CORPORATE FINANCE INC.

White Paper

CFI is a steadfast advocate of entrepreneurs and small business enterprise. We believe society's well being is, in large part, the product of entrepreneurship and that every citizen should care about creating an economic and social environment in which emerging ideas can flourish. CFI encourages research and analysis of issues about entrepreneurship and helps disseminate the ensuing White Papers – including many published by senior management of CFI portfolio companies.

Intellectual Property's Disruptive Niche

Merle Coe, CEO, Cash & Carry America

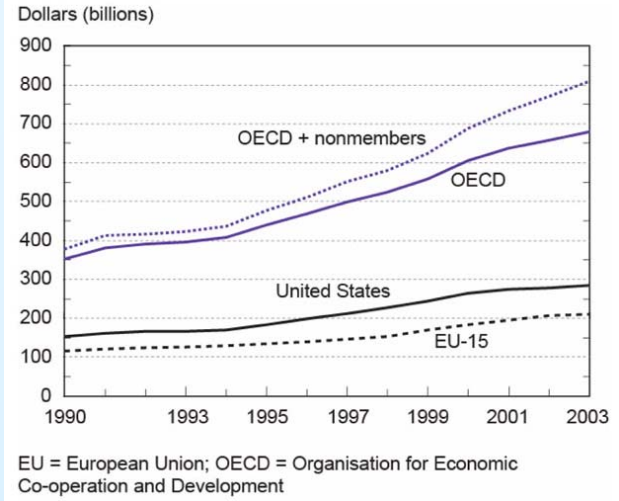
Googling for "tech transfer" yields more than 600,000 hits. Deeper digging bares an intriguing jumble of Intellectual Property representing a multitude of IP categories, potential applications, sources, and interests. Here and there, articles about research and IP expenditures, trends, and efficacy are referenced.

Many have speculated there is profit to be made by bringing order to the disorder that characterizes US research and its fruits. How IP is commercialized, and by whom, has enormous consequences for America. This paper identifies certain national policies that both facilitate and hinder commercialization. It also describes a niche within the overall "R&D/IP Market" and posits that the niche is more suited to commercialization by small companies and entrepreneurs than by traditional enterprises.

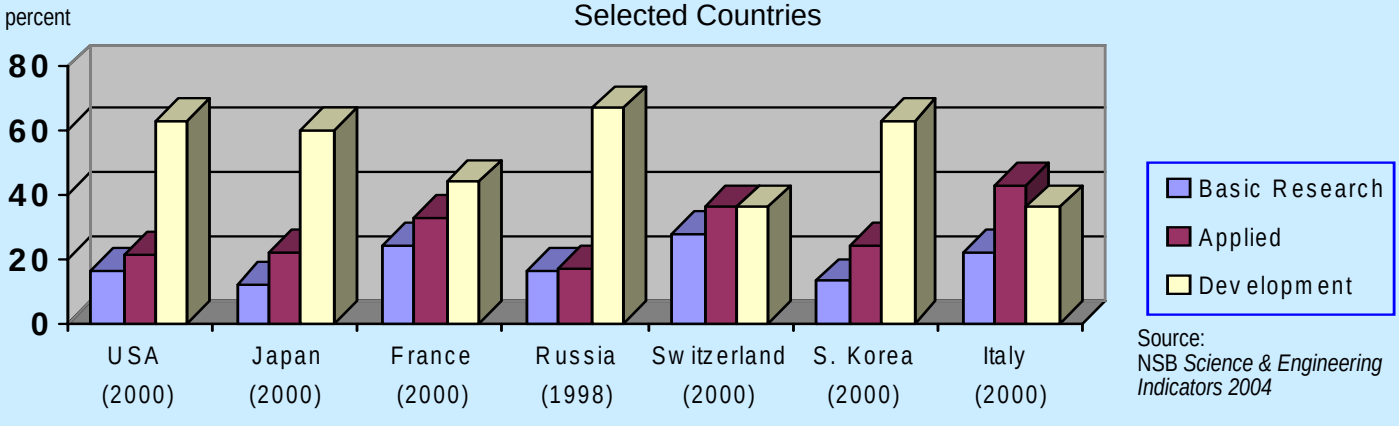
IP Market

Tech Transfer's raw material, Intellectual Property, is largely the product of R&D activity. According to the National Science Board ("NSB"), some $6 trillion was spent on R&D from 1993 to 2003. Past output from the activity includes an inventory of underutilized IP (tech transfer raw material) that dwarfs available commercialization resources.

Simply put, more IP is looking for a home than potential adopters can absorb. Steady increases in R&D budgets worldwide can be expected to further enlarge the pool of underutilized IP. Despite the fact that R&D expenditures are heavily weighed toward "development," commercialization significantly lags discovery.



Estimated Worldwide R&D Expenditures 1990-2003
Source: NSB *Science & Engineering Indicators 2006*



Source:
NSB *Science & Engineering Indicators 2004*

Over the past 20 years US companies have tended to allocate an increasing share of R&D funding to development, as opposed to basic and applied research. The impact of the trend is unclear. The trend may be a reflection that basic research is being performed more efficiently. Improved transparency may be a factor. The federal government, for example, has encouraged consortia with universities and companies to reduce duplication of effort and increase cross pollination. The Bayh-Dole Act of 1980, which granted universities and other federally funded labs ownership of their discoveries, encourages commercialization by letting scientists and their institutions share in profits.[1] The internet also contributed by facilitating collaboration and access to orphaned technology. The trends plus rising energy prices can be expected to accelerate IP's increasing share of international trade.[2]

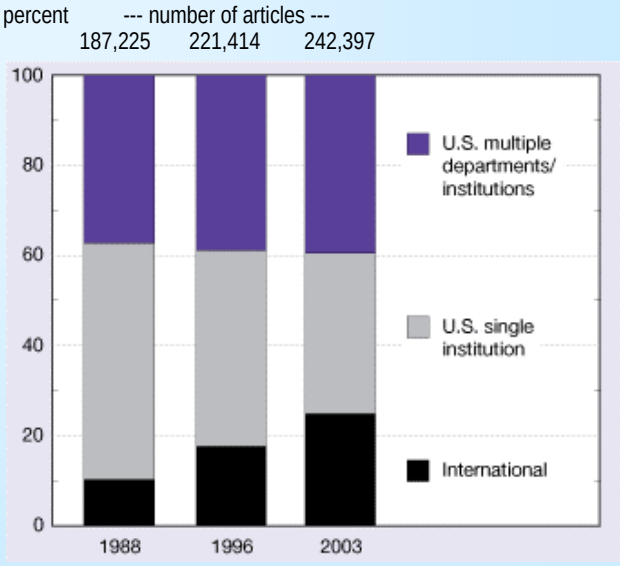
R&D expenditures are a reasonably accurate indicator of activity, but not necessarily a reliable indicator of performance results. As the GAO noted in a report to Congress, research measurement experts have tried for years to develop indicators that measure research results and efficacy. However, the nature of innovation makes performance measurement difficult. Numerous factors determine if and when a particular R&D project will produce a benefit. It may take years for a research project to achieve results. Eighty years, for example, lapsed between the time Boole developed his algebra and Shannon adapted it for computers and communications. Benefits may also be serendipitous, as in the case of penicillin.

National Science Foundation Definitions

Basic research has as its objective to gain a more comprehensive knowledge or understanding of the subject understudy, without specific applications in mind.

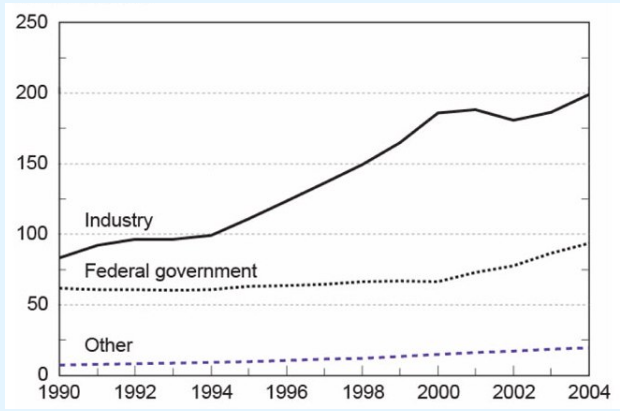
Applied research is aimed at gaining knowledge or understanding to determine the means by which a specific, recognized need may be met.

Development is the systematic use of the knowledge or understanding gained from research directed toward the production of useful materials, devices, systems, or methods.



Collaboration Trends 1988-2003
USA S&E Articles Distribution by Authorship

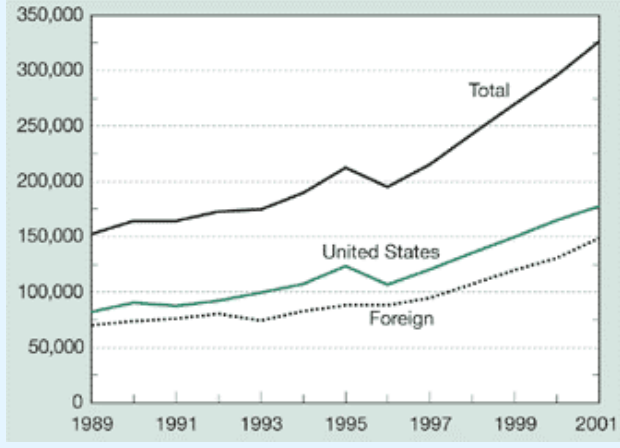
Source:
NSB *Science & Engineering Indicators 2006*



USA R&D Expenditures 1990-2004
By Source of Funds

Note: Current dollars. Other includes $8 billion of university own funds.

Source:
NSB *Science & Engineering Indicators 2006*



USA Patent Applications 1989-2001
By Residence of Inventor

Source:
US Trademark Office, IPD, Assessment & Forecast Branch, special tabulations 2003.

Because of the difficulty of directly measuring research output values, quantitative and qualitative proxy indicators have evolved. Currently used quantitative indicators include: return on investment ("ROI"), patenting rates, and bibliometrics (the study of published data.) Qualitative assessment is potentially more accurate but is dependent on expert judgment. At best, such instruments are blunt.[3] The Research Roundtable and other organizations frequently warn about the difficulties of quantifying R&D results and the potential for incorrect application with subsequent harm to scientific endeavors.

Evolutionary vs. Transformative IP

Most technologies improve *existing* product performance measured by the *existing* criteria used by *existing* customers. They can be thought of as sustaining or evolutionary product line extensions or improvements.

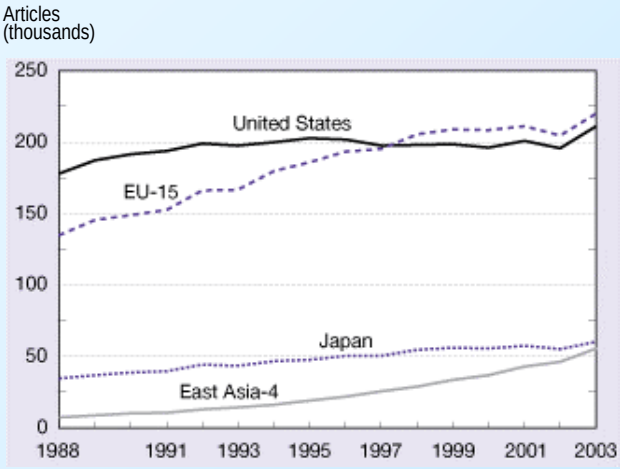
Relatively few technologies have potential to transform industries. By changing core value propositions, they change the basis of competition. The latest buzzword for them is "disruptive."[4]

For a number of reasons, tech transfer deals that make headlines are usually of the sustaining category:

- most tech transfer deals involve technology that is sustaining rather than disruptive;
- only large companies can afford the expenditures that attract headlines or Wall Street; and,
- large companies, it is argued, have traditionally been less adept than small companies at fielding disruptive technology.

Seagate Technology is an example case. In 1985, it manufactured a commanding share of 5¼ inch floppy drives. Its engineers designed a 3.5 inch floppy which was shelved as the company continued to invest in 5¼ inch product improvements. Sales increased significantly. However, ex-Seagate employees founded Corner Peripherals which began manufacturing 3.5 floppies, initially for "luggables." Eventually Seagate was pushed out of the floppy market for PCs.

Disruptive technology, when combined with practice improvements, sometimes transforms industries. Pharmacy management systems in the 1980's were behind the sudden drop in drug stores from 68,000 to less than 45,000: chains changed the basis of competition to such criteria as automatic drug interaction alerts and third party payment facilitation. Wal*Mart used perpetual inventory technology and management practices to become the largest USA grocery retailer with roughly 20% share.



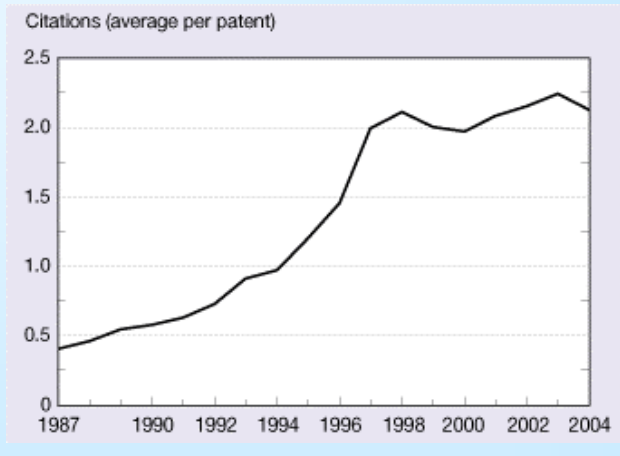
S&E Article Output: 1988-2003
By Major Region or Country

Source: NSB *Science & Engineering Indicators 2006*

Patent Citations

When applying for a patent, applicants usually include references to previous patents or non-patent literature to distinguish the subject invention from previous inventions.

These references to "prior art" are used by the granting agency to investigate and establish the validity of the applicant's claims. During the examination of the application, patent examiners consider the applicant's citations to prior art and may add other citations that examiners believe are relevant.



Citations of S&E Material in US Patents 1987-2004

Source:
NSF, Division of Science Resources Statistics, special tabulations

Entrepreneurs and small companies face competitive disadvantages, compared to large companies, when commercializing sustaining IP. Large companies are often ideally positioned to rapidly exploit incremental product improvements. A breakthrough that increases hard disk capacity from 100 Mb to 20Gb in the same form factor, though technically revolutionary, can be quickly exploited by a large hard disk manufacturer. Existing customers that buy 100 Mb drives appreciate additional capacity in the same space, increased speed, and lower cost per Mb of storage.[5] A small company wishing to exploit the same technology faces billion dollar investments in manufacturing capacity and marketing.

Conversely, entrepreneurs and small companies may have an advantage in commercializing disruptive technology.

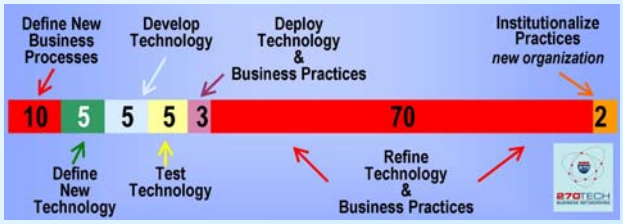
Large Companies vs. Disruptive IP

In *The Innovators Dilemma*, Christensen argues it is in the nature of traditional companies to view disruptive technology as a nuisance or threat rather than an opportunity.[6] Reasons cited for the position, include:

- In customer centric (a good thing) companies, customers rather than management drive resource allocation. Few large customers, particularly few market leaders, envision or seek out new paradigms and midlevel managers tend not to invest in technologies that are not directly appreciated by large clients.
- Markets that do not yet exist cannot be analyzed. New market "imagineering" isn't taught in B-school and may not be teachable.
- Small markets are perceived as not meeting the growth needs of large companies. For example, managers of a CFI (Corporate Finance, Inc) portfolio company presented New York State's lottery system opportunity to AT&T's board when state and national lottery automation was in its infancy (now a $100 billion market.) The response was twofold, "we sell dial tone" and "if the numbers don't have at least 10 digits we don't get involved."
- Technological development can outpace users' assimilation stamina.

Executives of bleeding-edge CFI portfolio companies frequently express a 5th reason. Midlevel managers of potential clients do not willingly go into the night with new technology or paradigms. Most who have built careers on painfully learned practices associated with familiar technology resist with every ounce of being.

In Christensen's sequel, *The Innovator's Solution*,[7] he recognizes what management consulting firms such as McKinsey and Huthwaite have long known: technology is not disruptive. Practices, not technology, disrupt and transform industries.



IT Development: Time & Money Timeline
as percent of total

Source:
270TECH, *Why Most IT Projects Fail,* September 2006

Big 3 Queue-up Seagate-Corner Rematch

Articles in Psychosomatic Medicine and other journals explain why seeking diversion in familiar activities, when adversity strikes, is often used as a coping mechanism. Big 3 automakers are evidentially not immune.

Horsepower Nation: New Car Models Boast Speed, Size, Power in the April 5, 2007 WSJ describes a typical large company phenomenon – when in extremis, revert to type. Though hammered by billion dollar losses and plummeting sales, buzz at the New York International Auto Show was about such cars as Ford's 540 horsepower Mustang and Daimler-Chrysler's V-12 CL65 (0-60 in 4.2 seconds.)

When questioned about the industry's reluctance to improve fuel efficiency, GM's vice chairman for product development responded, "if the technology were available… what would be our motive for withholding it?"

A Seagate-Corner rerun may be here. Pure electrics are manufactured by both Phoenix Motorcars and Tesla Motors – both offer 250 miles per charge. Tesla's 2007 production sold out in less than 4 months.

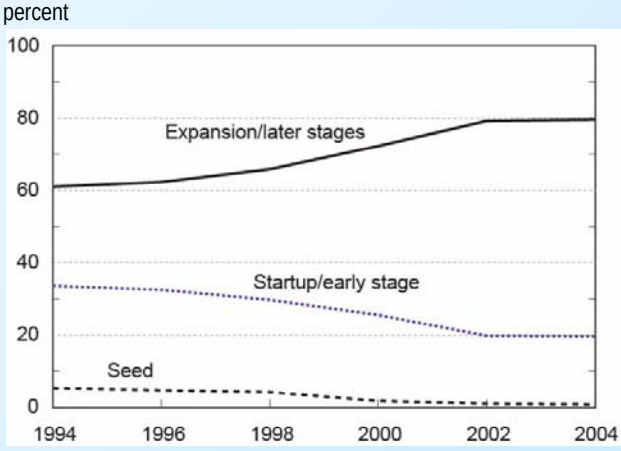
Practice Drives Transformation

Transformations frequently follow four distinct stages:

- Pioneering, sometimes prickly, visionaries such as Deming and Rackum develop new practices,[8] often based on newly developed or orphaned technology.
- The practices are adopted and refined by small early adopters with more to gain than to lose.
- Once established, the practices are incorporated into the "best practice" recommendations of management consulting firms.
- A new or transformed industry stabilizes around new market leaders and new relationships.

The initial stages of the above process are always messy, always uncertain and prone to surprise. According to 270TECH, most IT development projects fail because time and costs related to practice development are often grossly underestimated (see sidebar on previous page). Skills needed to envision new ways of doing business are also different than those that make for good hardware and software. So are the skills, leadership attributes, and intellectual ascendancy needed to build consensus and herd the complex mix of requirements, personalities, fears, and aspirations. Equivocally, it's no less complex to engineer a culture than an enzyme.

It is not surprising that successful companies shy from the initial stages of such endeavors considering that: potential payoff is difficult to predict; failure rate is high; exceptional talent is required; and, high margin revenue may be cannibalized.



Venture Capital Disbursements 1994-2004
By Stage of Financing

Source:
NSB *Science & Engineering Indicators 2006*

Relative Value

Despite the obstacles, increasing numbers of IP "systems" emerge from the pure concept stage to reach prototype and pre-revenue stages. Once there, many stall. In the late 70's and early 80's, concept and early stage IP was widely sought by Venture Capitalists. IPOs for companies with as little as $2-3million of revenue were common and accounted for 90% of VC exits. No longer. The era of exits via early IPOs is over. Today, experts such as Don Bosic, former Senior VP of NASDAQ, caution that, "without exceptional circumstances, the realistic bar [for public companies] is now in the billion dollar revenue range.[9]" IPOs now account for less than 10% of VC exits which reduced VC appetites for early stage deals.[10]

A pattern detected in CFI transactions, labeled the "10^2 rule," roughly expresses the latent value proposition when a technology company

Rank	***United States***	***Japan***	***Germany***
1	Business practice, data processing	Electrophotography	Printing
2	Surgery: light, thermal, and electrical	Television signal processing	Clutches and power-stop control
3	Computers & DP systems	Computer storage and retrieval	Land vehicles, bodies, and tops
4	Data processing, file management	Photography	Machine element or mechanism
5	Surgery instruments	Photocopying	Brake systems
6	Data-processing software	Liquid crystal cells	Power delivery controls, engines
7	Wells	Ceramic compositions	Internal combustion engines
8	Prosthesis	Facsimile	Metal forming
9	Processing achitectures	Power delivery controls, engines	Valves
10	Input/output digital DP systems	Optical image projector	Joints and connections
11	Data processing, artificial intelligence	Printing of symbolic information	Sheet-feeding machines
12	Analytical and immunological testing	Bearings	Land vehicles
13	Surgical, medicators, and receptors	Electric lamp & discharge devices	X-ray or gamma-ray systems
14	Multicellular living organisms	Electrical generators	Rotary motors or pumps
15	Computer memory	Radiation imagery chemistry	Chairs, seats

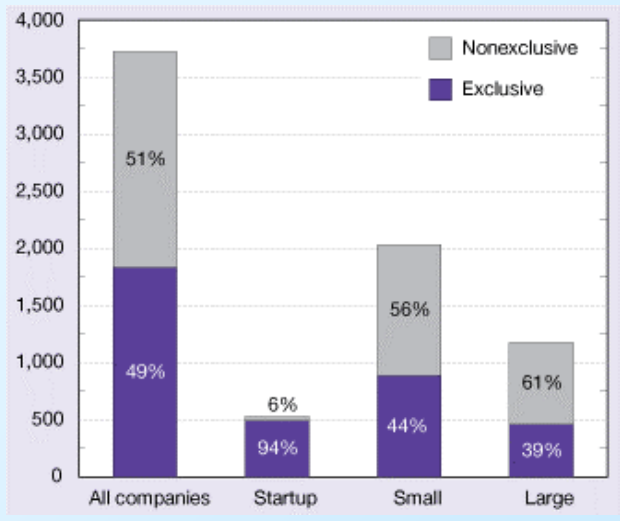
15 Most Emphasized Patent Classes for Corporations: 2003

Source: NSB *Science & Engineering Indicators 2006*

begins selling a system (technology) with transformative potential to users. For each dollar paid to the technology company, users spend an additional ten dollars internally or with outside consultants to develop and refine new business practices. If all goes well, the user's valuation (market cap) increases ten times as much as the amount spent for consulting.

Entrepreneurs Advance on Tech Transfer's Facile Ground[11] uses three case studies involving IP that CFI portfolio companies licensed from Mitre, Johns Hopkins, and MicroNEX to illustrate $x10^2$ concepts. The concepts are developed further in *Seed Stage Advocacy*, a 270TECH White Paper.

Recognition of the relative cost (value) of practice (x10) versus technology (x1) is reflected in increasing rates of patent activity for business practices (now first in USA ranking.) Gerstner's eye was on x10 revenue when he positioned IBM away from IBM's primary reliance on x1 revenue. CFI has helped a number of early and concept stage technology portfolio companies to refine their strategies with the aim of capturing some $x10^2$ revenue in addition to x1 and x10 revenue.[12] In addition to driving early valuations, because of increased revenue potential, the strategies help accelerate market capture.



Characteristics of Licenses & Options Executed by USA Universities: 2003

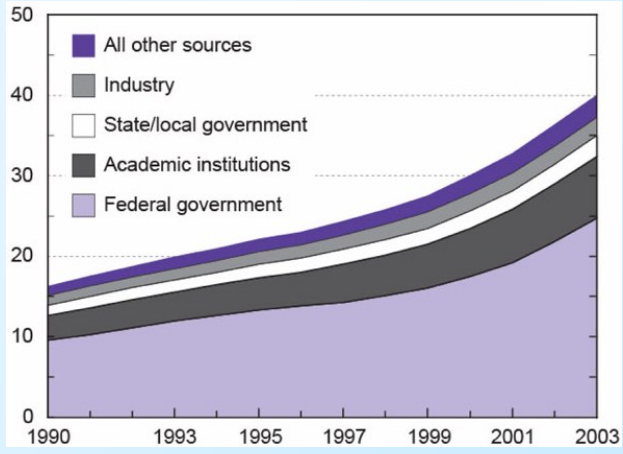
Source:
NSB *Science & Engineering Indicators 2006*

Lessons Learned

The following observations are based upon an analysis of CFI's work with more than 300 concept, development, and early stage portfolio companies. Almost all were pre-revenue. One third required tech transfer, including transfers to or from more than a dozen countries. The analysis included a review of the some 30 technologies with which CFI is currently engaged.

It's a buyer's market. For an R&D organization, academic and otherwise, tech transfer may be the only viable path to commercialization. For a potential "commercializer," tech transfer is a build/buy option with important pros and cons to consider.

It's a buyer's market. Institutional investors (VCs, hedge funds, private equity firms) are cherry pickers. For each business plan invested in, hundreds are reviewed and rejected. Most plans are completed staff work: need and market potential researched; management team in place; projections and ROI modeled; and, funding requirements defined. Many plans are packaged in layers of progressively increasing detail to facilitate investors' decision making processes: executive summary, business plan, and confidential information memorandum (extensive due diligence information). Typical IP packaging by research institutions is not competitive. As a result, many institutions are simply not in the main game.



USA Academic R&D Expenditures 1990-2003 By Source of Funds

Source:
NSB *Science & Engineering Indicators 2006*

It's a buyer's market. The "Nine Points" of licensing recommendations promulgated by the conference of representatives from elite American universities that was organized by Stanford's Dean of Research, are important considerations.[13] In the real world, however, IP licensing terms are set by the market: by buyers, not

sellers. Improved terms are more likely to result from better selling than from better lawyering. In measuring the efficacy of their tech transfer function, institutions would do well to consider the "multiple term sheet" metric.

One size does not fit all. Cookie cutter approaches get in the way of success. Disruptive IP and Sustaining IP are different animals with different marketing, licensing, and relationship requirements. So are small licensees and large licensees. Thinking of tech transfer as the collaborative design of an "alliance solution" that best meets the needs of both parties, rather than as a negotiation, is helpful. Exceptional talent and patience are also helpful. A list of broad "big picture" goals is a better starting point than a list of legal objectives. The ability to continue using the IP, a development contract to refine the IP, bragging rights to an industry transformation, and stock in a future Google may be more beneficial to a university than derivative rights minutia or an upfront $500,000 fee.

Practice makes perfect. Though crafting alliances can be frustrating and time consuming, the process is important: it frequently spawns unexpected insights and opportunities. The most successful players focus as much on improving the process as on current work in process. Just as seasons are won on the basis of singles and doubles rather than homeruns, a portfolio of "slivers of equity" is potentially more valuable than the one perfect deal. Perfect can be the enemy of the good and, in tech transfer, "perfect" is usually defined by hindsight.

Small companies are sometimes the best licensees, especially for disruptive IP. Large companies can afford to shelve IP and cancel multi-million dollar projects. CFI's experience indicates that small companies with special expertise sometimes excel as joint venture partners in packaging IP and bringing large licensees to the table.[14] According to CFI's president, Tom Trexler, "the creativity, passion, and single minded focus found in small companies can offset the relative lack of capital." Conflicts of interest and turf competitions are fewer. Meaningful alliances and stock rights are easier to negotiate.

Network outside the box. Deals originate at industry events, bars, and water coolers. Forums[15] organized by 270TECH, for example, strike an excellent balance between increasing physical vs. virtual transparency of IP in the Washington/Baltimore market.

Bet on people. Good people often make mediocre IP succeed, but not vice versa. "Executives in Residence" is a formal CFI program dedicated to the crucial function of matching IP and other entrepreneurial opportunities with experienced leaders. The pool of available talent has grown to include some 300 advisors and senior managers.

NOTES

[1] The Act is the subject of some controversy. The Economist magazine called it "possibly the most inspired legislation to be enacted in the past 50 years." The title of Jennifer Washburn's book, *University, Inc: The Corporate Corruption of Higher Education*, discloses her position. It is a fact, however, that hundreds of products now smoothing the way for humanity would not have seen the light of day without the Act. It can also be argued that the cultural divide between scientific and business communities mitigates concerns expressed by critics such as Washburn: it is a bulwark against the feared perversion of academic integrity and independence. As Regis Kelly, former UCSF executive vice chancellor said of 150 researchers who had been handpicked because their studies were commercially relevant, "getting them to focus on tech transfer was like pulling teeth." The risk, if any, is arguably overblown considering industry accounts for less than 5% of academic R&D funding.

[2] Energy price increases tend to decrease trade in physical products, but not intellectual property. Friedman, Thomas L., *The World Is Flat: A Brief History of the Twenty-first Century*, Farrar, Straus & Giroux, April 2006

[3] Research value indicators are relatively controversial. Patent count, an often used indicator, is an imperfect measure of innovative output. *How to Count Patents and Value Intellectual Property: the uses of patent renewal and application data*, published December 1998 by The Journal of Industrial Economics is an example of numerous proposals for improving IP metrics.

[4] The term *disruptive technology* was coined by Clayton Christensen in his 1995 article *Disruptive Technologies: Catching the Wave*. He further defines the term in his 1997 book, *The Innovator's Dilemma*.

[5] Even minor product extensions, however, may require significant investment and testing. Procter & Gamble, for example, tests small incremental product extensions (such as adding a lemon flavor SKU to an existing cake mix line) for a year in regional markets before rolling-out nationally.

[6] *The Innovator's Dilemma*, Clayton Christensen (New York, 2000), HarperBusiness Essentials.

[7] *The Innovator's Solution*, Clayton M. Christensen and Michael E. Raynor. 2003 Harvard Business School Press

[8] William Edwards Deming is credited with developing statistically based quality control processes which Japanese auto manufacturers used to capture the USA market. His work spawned an international consulting industry. Neil Rackam's statistically based work is similarly transforming sales processes internationally. Unlike Deming's intellectual property, which passed into the public domain, Rackum's was acquired by Huthwaite which used the IP to become the premier management consultancy for reengineering sales processes.

[9] Sarbanes Oxley, NASD's winnowing of small broker/dealers, and other factors contributed to the change. Wall Street's image suffers from Buickization, as in "your father's exchange." Early stage IPOs are largely done offshore. In a WSJ editorial (April 7, 2007), Yale Law School's deputy dean wrote, "it's no longer fashionable to be a US public company… it's for suckers who can't access sophisticated global markets." Implications for American competitiveness and humanity's long term well being are extensively documented. Examples of recent analysis include CFI's 2006 White Paper, *The Risk Taking Gene*, by Merle Coe and *Small is Beautiful* by Stephen A. Boyko & Alan Gottesman, The National Interest, No. 77 – Fall 2004.

[10] In addition, arbitrary Blue Sky law enforcement restricts SME (Small to Medium Size Enterprises) access to "angel" financing. Jeffrey Sohl, The private equity market: lessons learned from volatility, http://www.angelcapitalassociation.org/downloads/resources/Research_LessonsVolatility.pdf

A growing number of voices suggest the situation is a major threat to America's future. They argue that overregulation (regulation being an operational tax) has reduced commercialization of innovation (by discouraging entrepreneurship) while simultaneously, and perversely, decreasing capital market transparency (by increasing the number of going-privates.) Christian Leuz, Wharton Newsletter, http://www.philly.com/mld/inquirer/business/10410106.htm?1c

The Small Business Administration (SBA) recently reported that SMEs create more than half of all new jobs in the U.S. economy. A companion 2003 SBA study also found SMEs were a major source of technological innovation. Even more impressively, SMEs accomplished this with minimal capital investment: roughly half the value created by the U.S. economy was produced with far less than 20% of new capital invested in economic growth. For an analysis, see *Can Real Regulatory Reform Lead to Job Growth?* (February 11, 2004) http://www.inthenationalinterest.com/Articles/Vol3Issue6/Vol3Issue6Boyko.html

Jared Diamond presents a historically based, macro view in his best selling book, *Collapse* (Penguin Group, 2005) noting that inability to adapt to changing conditions and competition was a major factor in the decline of certain past societies.

[11] Solazzo, Anthony, *Entrepreneurs Advance on Tech Transfer's Facile Ground*, CFI, 2007. On Facile Ground Sun Tzu (*Art of War*) advises, "Halt not and maintain close communications between all parts of your forces."

[12] The author is CEO of a company that engaged CFI to develop a $x10^2$ strategy for grocery industry enterprise system IP it wished to license. *Grocery Industry: Origins, Culture, Practices*; SAIC, White Paper 2006

[13] Stanford News, March 7, 2007, http://news-service.stanford.edu/news/2007/march7/gifs/whitepaper.pdf

[14] A recent example is CFI's portfolio company, Immunomic Therapeutics, Inc. (ITI) organized as a joint venture between Johns Hopkins and Capital Genomix (also a CFI portfolio company) to commercialize a portfolio of clinical applications based on "LAMP" vaccine technology. Within two months after completing the IP agreement, ITI sub-licensed LAMP to Geron Corporation (Nasdaq: GERN) for a specific application. One month later, Geron announced Phase II trials of LAMP.

[15] More than 5,000 people, including 2,000 Ph.D.s, have attended one or more of the 170 events organized by 270TECH, www.270tech.net

For information about White Papers, Executives in Residence, and concept stage enterprises, contact:
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