

Looking for Love (In All the Wrong Places)¹

An Essay on Technology Transfer

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Universities and National Laboratories have, for rather different reasons, become enthusiastic about exporting their discoveries to the world at large. Neither type of institution has been very successful at it, even though both have spent a great deal of money and have engaged some very talented people in the effort. As a latecomer to this effort and a survivor of some attempts, successful and unsuccessful, to accomplish such transfers, I've been trying to learn what others are doing so that I can understand their failures.

This effort came to a climax one Saturday in January, 1999 when I attended a symposium on university technology transfer at the annual convention of the American Association for the Advancement of Science (AAAS) in Anaheim, California. The panel was stunning: it included university presidents, gifted scientists and engineers from first-tier universities, and a Nobel laureate. "Surely," I said to myself, "I'll be enlightened."

After sitting through two-thirds of the session, I had to leave: the things I was hearing differed so much from my own experience that I had a mental dislocation: I had to go home and think about it, and try to understand why their perception differed so much from my reality.

It probably would help if I list my own beliefs first, and explain them as I go along:

Technology is Worthless

Well, almost worthless. An idea, or even an invention that has been demonstrated to work, is like the product of an in-vitro fertilization. It takes a lot of imagination to peer into the Petri dish and say, "What a nifty kid!" knowing very well that one has to find some poor woman to haul the thing around for nine months, then nurse it and change its diapers for a couple of years. And then she gets blamed for all its shortcomings, and receives scant praise for its success. After all this, it still needs a father, and a series of schools, an employer, and all of the other considerable infrastructure that turns a child into a useful adult. This process takes dedicated, competent people and a ton of money. And it doesn't always work: the proportion of people who turn into truly admirable human beings is small.

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Similarly, with a couple of exceptions I'll discuss below, the "mother" and most of the infrastructure to make a good idea into a good product simply doesn't exist: it has to be created anew for each idea. And like good families, companies, once created, can nurture only a few products: for the family or the company to survive, it must at some point begin to stop having new "children," no matter how pretty or smart they might turn out to be, to avoid damaging the ones it already has.

Universities Have a Problem, and It's Going to Get Worse

Responsible universities do research, and research costs money. Some of the money comes from industry, but that money usually comes with a prescription for its use: industry rarely funds the research that the university's faculty believes is important. Government money is less restricted, but people who approve grants are often not comfortable with the weirdness and apparent uselessness of really important research when it's first conceived. Money for leading-edge research comes from cross-subsidies from undergraduate programs and from cross-subsidies from paid research programs, and that's hard to do anymore. There are two reasons:

Undergraduate education has become competitive. As an ABET committee member, I visited an accredited for-profit engineering college which must remain nameless. I expected to find a diploma mill. What I found was a college that provides an excellent education, has competent, dedicated teachers who dress and act like professionals, treats its students very well (comfortable chairs! nice desks! lots of test equipment! professors with daily, scheduled office hours!), and which seeks student and industry comment and guidance at every opportunity. Employers gobble up their graduates as soon as they get their degrees.

All of that college's revenue comes from tuitions. The tuition for a four-year electrical engineering degree in 1998 was \$25,000. The cost of educating an electrical engineer at a traditional university (regardless of who pays) was about \$25,000 *per year*. Four times as much. And oh, yes, the for-profit university does make a profit.

As a Trustee of a traditional university, I was told that there are many advantages to campus life that aren't available to the for-profit student, (I wouldn't know: I held down a full-time job while in college), but I doubt if they're worth four times the money. And undergraduates who intend to go to work upon graduation do not get much benefit from the research activity at their university, so it's hard to argue that they should support it. Regardless of who pays, parents, State, or benevolent alumni, there is serious pressure to reduce undergraduate costs. The alternative is privatization of second-tier State systems, and eventually some of the first-tier State schools.

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Accountability has arrived in Academe. Both government agencies and industries know that universities cross-subsidize their pet research projects out of paid research programs. Because competition among universities for research funds is heating up, agencies and industries feel free to shop around. The terms of negotiations for paid research now include requirements for audited financial reporting, showing where the money goes.

It's hard to do research without money, so universities have decided to sell or license their technology to solve the problem.

Royalty-Based Research Funding Skews the Whole Institution

There are only two industries that accept "ungestated" ideas. They are the film industry, with independent agents and studios who organize on a moment's notice to turn a new novel into a movie, and the pharmaceutical industry, with its army of chemists, physicians and regulatory lawyers looking for new things to try. Each of these industries creates an ad-hoc "company" for each product, sharing some resources and management from the parent organization.

Universities and laboratories haven't yet been able to capture the work of their English professors, but they recognize the drug opportunity very well, and are expanding their biochemical efforts apace. This kind of expansion often steals resources, and always takes administrative mindshare away from other areas of research. Ultimately, it influences the whole structure of the university. The danger, of course, is that the university, having become dependent on this source of revenue, will become a virtual subsidiary of the funding companies and eventually lose its independence and its breadth.

One could argue that this already happened in the physical sciences during the Cold War, and that the villains of that piece are finally getting their comeuppance, but that's well beyond the scope of this essay.

Royalties Aren't Going to Come From Big Companies

In the AAAS symposium mentioned above, the panel noted that, except for pharmaceuticals, royalty schemes had pretty much been failures. They noted that from all universities, only 3000 or so licenses are negotiated every year; and at the "top universities," license revenue amounts to only 2% of their research budget. They then bemoaned the fact that, "...over 50% of licenses are to small or startup companies....," adding that startup companies are 10% of the overall total. The reason they don't like this, of course, is that the grantor of the license bears the risk that the small or startup company will fail, and they'll have to do it all over again. Their consensus was that small companies are undesirable licensees, and that they need to do something to get the attention of large, mature companies with big bank accounts. This will not happen.

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Mature Companies Are Terrified of New Ideas. Once upon a time, I was Technical Director of a large subsidiary of a huge multinational. One of my chores was to frustrate anyone with an idea. It worked this way: some nice person would write a letter to the company suggesting a product improvement or new product ("Why not make a cordless telephone?" — that kind of stuff). Such letters got routed to me.

I was instructed as follows: When I started to read any letter, as soon I thought it might contain an unsolicited idea, I was to fold the bottom of the letter up to the last line I'd read and staple the whole thing together. I would then attach a note saying, "This letter appears to contain an unsolicited idea, and I didn't read any further than the stapled edge," and hand it to my secretary, who would seal it in an envelope in my presence and forward it to the Legal Department. A lawyer would then send the submitter a completely unacceptable agreement to sign, in which the submitter waived all rights, both to compensation and to the idea itself. As far as I know, nobody was ever dumb enough to sign it.

Their excuse was fear of lawsuits, and lawsuits certainly happen, but the real reason was that new ideas take too much love away from the other "children." In addition, they undermine existing organizations, and thus threaten careers. Except in films and pharmaceuticals, structured so that single-purpose parallel organizations are set up to exploit individual ideas and live or die as separate entities, a new idea from outside a mature organization is unlikely to be adopted. If it has the support of an enlightened top management, it has a chance, but even then it's likely to be undermined or changed beyond recognition by the embedded organization. If a mature company isn't desperate (that is, potentially insolvent), it won't accept product ideas from outside sources.

Small Companies, Especially Startups, Are the Right Way to Exploit New Technology

A startup, or a small company that has a good stock option plan, is the appropriate entity to accept and exploit a new idea or technological advance. First, the company can give the appropriate amount of love and attention to the new effort. There are no, or very few, other products in the company.

More important, small and startup companies with rational stock option plans do not suffer from the Agency Dilemma, in which a manager has to choose between his own career and the good of the company. What's good for the company is good for the manager, and a couple of minutes on a pocket calculator is all it takes for the manager to renew his religion. His career is the company, not his job, and it doesn't matter whether he has a big department or not: he's going to get rich and famous if the company succeeds, and he's going to be poor and unemployed if it doesn't. If the idea is a good idea, the organization will make it work. And the funding risk, so terrifying to the licensor, is only the risk that the technology isn't very good and someone else is doing the same thing better. There's plenty of money out there, and a company with good management and good technology can attract it easily. There is, in fact, a reasonably

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efficient market for venture capital. And, as a bonus, the investors always make sure the management is good: they change it in an instant if it isn't.

Universities and Laboratories sometimes subscribe to the conventional wisdom that small and startup companies are extremely risky. This is because they fail a lot; most of mine did. However, a *product* has more chance of succeeding in a small-company environment than a large company. Even though small companies fail more often than large companies, *products* fail more often in large companies. They don't get as much individual attention, they have internal enemies, they have to compete for resources, and the new products don't get the best people. They get the people who are willing to risk their reputations without a large offsetting gain, and who are therefore either silly, incompetent, or hopelessly idealistic.

Note the distinction between "small companies" and "startup companies." Startups are not necessarily small.

Poor Emerson! He Wished He'd Never Said It

If a man can write a better book, preach a better sermon, or make a better mouse-trap, than his neighbor, though he build his house in the woods, the world will make a beaten path to his door.

-- Ascribed to Ralph Waldo Emerson by Sarah Yule, in *Borrowings*.

Actually, unless he didn't understand what his agent did for a living, Emerson was smarter than that. He later denied he'd ever said it, and it isn't in newly-published books of quotations. Unfortunately, it was well-said, and thus it's hard to get rid of. One of the participants in the AAAS seminar said, to my slack-jawed amazement, "If an idea is really good, someone will see that it's really good, and will pick it up."

That hasn't been my experience, and it certainly hasn't been the experience of NASA, who cannot be said to be short of good ideas. For years, NASA published a magazine full of its new ideas, trying to give them away. Some of those ideas were pretty darn good. NASA's terms were eminently reasonable. NASA was really, honestly eager for people to use them, and would bend over backwards to help. I don't even want to talk about the 200 or so people who call me up every year, saying they've got a good, valid patent on a good idea, and whining that nobody will talk to them. I'll talk to them, 'cause I'm a nice guy, but I can't help them. I've got ideas, you've got ideas, and maybe ten percent of those ideas are good ideas. All God's chillun' got ideas. Ideas are not the problem.

- **The problem is to find someone who will dedicate five to ten years of his or her life to making the idea happen.**

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Now It's Show Time

You've been very patient; largely, I think, because you knew that sooner or later I was going to have to tell you how to fix the problem, and thereby make an utter fool of myself. That time is now. First, some articles of faith:

- People who are good at managing companies are often not very creative, but they know their craft, which is managing, very well. They are not usually good at coming up with product ideas, but they are intuitive, and they know a good one when they see it.
- People who come up with good product ideas are usually not very good at managing companies, though the prevailing mythology is that it's a piece of cake. One of the chores of venture investing is convincing them that it isn't.
- People who try to do something with somebody else's ideas generally don't do a very good job of it. Therefore the inventor, and some of his or her staff, has to join the company that exploits their work.
- There is a lot of money out there looking for companies to be invested in, but the company has to have taken recognizable form before money managers will touch it.
- Professors, though they like to be part-time Presidents of companies, generally don't know anything about it, don't have time to do it, and make a mess of the job (unless, of course, they're business-school professors, in which case they have better sense than to try).
- Top management jobs in growing companies are moving targets. By the time an inexperienced manager learns her job, it has changed, and she has to learn it all over again. Therefore a CEO for a startup has to have experience running an organization as large as the startup is expected to be.
- Capital does not follow technology. Capital follows managers.

Given those axioms, the way to propagate ideas is therefore to do these things:

1. Find some competent managers.
2. Show them your technology and your inventors.
3. Pay the managers while they make a business plan for a Company.
4. Have them show the plan to venture capitalists.
5. Give them time to get to know each other.

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6. If they all fall in love, encourage them to get married. This means, simultaneously:
 - a. They form a Company, with the VC's money and the entrepreneur as CEO,
 - b. The inventor leaves, permanently, forsaking all others, and goes to the Company.
 - c. The Company licenses the technology, and gives some warrants to boot.
 - d. And, maybe, everybody makes a lot of money and lives happily ever after.

The university or Laboratory gets money two ways: it gets a royalty when the Company's revenue begins, and it gets some warrants or other equity in the Company. That way, if the Company is a huge success, the university or Laboratory makes a lot of money, but it doesn't burden the Company with big cash payments in its formative years.

This will work, and a little analysis will show that it will work a lot better than shopping among mature companies for licensees. It will work because it has these advantages:

- Making the product a success is life or death to the Company.
- The product doesn't get buried or suffer from benign neglect.
- If things don't work out, there's a clean event that returns the technology to its origin (Oops!).
- The universities and Laboratories get to deal with bright, young people right out on the cutting edge.
- Return is exactly related to the success of the technology. It's hard to cook the books in a startup.

Using competent managers avoids the incubator step, in which inexperienced managers attempt to learn their trade. Getting rid of incubators shortens time to market, and dramatically improves the Company's chance of success.

The crucial part of the process is finding the competent managers and keeping them around while they plan and form Companies. I submit that the university or Laboratory does this by setting up a staff department which employs, for short periods, people who have been experienced CEOs or Division managers. Their job is to work with inventors within the university or Laboratory to plan new ventures, attract capital, and leave, with the inventor, to operate the new Company.

If we can do enough of this, and do it well, we'll make the world a better place.