How Venture Capital Thwarts Innovation

THE TECH BUBBLE SAW AN EXPLOSION OF VC-FUNDED START-UPS—AND A DEARTH OF ORIGINAL IDEAS

By Bart Stuck & Michael Weingarten

Venture capital funds have swelled hugely in the past decade or so—and that's good, isn't it? Venture capital lights fires under scrappy and ambitious start-ups. It can help bring great new ideas to market, some of which go on to disrupt entrenched industries, spawn entirely new ones, perhaps even permanently change the world.

Old established companies rarely do that. They're much better at making incremental innovations, because they generally have more to lose than to gain from disruptive technologies. Yahoo and Google came out of left field, not the R&D labs of Microsoft or IBM. The personal computer as we know it came out of Apple Computer, not Hewlett-Packard, itself the original Silicon Valley start-up. Cryptography was brought to market by new companies like RSA Security and VeriSign, not by AT&T.

In theory, then, venture-capital-backed start-ups are the best engines of innovation. But are they in fact? With venture capital funding an order of magnitude greater today than it was in the early 1990s, now is an excellent time to ask: has all that funding over the past decade brought more innovation or less?

As venture capitalists ourselves, we've had considerable experience watching our colleagues make investment decisions. We had our own theories about how best to turn money into innovation but reserved judgment on the industry as a whole until we could accumulate and analyze the data from what has been the most frenzied decade in technology history.

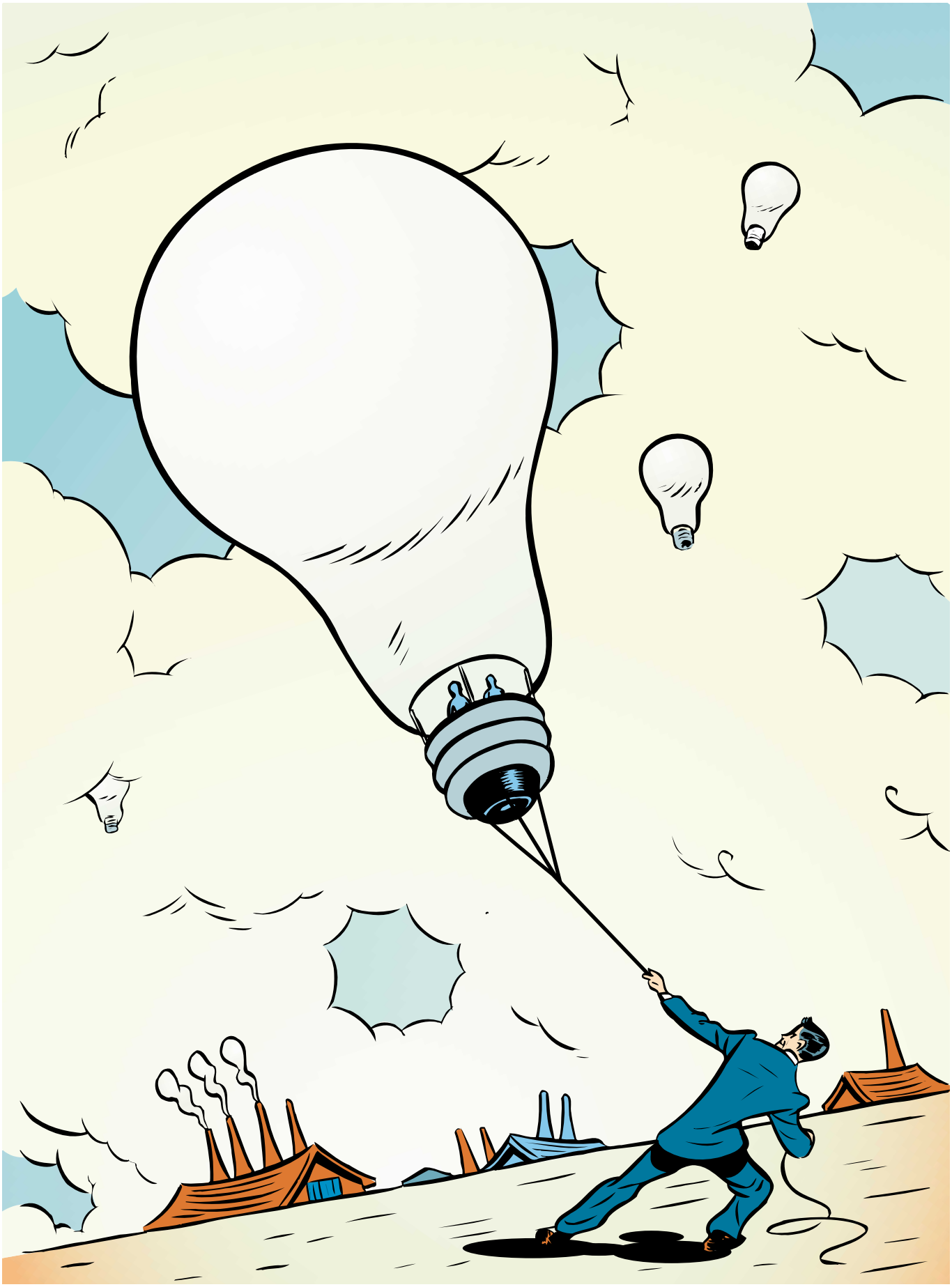
Our methodology was simple. We examined 1303 electronic high-tech initial public offerings for a 10-year period ending in 2002. We limited ourselves to IPOs from the New York Stock Exchange and Nasdaq, which were ground zero for the telecom and dot-com explosion of the 1990s. We sorted out those that were VC-funded and compared them with those that were not. We rated them on a scale of 1 to 5, with 1 being the most technically innovative. [See sidebar, "Scoring Innovation."]

We were shocked by what we found. Overall, the level of innovation during that decade was surprisingly low. Even more dismaying, it did not correlate well with VC funding: the level of innovation actually dropped sharply after 1996, even as venture funding was going through the roof.

TO FOCUS ON TRULY NEW TECHNOLOGY, we first excluded spinoffs, such as Lucent Technologies Inc., which broke off from AT&T Corp. in 1996, and recapitalizations, such as Accenture, which, under the name Andersen Consulting, was already a separate business unit when it severed ties with Andersen Worldwide in 2000.

We also eliminated eBay Inc. and other companies that relied on e-commerce business models rather than new technologies. While innovations in e-commerce have created businesses worth billions of dollars, and improved the lives of millions of consumers and retailers alike, finding a new way for them to interact with one another is quite different from coming up with a fundamentally new technology.

There is, of course, a reasonable point to be made about new organizational structures that would be possible only with the Internet. When a garage sale is limited to people who drive past



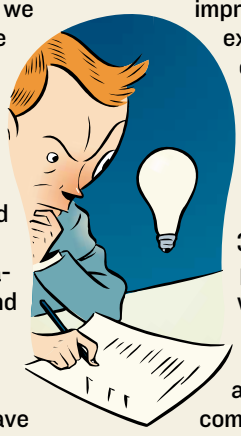
ILLUSTRATIONS: MARK MATCHO

Scoring Innovation

To start our list of initial public offerings, we looked to *The Technology IPO Yearbook,* 9th ed. (Morgan Stanley, New York, 2003), which lists, from 1980 onward, detailed information on each high-tech company making its initial public offering of stock. The yearbook gives the company's valuation at the time of its IPO, whether it was acquired or went bankrupt, and its market valuation as of 31 December 2002.

Of the 1303 high-tech IPOs listed there from 1993 to 2002, we first subtracted corporate spin-offs and other IPOs that weren't technology start-ups.

We divided the 823 remaining IPOs into a 1993 to 1996 baseline and a 1997 to 2002 follow-on period to measure innovation over time. This second period of six years also corresponds to an upsurge in VC spending, which in theory should have resulted in increased innovation.



To test for innovation, we rated each IPO on a scale of 1 (best) to 5, based on the following criteria:

No. 1: We reserved our top score for technologies representing a fundamental departure from anything existing previously and whose commercialization made possible an entirely new (and important) business market. Examples include bringing to the marketplace xerography, the microprocessor, the Web browser, public-key cryptography (VeriSign Inc.), distributed caching software for Web servers (Akamai Technologies Inc.), and high-temperature superconductors (Illinois Superconductor—now ISCO International Inc.).

No. 2: We gave this rating to companies able to demonstrate fundamental technology improvement in an existing product category. These include "disruptive technologies" that supplanted technologies in established markets. Ciena Corp. is a second-tier innovator, because it was one of the first to successfully manufacture wavelength-division optical multiplexing equipment to the exacting quality standards of wide-area network telecommunications customers, such as Sprint and MCI. Previously, optical telecom equipment could not handle multiplexing and so had many fewer communications channels.

No. 3: We gave this designation to companies able to demonstrate nontrivial technical improvements in existing product categories. These improvements generally extended existing technologies (for example, using ASICs with 0.13-nanometer instead of 0.18-nm traces), rather than deploying truly disruptive innovation. Juniper Networks Inc. is a typical tier 3 company—it developed packet-switch router hardware and software, which it then sold to telecom carrier customers, instead of doing a complete redesign of telecom carrier–class router hardware and software.

No. 4: Our fourth tier consisted of companies able to demonstrate modest improvement in existing technologies, perhaps by repackaging a combination of already commercial technologies. For example, Palm Inc., which went public in 2000, earned a 4, since the fundamentals of the personal digital assistant haven't changed much since the introduction of the highly innovative but commercially unsuccessful Apple Newton in 1993.

No. 5: Companies in this tier did not create new technology but were able to successfully market existing technology, or they developed new business models using well-established Internet technologies. HotJobs.com Inc. illustrates this theme: many other companies were using Web portals to post résumés and recruit individuals well before HotJobs went public.

You can find a complete list of the companies and their ratings at http://signallake.com/publications/IPOrankings.pdf. *—B.S. & M.W.*

your front yard, you're lucky to find a single person interested in that old weather vane, whereas when the buying universe isn't limited by geography, a bidding war between collectors is not only possible but likely. But the difference between e-commerce businesses and earlier auction or phone- and mail-order companies is largely one of degree, not kind, and doesn't compare to, say, using lasers for microwave communications or DVD players.

In fact, e-commerce business models are almost always grounded in only the slightest bits of incremental innovation. For example, eBay wasn't the first Internet auction site—that honor probably goes to OnSale Inc., founded in 1994. And the most novel thing about Amazon.com, the other e-commerce elephant, is its recommendation software ("customers who bought this book also bought..."), which was invented by the Software Agents Group of the MIT Media Laboratory, also in the early 1990s.

After subtracting spinoffs (21 companies) and e-commerce (459 companies), we had 823 firms in our study. Even with all those companies subtracted, we found few truly innovative companies and a sharp decrease in their number over time. We used 1996 as a peak dividing two temporal watersheds. That year saw the seminal U.S. Telecommunications Act, the Lucent spinoff, and the start of the tech bubble.

In studying the four years from 1993 to 1996, we found 20 highly innovative companies, ones that fell into our two highest levels [see table, "10 Years, 20 Companies"]. That's about five per year, only 4.4 percent of the four-year total. For the next six years, though, that already low percentage plunged to 1.4 percent—only five such highly innovative companies in the entire period. That's not even one per year.

There was also a big drop in the middle range of innovation—companies that took some less-than-fundamental innovation and brought it to market in a clever way. Some of these companies, scoring a 3 on our scale, have been highly successful. The number of these midrange companies decreased substantially, from 29 per year during 1993 to 1996 to only 7 during 1997 to 2002.

By far the largest number of IPOs over the course of our 10-year period received a low rating of 4, which was essentially the bottom. (Only a few companies remained in the very lowest tier of 5 once we excluded Internet e-commerce plays.) For the first four of the 10 years studied, two-thirds of the 823 companies fell into this No. 4 tier. That proportion rose to 87 percent in the next six years—a further decrease in an already disappointing level of innovation.

The reasons for this failure are complicated and deeply entrenched in the VC way of doing business. But a common thread runs through many of them, and it has to do with risk. Based on our experience, we believe that VCs really aren't the risk takers they're often made out to be.

TO UNDERSTAND THIS RISK AVERSION, you've got to know more about how VC firms are organized. First, a venture capitalist isn't a guy with a giant bag of money over his shoulder, dollar bills and gold coins spilling out. Behind the cartoon character is not one but several different people with different roles. The people with big money to invest—sometimes billions of dollars—don't know much about technology and innovation. Instead, they turn their money over to people who do (or so they hope).

Basically, venture capitalists combine these investments into a sort of mutual fund of start-ups. As the start-up passes through various well-defined stages of development, other investors are brought in to fund the company, thereby lessening the risk, and also the potential reward, as the fund matures. It turns out that most investors won't fund an operation before it has a measurable cash flow, so it takes a special investor to put money into a company at its earliest stages of existence.

VCs talk about funding rounds in alphabetical order. Series A investments are backing something that's little more than a technology and a team. The business will need to acquire other skills, such as sales, marketing, customer service, and operations management, to be successful. Series B investments are the order of the day when a company has a working prototype product and initial orders, as well as a more complete management team with diverse business skills. Series C investments are made when a company has more than one customer, working products, marketing and sales channels in place, and a growing pipeline of sales prospects. Pricing and gross profit margins on those sales are no longer mysteries, and working capital is needed mainly for components and support.

Series A funding is usually in relatively small amounts—there are often fewer than 10 people employed by the company, and the biggest expense is their salaries. Series B is typically much larger; not only is more money needed, but it's easier to get, because risk has decreased. By the time of series C, the dollar figures have increased again, to meet the heavy expenses of raw materials, components, and inventory; moreover, risk has decreased even further. The number of potential investors increases with each funding round, and each new investor at each round tends to commit more than the earlier-round investors did. These stages aren't haphazard. A start-up usually plans the different funding rounds right from the get-go—it hopes to increase its valuation between funding rounds and therefore to give up less of its equity per dollar of capital invested.

Most VC businesses are limited partnerships, in which well-heeled investors—large pension funds, university endowments, and wealthy individuals—agree to invest as limited partners. The funds are organized by experienced fund managers, also known as general partners. These managers decide how the funds are invested.

To use an example we will return to, the general partners might decide (as we did) to invest in a holographic-storage company for several reasons. The storage market promises long-term growth. The capacity per dollar is expected to increase by an order of magnitude over magnetic and optical technologies. And the risk-adjusted payoff is 10 times the initial committed capital in an acceptable time frame. Fund managers get where they are by demonstrating an ability to generate high returns, based on their track records in previous funds. Typical funds are organized for a finite life, often six or seven years, after which the fund is required to wind down operations—and distribute any proceeds to the limited partners.

Neither the limited nor the general partners welcome risk. Limited partners are looking for a higher rate of return than they could get in the stock market but with not much more uncertainty. And general partners are playing with other people's money. They hope that if they consistently hit the ball well, once in a while a home run will fly off their bats.

General partners are compensated in two ways. First, they receive management fees for running the fund, typically 2 percent of funds managed. So if a general partnership is managing a US $1 billion fund, it will receive $20 million in management fees, as well as reimbursements.

Second, the general partners receive a share of any profits after the limited partners are paid back their initial investments and their share of the profits. For example, if a $1 billion fund returns $5 billion after management fees and expenses are deducted, the limited partners receive their initial $1 billion plus 80 percent of $4 billion, for a total of $4.2 billion. Typically, the general partnership gets the other 20 percent of the $4 billion profit, or $800 million. This percentage is known as the general partner "carry," which is short for "carried interest." That's a pretty good paycheck to divide up among, say, 10 to 20 managing directors who might share in the carry.

And then there are the bargains struck by the "A-list" VCs, such as Kleiner Perkins Caufield & Byers, in Menlo Park, Calif., or Greylock Management Corp., in Waltham, Mass. These VCs add substantial prestige to start-ups, so they tend to see the hottest action. A-list VC firms get to charge more—3 percent management fees instead of 2 percent, and a 30 percent carry instead of 20 percent. It's no wonder you see so many Ferraris sitting in the parking lots on Menlo Park's Sand Hill Road, home base for the VCs of Silicon Valley.

BUT NOT EVERY FUND makes $5 for every $1 invested. A fivefold payback is, in fact, remarkable, even in the extraordinary world of VC. According to *Venture Economics* magazine, the typical 20-year average industry return is around 16 percent annualized—still not bad nowadays, when the average return from stocks and bonds is in the single digits.

10 Years, 20 Companies

Of the 823 companies in our study, only 20 fell into the top two tiers of innovation. And four times as many went public in the first four years as in the remaining six, despite year-by-year increases in venture capital throughout the decade.

	1993–1996	1997–2002
TIER 1	Conductus,* Illinois Superconductor,† Security Dynamics (RSA Security Inc.), Superconductor Technologies Inc.,* Yahoo Inc.	Akamai Technologies Inc., VeriSign Inc.
TIER 2	Fore Systems Inc., Level One Communications Inc., Maxis, MindSpring Enterprises Inc.,* Orckit Communications, Ortel Corp., ParcPlace-digitalk (Object Share), Pixar, Rogue Wave Software, Sawtek Inc.,* SDL Inc.,* TriQuint Semiconductor Inc., Uniphase (JDS Uniphase Corp.),* Veritas Software Corp., Versant Object Technology (Versant Corp.)	Ciena Corp., Inktomi Corp., RealNetworks Inc.

Source: Signal Lake Management LLC

* Since its initial public offering, this company has merged with or been acquired by another company.

† Now called ISCO International Inc.

A Matter of Degrees

More than 64 percent of the general partners in a typical venture capital fund have advanced business degrees; less than 29 percent have advanced science degrees. The result: VCs may be more comfortable with business plans than with technology.

DEGREES	NUMBER OF GENERAL PARTNERS	PERCENTAGE OF GENERAL PARTNERS*
Total (20 leading venture capital funds)	**180**	**100**
Bachelor's: science/ engineering	115	63.9
Master of business administration	116	64.4
Master's: science/ engineering	52	28.9
Doctorate: science/ engineering	10	5.6

Source: Signal Lake Management LLC

* Not all general partners provided complete biographical information.

Now consider that this 16 percent return comes from a blended average of successes and failures. A general partnership might invest in 10 to 20 companies. The VCs, of course, are betting that the successes will more than pay for the failures; in fact, their idea of a successful company is one that generates a 10-fold return on investment within five years. That's equivalent to a 58 percent return per year.

With that definition of a home run, VCs can hit a few foul balls. If a successful investment gives you a 58 percent annual return, you could have three failures as well and still do better than the VC industry average. You can reduce your risk further by investing a limited amount of money, often as little as $5 million or $10 million, in the earliest, high-risk, high-reward funding rounds and putting in bigger bucks in later rounds when a company is beginning to look like it will succeed.

All this structure seems designed to maximize investment in true innovation. Yet, as our study showed, the very opposite is true. We believe there are four basic reasons that innovation often gets short-circuited.

1. A venture fund has a life cycle.

VC general partners don't work with an amorphous pile of cash; they manage discrete venture funds. For example, in 2003 the Kleiner Perkins Caufield & Byers XI fund was created—the 11th since the firm began. Each fund has a different set of general and limited partners. To protect against conflicts of interest—that is, to make sure fund XI doesn't bail out failing investments from fund X—most VCs won't invest in two different funds if the same company is funded in both.

The general partners of each fund need their investments to pay off within the fund's life span, which is six or seven years. So the general partners look for investments that can generate revenues in two to four years and break even soon after. Their ideal scenario is one in which they sell the company for a lot of money, or it goes public for a lot of money, within the fund's lifetime.

This short life cycle for venture funds has dramatic consequences for innovation, none good. Typically, when a fund invests in a new company, it needs to reserve additional funding for up to three follow-on rounds, just in case the start-up runs out of money, which is inevitably the case. When you total up the bills for management fees; accounting, legal, and other expenses; and reserves for the follow-on rounds, an initial funding round of $200 million to $300 million might involve a $1 billion commitment over seven years. If that $1 billion sum represents the entire fund, the VC may need to start a new fund to invest in even more companies beyond the ones in the previous fund. Thus, the gap between one fund and the one that immediately follows it might be only two to three years.

That's a big problem, from an innovation standpoint. To raise fund [n + 1], institutional investors are going to look at the interim results for fund [n]. They want to see the start-up company booking substantial revenues or showing other signs of progress, such as contracts awarded or design agreements with major customers. In other words, VCs need to see a company end its start-up phase and become a real business in three years at most.

The upshot is that VCs won't look favorably on funding proposals involving years of research—regardless of the potential payoffs. It's not that they are not interested in innovation. They just won't fund innovation that takes time.

A good example from our own current portfolio is InPhase Technologies, in Longmont, Colo., which is developing holographic storage media and hardware. The company had its technical inception at Bell Labs in 1995 and was venture funded in 2000. This past January, it showed a prototype 5-inch drive. Its first product, expected in 2006, will be a 300-gigabyte removable disk cartridge that will be the same size as a DVD drive but will hold 60 times as much data. But the company will have taken 11 years to hang its first dollar on the wall, which is 7 or 8 years too many for InPhase to be attractive to the denizens of Sand Hill Road.

In funding InPhase, we decided to forgo the traditional short-term window, because we saw a huge potential payoff for investors. Naturally, there's commensurate risk. Corporate research labs, such as those at IBM or Pfizer, and U.S. government agencies, such as DARPA or Sandia National Laboratories, can take this long-term view, but it's rare for venture funds.

2. VCs act like businesspeople, even when they have a technical background.

Engineers who work with VCs for any length of time are inevitably frustrated by what they see as the VCs' limited ability to understand revolutionary technology. Combined with the VCs' strictly bottom-line orientation, the result is an inability to accurately access technological risk.

In fact, it would be difficult to argue that VCs are ignorant of engineering and other technical areas. A review of the backgrounds of 180 general partners at 20 leading VCs shows that 64 percent of general partners have undergraduate engineering degrees [see table, "A Matter of Degrees"]. But 64 percent also have MBAs, while only 29 percent have master's degrees in engineering or science. So by a wide margin, it seems that the business training of the average general partner exceeds his or her understanding of technology, and that for the people who have both, the technical background supports a business outlook, not the other way around.

As a result, most VCs are more comfortable with business plans that are logical extensions of existing technologies. They're also good at conducting reams of due diligence. The typical VC firm today has lots of junior associates who love poring over market and growth projections and cash-flow forecasts.

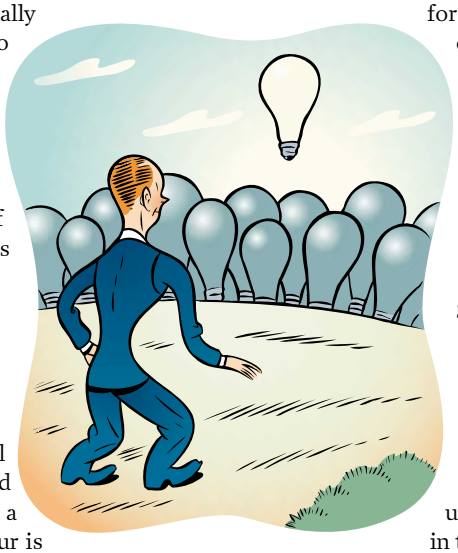
VC investing is all too often a mechanical process of reviewing business-school checklists. The dearth of venture capitalists who can really understand fundamental research and who eagerly talk to

brilliant researchers with exotic, extraordinary ideas is one of the key challenges facing the industry. Unfortunately, the average Ph.D. scientist or engineer knows little about business, and in our experience, most VCs really don't want to talk to people like that.

VCs do have venture partners with technical backgrounds, whom they can call on for due diligence advice. However, these people are generally consulted only when a project gets past the initial screening process. Many innovative technologies are rejected well before then.

The case of the physicist David Huber shows that while mainstream companies can't recognize a good idea when they see it, neither can venture capitalists. In the early 1990s, when he was with General Instrument Corp. (now part of Motorola Inc.), Huber developed some interesting technology for multiplexing different wavelengths of light onto a single optical fiber. General Instrument decided that the technology was "not strategic" with regard to its business plans and gave Huber 18 months to find a buyer for the group or be shut down. In the end, the group did not shut down (partly due to our intervention), and the company eventually went public. But it came perilously close to extinction, reflecting the level of risk aversion that prevails at most VC firms.

Huber's start-up was Ciena Corp., of Linthicum, Md., which today is a $300 million business, despite the collapse of the telecom industry in 2001. The roster of A-list VCs who passed on the company is embarrassingly long.



3. VCs can't distinguish between smart and lucky.

The opposite of the "nerdy Ph.D." is the "serial entrepreneur"; VCs hate funding the former and love funding the latter. Serial entrepreneurs write good business plans and assemble complete business teams. There is a basic assumption that the serial entrepreneur is smart rather than lucky. So, having a track record of exactly one success, the same physicist who couldn't get funding for Ciena (David Huber) got lots of money for his next company—Corvis Corp. (now Broadwing Corp.), in Columbia, Md.

Being in the right place at the right time does wonders for your apparent intelligence, but the bankruptcy courts are filled with entrepreneurs who made millions the first time, then doubled down on Start-up B with loans secured by the assets of Success A. By the way, investors who bought Corvis, Huber's second company, at the IPO price of $11.8 billion have lost over 90 percent on their investment.

Even assuming that an entrepreneur is smart as well as lucky, serial entrepreneurs—almost by definition—do logical extensions of existing technologies. After all, it's smart to go with what you know. So while Start-up B may be successful, it's unlikely to be disruptive and therefore transformative. For example, we gave Huber's first company, Ciena, a rating on our innovation scale of 2, but Corvis, which develops long-haul optical networking equipment, where there are many alternatives already available, got a 3. The lightning rod of raw innovative brilliance rarely strikes the same technologist twice.

Compounding the focus on serial entrepreneurs is an overemphasis on parallel investing. VCs love to invest in deals that are fashionable. No one likes to invest in anything that seems daring. As a result, we see lots of indistinguishable deals for whatever is hot. For example, after the success of a few storage-networking companies, notably EMC Corp., in Hopkinton, Mass., and Veritas Software Corp., in Mountain View, Calif., more than 50 different investment opportunities in different niches of the same field were venture funded between 1998 and 2001.

The problem with this groupthink is that fashionable companies, again by definition, are going to be companies that are variations on the same technology themes; they are, at best, evolutionary. Arguably, if we want innovation, we need to replace serial entrepreneurship and parallel thinking with a willingness to judge a start-up on its merits, disregarding track records and the hot idea du jour.

4. VCs sync investments to business cycles.

During the Internet bubble, it was remarkable, and a little depressing, how many VC deals could be described succinctly as follows: a group of 10 to 20 engineers shows off some nifty PowerPoint slides and gets funding from a VC, which sells the company 12 to 18 months later to Lucent, Cisco, or PMC-Sierra for $250 million to $500 million before there is even a working prototype.

You can't really blame the VCs for grabbing that easy money, but those days were dark ones for innovation, because they rewarded vaporware, not real achievement. In the long run, the Lucents of the world saddled themselves with debt that's still weighing them down. They're unlikely to make that mistake again any time soon, and VCs are rightly gun-shy now about funding engineers whose main product is good PowerPoint shows.

So, of course, the pendulum has swung too far the other way. Since the 2001 telecommunications and Internet depression, even VCs sitting on piles of cash have been afraid to invest. As we've already noted, start-ups rarely get more than $5 million to $10 million in the earliest rounds, and these days that money is expected to last for two years. On $200 000 to $400 000 per month, you can't do real R&D. All VC-funded companies are required to spend lots of money on nonengineers: the CEO, CFO, vice president for sales, vice president for business development, and so on. (We're always amused that a 10-person start-up needs a chief financial officer.) And no one is going to fund a development project that takes four to five years with significant development risk.

True innovation requires patient investing rather than the boom-bust mentality we have been seeing from VCs. A good example from our current portfolio is InPhase, the holographic-storage company. Whether or not it succeeds, we gave it a 1 or a 2 on the innovation scale.

THERE'S ONE LAST THING TO CONSIDER. The decrease in innovation we've seen in the last decade might also be due to the vastly enlarged pools of VC money that have been sloshing around Silicon Valley, Boston's Route 128, and elsewhere. Venture capital funding increased 12-fold between 1993 and 2002.

Perhaps there's just too much money chasing too little innovation. But perhaps the same money, better spent, would encourage more innovation. ■

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