortems and re-adjust how you react to resistance? What do you do about this if you want to bring new ideas to your workplace and have a passion for improvement?

Ironically, in most organizations, advocates of change are not viewed favorably by the people in charge and vice versa. As a result, too frequently, the dialog between change agents and those protecting the status quo breaks down because both sides pigeon-hole one another into simple, negative and convenient stereotypes. Change agents may describe their change-resistance staff and management as "dinosaurs," "incompetent" and "asleep at the wheel." The incumbents fire back and call the innovator "a loose cannon," "clueless," or a "troublemaker."

Both sides may smile publicly and hold endless meetings about the "change process" (if they even get that far), but privately, the conversations are very different. As a result, the proposed idea or pilot program fails. In the worst case scenarios, the change agent

gets branded as disloyal. If the change-resistant boss perceives a charismatic and convincing change agent as a coup-waiting-to-happen, he will do his best to get the innovator out of the way by firing him for poor performance, or for not being a team player.

There's a better way to nudge your cautious organization towards the future. Here's a technique that may help. Next time you unsuccessfully try to convince your conservative, change-resistant boss or co-workers to try a possibly better (but unproven — hence risky) approach, ask yourself this question: "what are they guarding?" This question is a powerful one for two reasons. One, it pulls your mind out of a frustrating situation and two, the question focuses your energy away from a fault-finding and emotional channel into a problem-solving and analytical channel. What are your colleagues and directors guarding when they pay lip service to innovation, yet cling to the outdated and inefficient status quo?

First, just to get it out of the way, we may as well call out the bad stuff that you've probably already suspected and hopefully, kept to yourself. If you assume all change-resisters are motivated by the reasons below, you, the lone ranger, will die alone and the will of the herd will continue to prevail.

The number one bad reason people resist change is because they are protecting themselves. Perhaps the boss or colleagues benefits from the outdated paradigm; changing how things are done puts his or her authority, hence privileges at risk. Or maybe staff already know how to manage the existing process and products and in order to change, would have to master new skills and new ways of thinking. For people who are just going thru the motions til 5pm rolls around, learning new stuff at work is not considered a perk. Some people ferociously protect the status quo because it gives them something – status, access to vital information, or even just simple

physical pleasures such as a nice travel budget or shadowy, out of town meetings that get them out of the tedium of daily office life.

There are indeed people like this scattered throughout every organization, but self-protectors are the minority. While we notice and remember the corrupt, deadwood boss or the icky co-worker more vividly than others (yes, they do exist), smart, hard-working and forward-thinking people may resist change for very good reasons. If you believe everybody who resists change is only protecting themselves, then you'll find yourself stranded without a strategy or a shared goal: the only tool that will be left for you will be to brand the change-resistors as the bad guys and resort to brute force. As the minority, your efforts to push against the tide will be squashed like a wine grape.

While you're at it, check your own motives. Change agents may be brighter than the average bear, but they're not necessarily pure of motive either. How much of what you're pushing for is motivated by your own ego, your desire to make a name for yourself? How much of what you're proposing is genuinely aimed at the greater good?

Innovators and existing organizations must go beyond name calling and political warfare and find a way to rationally explore the value of a proposed new idea. There's actually a good reason why it's not easy. In their recent book, *The Other Side of Innovation*, Dartmouth business school professors Vijat Govindarajan and Chris Trimble conclude that organizations are not designed for innovation, but for ongoing operation. Govindarajan and Trimple refer to an organization's ongoing operation as the "Performance Engine." Smart, hardworking business-savvy reasons people may be resisting your innovative idea, not because they are protecting themselves, but because they are guarding their organization's Performance Engine.

When you view resistance to change in the context of guarding the Performance Engine and apply it to your workplace, your boss's resistance begins to look different and maybe even solvable. If someone is protecting her organization's profitable, and thus far effective, business model, while she may not articulate it in those terms, when she resists change, she is guarding her and your company's Performance Engine.

Here's why responsible and intelligent people protect the status quo, or the Performance Engine:

Risk: Stakeholders such as shareholders or high-level university administrators want reliable results; change puts productivity and efficiency at risk

Performance pressures: Middle managers are evaluated on rigid performance targets; they can't request new targets. If a change lowers their perceived performance, their units will be at risk

Operational efficiency relies on repeatability and predictability. If a change agent tries to sell her idea that it "breaks all the rules," people responsible for things running smoothly will do whatever they can to crush the new process or product

The innovator's job is not to push their colleagues into new terrain against their will, but to first deeply understand what they're protecting, and then figure out how to sell the innovation to them as an extension of what they already do well. Next time you see a good idea being shot down, ask yourself what the nay-sayers are guarding. Once you get down to facts, profits, pressures and other tangible realities, you have a small opening in which to insert your proposed idea.

Innovation happens when the innovator and the incumbents stop squaring off and instead, agree that they will together protect the performance engine while they incubate the great new idea from imagination to implementation. Next time you pitch an innovative idea that will make your organization more effective, help your boss and co-workers see how your idea will enhance the Performance Engine. Start small, don't say your idea is going to "break all the rules." If your colleagues are going to assume some risk in order to test-drive your idea, make sure you make it clear to them that they, too, will share the glory if things go well.

Why smartfailing will improve university innovation strategy

Author Stefan Lindegaard uses a term called "smartfailing" to describe a new approach to failure. Smartfailing is failure with a new, positive twist: when things go wrong (as they frequently will), a smartfailing organization does not focus its energy on assigning blame and doling out consequences. Instead, the smartfailing organization uses failure to become better. When an organization embraces smartfailing, it de-stigmatizes failure internally and uses failure as an opportunity to learn and to find a better course.

I recently thumbed through an old issue of the *Harvard Business Review* whose theme for that month's issue was how to learn from failure. Article after article penned by consultants and corporate executives stressed that failure was no longer a dirty word, that wise companies are learning to view failure as something to be understood and learned from rather than punished or suppressed.

If hardnosed corporations are learning to learn from failure, why not universities? It seems that universities should be even more comfortable with the idea that failure is a learning opportunity. After all, U.S. research universities are under less short-term pressure to make a profit. At least in theory, universities seem like natural smartfailers since university culture celebrates open-ended basic scientific inquiry and academic freedom. Yet, in my experience, many university work environments are not yet ready to embrace smartfailing.

A good starting place to launch a smartfailing university culture would be inside the business unit that manages the university's patent portfolio, aka the technology transfer unit. Given the endless

public debates on improving the commercial uptake of innovative university research, in a perfect world, right now, the university technology transfer unit would already be a hotbed of courageous and well-supported smartfailing. With some no doubt inspiring exceptions that I would love to hear about, the culture inside many university technology transfer business units is not yet failure-friendly.

By this I do not mean that internal and external stakeholders do not perceive that failure is taking place. Nor is it because the technology transfer staff aren't ready to learn from their mistakes — they are. Instead, resistance to smartfailing appears to be the product of several converging forces at play in the university's cultural climate that when combined, make people reluctant to admit to failure. For example:

- research universities invite the risk of burdening themselves with an unclear and unrealistically broad tech transfer mission that invites a disproportionate amount of sub-optimal results, creating pressure on staff and administrators to downplay negative outcomes lest they overshadow the wins
- a hierarchical, slow-moving non-profit environment where people with long memories entrench themselves in a single technology commercialization paradigm and stay for years in the same jobs
- since staff and senior staff lack firm and objective performance measurements, under-performing "spin doctor" types are able to stay in their posts far longer than they should.
- as is typical of bureaucratic and old-fashioned organizational culture, admitting failure is perceived as equal to admitting fault

Creating a psychologically safe environment for failure

University administrators should begin by inviting their technology transfer staff to fail smarter. Creating an organizational

culture where smartfailing can flourish relies on the powers-that-be establishing what's called a "psychologically safe environment." Amy Edmondson, in a *Harvard Business Review* article entitled "Learning from Failure," describes the steps that leaders can take to reinforce a culture that "counteracts the blame game and makes people feel both comfortable with and responsible for surfacing and learning from failure."[22] Edmondson lays out a spectrum of reasons for failure, ranging from the not good (or "blameworthy") to the appropriate ("praiseworthy").

According to Edmonson's spectrum, poor reasons for failure are the ones we are already all-too-familiar with: individual deviance, inattention to the job, and individual lack of ability. However, heading towards the praiseworthy end of the spectrum, we encounter better reasons for failure: task challenges, process breakdown, insufficient clarity about future events, hypothesis and exploratory testing. It's too easy to follow up a failure by blaming the individual. Viewing failure from a systemic perspective would help us build the foundation for a better, more up-to-date university technology commercialization business model.

Like any business, sometimes outcomes in the world of a university technology transfer unit don't go as well as they could. A typical failure point in the process of getting a university invention into practical use is during license negotiations, when the involved company decides it doesn't like the university's licensing terms and fees (what Edmondson deems process breakdown). Next time a lucrative deal fell apart at the negotiating table, a smartfailing tech transfer unit would resist the urge to dismiss the company's contractual demands as unreasonable. Instead, staff would ask themselves whether their university's patent licensing process is as

streamlined as possible, and whether the university's licensing and royalty fees are appropriately priced.

Another constant challenge faced by tech transfer staff is the struggle to describe university inventions in business-oriented terms that will spark industry interest (what Edmondson deems a "task challenge"). A smartfailing approach would set aside habitual layers of denial and encourage tech transfer staff to test out alternative marketing techniques. A related challenge that could benefit from organizationally supported smartfailing would be on-campus outreach: why won't university inventors attend technology transfer educational events or submit more of their inventions for commercialization? What would incent faculty to take a more active role in finding industrial applications for their inventions?

Finally, the process of assessing the commercial value of an early-stage but promising university invention remains a black art (or represents a situation where there's insufficient clarity about future events). A smartfailing person would ask herself "do the patents that cost a lot of money but never got licensed have anything in common?"

First steps towards failing smarter

It's too easy to blame the individual technology transfer staff when the real culprits are deeper, systemic challenges. When I worked in a tech transfer unit, I saw how vulnerable front-line staff were when carrying out an under-performing technology transfer strategy: to irate stakeholders, frequently the easiest target for criticism tends to be the tech transfer staff. Blaming individuals for systemic failure is not fair and it focuses energy on the wrong end of Edmondson's spectrum.

In an ideal world, critical stakeholders would also adopt a smartfailing attitude. After a disappointing experience, enlightened stakeholders would challenge themselves to look deeper, past the skill levels of the individuals involved. Smartfailing critics would ask themselves whether it's possible the failure lies in the underlying business strategy of their technology transfer office. Systemic failure is still a formidable challenge but at least any resulting post mortem discussion is elevated from simple finger-pointing to discussing strategy.

A devastating form of finger pointing can take place within an organization. In interviews with executives, Amy Edmondson learned that in most cases, they blamed a failure on an individual employee's incompetence. However, when asked to think again, interviewed executives admitted that the majority of failure they had witnessed in the past was actually not due to individual actions but to strategic and environmental causes.

In a university work environment, goals are vague, success is hard to quantify and the culture embraces tradition rather than change; therefore, untangling the individual from the underlying infrastructure takes extra thought and compassion. In my experience, regardless of type of organization, the majority of failure stems from underlying barriers: management emphasis on inappropriate or unattainable goals, a shortage of resources, lack of incentives and so on.

Don't shoot the messenger

Like any senior decision makers, university administrators need to learn to "look under the hood" and ask themselves some uncomfortable questions. Might they be inadvertently putting pressure on their staff to under-report failure in order to

manufacture the perception of success? I call this "The Reporting Shell Game." Surface value tells you nothing. People who set strategy must question the carefully orchestrated updates they may likely receive from their technology transfer office.

Ina smartfailing organization, the boss makes it clear she wants to hear the whole story, warts and all. Otherwise, she'll continue to receive incomplete, scrubbed information designed to present the perception that things are going great, even when they're not. The Reporting Shell Game prolongs the pitiful life of a failing business strategy.

To eradicate the Reporting Shell Games, one important aspect that seems to be frequently overlook is that higher-ups must be prepared to protect honest employees from negative consequences if they tell the truth, and share negative performance metrics or when they report failure. University leaders must reward honest employees report real results. Defenders of the current system need to become comfortable in discussing alternatives.

De Nile is a river in Egypt, the old joke goes. Denial is the coin of the realm in organizations that hid their own failures internally. If you listen to a public (or private) discussion about our university tech transfer system in which real problems are raised, you'll hear a typical response from people with a stake in the current, incumbent system. Their answer to hard questions? That their questioner "does understand what the tech transfer office is trying to do."

Dismissing critical questions as the product of ignorance is not failing smart. Instead, it demeans the questioner and shuts down exploration of potentially valid and valuable alternative methods to get things done. Assuming that stakeholders who question the current process simply don't know anything about university

technology commercialization keeps things frozen in place for that much longer.

Get comfortable with change, especially in arenas transformed by the Internet

In general, smartfailing enables staff to adapt to changing conditions more quickly so they can do their jobs better. Consider what happens when failing smarter is not applied to outreach and marketing strategies. Some university technology transfer units continue to spend the bulk of their marketing budget on hosting in-person events aimed at attracting venture capital or fostering networking. Or, a so-called technology "marketing campaign" consists of sending blind form-letter emails with an attached pdf describing the invention's technical specifications.

In my experience, the percentage of licensing deals that arise from events or blind email blasts is in the low single digits, if at all. Events don't scale and the key players don't have time to come. Blind emails get tangled in the spam filter and are never read. Marketing is a fast-moving field and global online marketing channels are scalable, cheap and abundant. However, staff need permission to fail smarter and make mistakes in order to master contemporary marketing tactics.

Don't bet on the "Porsche effect" to get faculty involved in commercializing their inventions

A common complaint amongst technology transfer administrators is that university scientists aren't interested in helping them find companies to license their invention. If a unit is not failing smart, it fails to deeply consider the implications of the fact that perhaps faculty goals and priorities are not aligned towards taking their research to the commercial marketplace. When

smartfailing is applied, the solution for getting faculty involved turns hopefully towards "the Porsche effect."

The thinking behind the Porsche effect goes like this: faculty haven't yet seen any of their colleagues strike it rich. If just one university scientist gets rich from a patent, then their colleagues would stampede the tech transfer office and staff would never struggle to attract faculty mindshare again. It's counterintuitive, but the Porsche effect is a blame game. Smartfailing would unearth the fact that it's not a matter of attracting the interest of individual faculty (e.g. it's not individual failure), instead it's more subtle: it's a matter of overcoming mis-aligned incentives.

Explore alternative ways to share university inventions with companies

Right now, the formal university technology transfer process is heavily focused on obtaining patents and then licensing those patents to a company. However, perhaps there are better ways to get university inventions into play. Commercial licenses certainly have their place, but what happens when a promising licensing deal falls apart? Companies walk away from a patent license for a number of reasons.

In the blame game, the university side perceives the companies to be greedy or unrealistic, while the company side feels the university is too focused on protecting its own interests rather than compromising to make a deal. The faculty is tempted to blame the university staff member in charge of the deal. Ideally, universities should have periodic, blame-free post-mortems on failed licensing deals. Hospitals do it when things go wrong. Why not the university technology transfer office?

Let university faculty and staff tinker with new ways to get things done

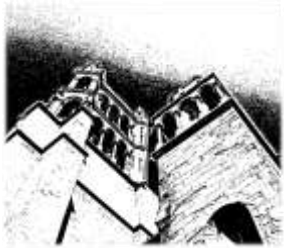
If a motivated staff member is willing to collect data on failed license deals or other types of failures, why not let that staff member put together a proposal for a small-scale pilot to try a new approach? Small-scale pilots cost staff time, but the pay-off in learning and hopefully a new best practice could be significant. Perhaps most importantly, encouraging a fact-based and rational approach to seeking alternative strategies makes the job more interesting and steers staff energy in a positive direction.

Significant failures deserves to be treated as learning opportunities, not as the reason for unleashing blame and negative consequences on those involved. Amy Edmondson wraps up her *Harvard Business Review* article with this:

> *"The courage to confront our own and others' imperfections is crucial to solving the apparent contradictions of wanting to neither discourage the reporting of problems nor to create an environment in which anything goes. This means that managers must ask employees to be brave and speak up — and must not respond by expressing anger or strong disapproval of what may at first appear to be incompetence. More often than we realize, complex systems are at work behind organizational failures, and their lessons and improvement opportunities are lost when conversation is stifled."*

The beauty of learning to fail smarter is that failure is already taking place. The lessons are already there, waiting for intelligent interpretation. Failing smarter means spending less energy putting lipstick on the pig, and putting more energy into finding better ways to get things done.

Some closing thoughts



Myth, myth! University intellectual property strategy and the fine art of storytelling

In closing, I'd like to leave you with a quick guide to most common myths about university technology commercialization. Cultures use myths to make sense of their reality. Cultures use myths to justify the way things are.

A myth is a cousin to another cultural phenomenon, a method of passing knowledge from generation to generation: the oral tradition. My father was a translator of Estonian folk tales and poetry, which are passed down from generation to generation via the oral tradition. Folklorists define an oral tradition as verbal messages that are passed from generation to generation but are never written down, nor validated against a written, originating source.

Interpretations of the Bayh Dole Act are passed along in the oral tradition. How many times have you heard a person justify their stance by claiming that whatever rule they're defending is federal law as per the Bay Dole Act? Same for many university IP policies. The oral tradition is a rich and important medium to pass along a culture's values and myths, but it's not the right channel to pass along interpretations of IP-related federal laws and regulations.

Both myths and the oral tradition are valuable methods that help a culture to sustain and define itself. However, if you're seeking different points of view, or if the myths and stories you're hearing don't ring true, then some myth-busting is in order.

One effective tool to help you untangle enduring myths and draw your own conclusions is data. In the final few pages of this book, I'd like to leave you with a list of the most common tech transfer myths, as well as some accompanying datapoints that disprove the myth.

Myth 1: Before Bayh-Dole, university research was mostly theoretical with little relevance to industry problems, therefore had little impact on industry

In the United States, engineering colleges, agriculture programs and medical schools were created to train people for practical work. In fact, U.S. universities, the government and industry have been in close collaboration for more than 150 years.

- The Morrill Acts of 1862 and 1890 created land grant universities whose mission was to educate and further the body of knowledge in fields such as agriculture and the "mechanic arts." As need developed for engineers, computer scientists and doctors, universities such as West Point (1802), RPI (1824), and MIT (1865) were founded. Yale set up courses in mechanical engineering as early as 1863 and Columbia University created a School of Mines in 1864.[23]
- In 1912, Berkeley scientist Frederick Cottrell found The Research Corporation, a non-profit third party agent to patent and license his and other university inventions. In 1937, MIT signed an "invention administration agreement"

with the Research Corporation to manage MIT's technologies. In the 1940s and 1950s, other universities followed.[24]

Following World War II, the federal government gave universities money for R&D with the condition that the benefits of research be diffused widely throughout society and the economy. This investment laid the foundations of the development of world-changing technologies such as lasers, GPS and fiber optic communications.[25]

Other early inventions based on university technologies include the Pap Smear (1939), vacuum tubes (1940s), the polio vaccine (1955), the pacemaker (1958), the seat belt (1963), and the LCD display (1967).[26]

Myth 2: Patenting university research aids innovation since companies will only invest in product development of a patented technology

Patents are most relevant in the biotech industry. Other industries rely more heavily on trade secrets, service models and first mover advantage.

- While many consider patents a "gold standard" in IP protection, of 2,849 firms that performed research and development, the most effective protector of competitive advantages was lead-time (50%), followed by secrecy (18%), complexity of the product/service being developed (17%) and finally, patents (10%).[27]
- A survey of technology transfer officers at major universities discovered that university research tends to be "embryonic."

48% of university inventions are "proofs of concept" at the time of licensing and only 12% "ready for use," indicating that a substantial amount of university research is licensed without being patented.[28]

- In fact, companies and university researchers state that patenting building block technologies such as nanotechnology and biotechnology may eventually have a negative effect on these high-growth industries. Since products in these fields tend to be cobbled together out of many small pieces, paying many different license fees to different universities may make the project economically untenable to small companies. [29] (universities own more than two-thirds of nanotechnology patents and 18% of new patents in biotechnology).[30]

Myth 3: Patents and licenses are the most critical channel in connecting innovative university research and ideas to the commercial marketplace

Patents are by no means the only way to motivate innovation, nor is a license always the best way to boost an early stage invention into commercial use. Patents and licenses are actually the smallest channel between university researchers and the rest of the world. A great deal of effort and discussion is devoted to the patent/license channel, perhaps because it's the most concrete and leaves the most trackable paper trail.

- Most university research generates not patents, but what could be called "research tools," for example, new test platforms, materials, data and novel processes that are not going to be patented or licensed.

- University scientists make the largest impact on university and industry colleagues by sharing information in publications and conferences, work exchanges and consulting and student graduation. Patents and licenses are a trivial channel in comparison, transferring less than 10% of university research and ideas to companies.[31]
- Not all patents are created equal. Patents in the biotech and pharmaceutical industries are perceived by some observers as having higher value since they are easier to defend. [32] Conversely, in electronics, software, and engineering, the significance of university patents in terms of facilitating technology transfer is considered dubious.[33]
- Patents may actually have a blocking effect to sharing scientific information. Of 210 life-sciences companies surveyed, 82% of them required academic researchers to keep information confidential long enough to file for a patent application.[34]

Myth 4: Universities and university scientists can make a lot of money by patenting and licensing their inventions to industry

The majority of faculty and student inventors are savvy enough to understand how slim their odds are of actually making a significant amount of money from an industry license or a startup. University administrators mistakenly believe that a profit motive will incent otherwise uninterested researchers in paying more attention to the university's tech transfer efforts. It's not necessarily a bad thing, but profit is unlikely: all but the top 8-10 tech transfer offices spend more money than they earn.

- Faculty do not typically make money off of their commercialization efforts. Since most inventions yield less than $10,000 in gross royalties per year, few faculty inventors realize any significant gains from what's left of the 33% revenue share after they pay back the cost of patent prosecution. If there are co-inventors, that money must be further divided.[35]
- For untenured faculty, advancement and tenure depend on choosing impactful research problems and disclosing research results openly and quickly;[36] at most universities, having patents and commercially licensed inventions is not a major factor in determining tenure and aiding career advancement.
- Most universities lose money practicing "technology commercialization," spending more on processing patents and paying staff salaries than they earn from license revenue.[37]
- Almost 75% of universities with technology transfer operations pay more to cover the costs of procuring patents and run their office operations than they earn in revenue. Approximately 15% barely break even, re-couping less than 4% of university research expenditures.[38]
- For example, at the University of California, of the 973 new discoveries received in 2002, only 5% were be licensed and most of these failed to reach the market.[39]
- Yet, despite the "lotto ticket" nature of earning a lot of money from licensing university inventions, a sample of 128 university technology transfer office mission statements revealed that they mentioned licensing for royalties 78% of

the time and intellectual property protection and management 75% of the time. Studied mission statements mentioned the public good 54% of the time.[40]

Myth 5: University scientists are inexperienced in dealing with industry; university scientists are not aware of the problems that their industry counterparts are trying to solve

Several research studies have demonstrated that it's the inventor who has the best sense of what sort of industry problem their invention would address.

- The majority of licensing deals are brought to the technology transfer office by the faculty member, not the other way around. An estimated 60% of licensing deals arise from contacts provided by faculty to technology transfer staff. [41]
- 76 surveyed firms in the fields of information processing, electrical equipment and instruments, drug, metal, and oil firms estimated that academic research sped up their product development process. Their estimate was that 10% of new products and processes would have been delayed a year or more if they had not had access to basic academic research conducted within the prior 15 years. [42]
- A survey of scientists found that 65% of university researchers reported that interaction with industry has influenced their university research. [43]
- Since most university research is very early stage, if they choose to be, inventors can be a critical part of a company's interest and strategy in licensing that invention for product development.[44]

Myth 6: IP clauses in sponsored research contracts and in multi-organizational research collaborations encourage industry participation since they protect everyone's interests

- Companies surveyed mention that the most common obstacles to university-industry relations are university bureaucracies that make it too complicated to conclude an agreement, and 34% of companies report having disputes with their academic partners over IP.[45]
- Many companies report disproportionately lengthy negotiations to license basic research tools such as biological materials and data.[46]
- Some industries rely less on patents; in these cases, IP clauses insert unnecessary complication. For example, semiconductor, hardware and software industries move faster and have short product cycles so patents quickly become obsolete. Companies in these industries rely on first-mover advantage, trade secrets and product tie-ins.[47]

Myth 7: University scientists who patent their technologies will publish less; the presence of patents on research data may deter university scientists from using the technology or material in further research

- The annual number of publications for a faculty member is actually higher following application for a successful patent, controlling for field, year, and time profile of publications by matched non-inventors. [48]

- The more citations a scientist enjoys, the more patents they tend to have, suggesting that highly productive scientists generate high impact research that's both frequently cited and patented. [49]
- In a survey of 414 biomedical researchers in universities, government, and nonprofit institutions, academic bench scientists do not currently pay much attention to others' patents. Only 5% regularly check for patents on knowledge inputs related to their research. Of 381 academic scientists, even including the 10% who claimed to be doing drug development or related downstream work, none were stopped by the existence of third-party patents, and even modifications or delays were rare. [50]
- The existing empirical studies that attempt to uncover the relationship between academic patenting and publishing activities present contradictory pictures. Several surveys of academic researchers document secrecy, delay of publication, and re-focusing of research activities that are brought about by patenting and commercialization activities. [51]
- Interestingly, scientific competition is a bigger barrier to sharing data. Over a 1-year period, an average of one in six respondents reported that delays in receiving materials from other academics not because of patent complications, but because other researcher did not want to share the material.[52]

Why should anyone care about an arcane corner of the world called "university technology transfer?" Because public investment

in university research - like public investments in road systems, public schools and the Internet - keep us moving forward. Unexamined, centrally-dictated, "one size fits most" university technology transfer strategies affect all of us if their use chokes the vitality of an ecosystem that's been productive and intensely innovative.

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